REMEDIAL INVESTIGATION FOR THE FORMER MAINTENANCE AND FUELING FACILITY IN SKYKOMISH, WASHINGTON

Prepared for

BURLINGTON NORTHERN RAILROAD
Overland Park, Kansas

Prepared by

REMEDIATION TECHNOLOGIES, INC.
Seattle, Washington

RETEC Project No. 3-1161-350

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1.0 INTRODUCTION

This report presents the remedial investigation (RI) results for Burlington Northern Railroad's (BNRR) Former Maintenance and Fueling Facility located in Skykomish, Washington. The facility was historically used to refuel and maintain locomotives, provide electricity for electric engines, store snow removal equipment, and as a base of operations for local track repair and maintenance. Currently, facility use is limited to the latter two activities. The Site includes the former maintenance and fueling facility and adjacent properties that have been impacted by releases from the facility.

In 1993, BNRR entered into an Agreed Order (No. DE91TC-N213) with the Washington Department of Ecology (Ecology) to conduct a Remedial Investigation and Feasibility Study (RI/FS). This action was prompted by the discovery of petroleum-related products in soil and groundwater at the Site, and the presence of oily seeps to the South Fork of the Skykomish River. These discoveries were made during various phases of exploration performed from 1973 to 1992.

This document is submitted to Ecology as the Final Remedial Investigation Report for the Site. The RI was conducted in accordance with the work plan entitled *Burlington Northern Railroad Remedial Investigation/Feasibility Study Work Plan, Skykomish, Washington* (RI/FS Work Plan) (GeoEngineers, 1993) and the detailed field activities plan entitled *Sampling and Analysis Plan for the BNRR Maintenance and Fueling Facility, Skykomish, Washington* (SAP) (RETEC, 1993).

This report provides a description of field investigation methods, describes the conditions encountered, provides results of analytical testing and presents the conclusions developed under the RI. The purpose of the RI, a brief description of the Site background, and a summary of previous site investigations are presented below.

1.1 Purpose and Objectives

The purpose of the RI is to determine the nature and extent of contamination and assess potential risks to human health and the environment posed by the contamination. A separate feasibility study (FS) is being prepared to define and evaluate the feasibility of site cleanup alternatives. Together, the RI and FS will provide sufficient information to allow selection of a remedial action. Specific RI tasks and their objectives are:

- Explore the subsurface through boring and well installation to characterize the Site's subsurface stratigraphy.

- Collect and analyze soil samples from the surface and subsurface to evaluate the nature and extent of soil contamination.

- Install monitoring wells to characterize hydrogeologic conditions and identify the extent of free product and dissolved contaminants.

- Complete physical tests of soil samples and conduct slug tests to evaluate aquifer characteristics.

- Collect sediment and surface water samples from the creeks and river to evaluate impacts from the Site.

- Collect product samples for physical characterization and conduct product baildown tests to evaluate recoverability.

1.2 Site Background and Operating History

1.2.1 Site Description

The Site is located in the City of Skykomish, and includes the BNRR property and those areas impacted by activities performed at the facility. The general Site location and boundary are shown in Figure 1-1. The Site is located in the southern half of the southwest quarter and the southwest quarter of the southeast quarter of Section 26, Township 26 North, Range 11 East, (S½SW¼, Section 26, T26N, R11E and SW¼SE¼, Section 26, T26N, R11E), King County. The latitude and longitude of the Site are 47E42'36"N and 121E21'37"W, respectively. The areal extent of the Site is approximately 40 acres.

1.2.2 Operational History

The facility was originally owned and operated by the Great Northern Railroad (GNR). GNR owned the property from the late 1890s until 1970 when GNR merged with four other railroads and became BNRR. The facility is currently owned and operated by BNRR.

A detailed history of the facility is presented in the *Site History, Skykomish Maintenance and Fueling Facility, King County, Washington, Final Report* (Berryman, 1990). This report is included in Appendix B of the *Response to Ecology's Comments/Questions* (GeoEngineers, 1991b). The facility has gone through five overlapping operational eras. Each era is discussed below in terms of the activities conducted and the products used during the era.

Coal and Steam Era

Steam produced by coal heat was used to power locomotives operating out of the facility during this era. Structures reportedly present during this time period included an engine house and turntable, sandhouse, blacksmith and machine shop, coal tower and chute, depot, and water tower. The engine house originally had nine stalls for repair work but, by 1902, only six stalls were being used. Each stall had a pit where a repair person could service the underside of a locomotive. Repair activities reportedly performed during this era included insulation of engine parts and boilers, cleaning and rebuilding seals, cleaning and repairing boilers, testing gauges, oil and degreasing, painting, and cleaning engine parts. The turntable was used to turn the locomotives around. The sand tower dispensed sand that the locomotives used for traction on steep grades. The machine and blacksmith shops were used to manufacture parts for repairs. Petroleum-related products reportedly used during this period included grease, lubricating oil, and fortnite oil (kerosene-like petroleum product used to clean parts).

Oil and Steam Era

Bunker C oil replaced coal as the heat source in steam locomotives in about 1908. The coal tower and chute were replaced by an oil unloading shed and sump and an aboveground oil storage tank. Bunker C oil was stored at the facility in below-grade wooden, concrete and steel sumps, and aboveground steel tanks. Fortnite oil was the only cleaning fluid reported to be used during this period. The depot was moved from the south side of the tracks to its present location north of the tracks on Railroad Avenue.

Electric Era

Construction of an 8-mile-long tunnel between Skykomish and Leavenworth and of an electric substation was completed in 1929. Electric-powered locomotives replaced Bunker C oil-powered locomotives through the tunnel to eliminate exhaust fumes. The facility became the transition point for Bunker C oil- to electric-powered locomotives.

The engine house was used for repairs on both road and helper engines until it was destroyed by a fire in 1943. However, evidence suggests that some elements of engine repair and maintenance continued at the facility through the mid-1950s.

Diesel Era

Diesel was used for locomotives traveling west of Skykomish as early as the mid-1940s and replaced both Bunker C oil and electricity. In 1956, installation of a tunnel ventilation system permitted diesel locomotives to operate within the tunnel and electric locomotives were abandoned. The diesel was stored at the facility in aboveground and underground storage tanks until 1974 when BNRR discontinued fuel handling activities at Skykomish.

Maintenance Era

Most engine repair and maintenance activities ceased in the mid-1950s. The electric substation building was used as a sandblasting facility for a period in the 1960s. BNRR discontinued all fueling operations at their Skykomish facility in 1974. At the same time, they also reportedly excavated and removed all known sources of petroleum product. The former structures of the facility are shown in Figure 1-3. The substation was demolished in August 1992. The depot building and maintenance building are the only structures remaining at the facility. Three sets of railroad tracks and at least four spur lines surrounded by railroad ballast and gravel comprise the remainder of the facility, which is currently used as a base of operations for track maintenance and snow removal crews.

1.2.3 Regulatory Background

A report of a potential problem associated with diesel fuel was found in the Washington State Pollution Control Commission Progress Report No. 14, dated December 1947. This report states:

> "Another recheck of the reported oil pollution of the Skykomish River at Skykomish showed there was some danger of the oil from the Railroad roundhouse dump being washed into Maloney Creek, from which it may make its way into the Skykomish River. The foreman of the roundhouse was contacted the condition pointed out, and he promised that immediate steps would be taken to correct the situation. He will build up the banks around the oil and refuse dump to a level that will prevent any spillages from entering the waters [of the] creek."

No initial or follow-up report was found in Ecology or BNRR records.

On June 22, 1973, Ecology responded to a complaint reporting black oil seeping into the Skykomish River adjacent to the bridge in the City. Their investigation found oil seeping from the south river bank. Ecology documented statements from area residents that oil had been seeping into the river for roughly 40 years. Information from Ecology files indicates the seeps may have occurred as early as 1912. As a result of this investigation, BNRR was cited by Ecology with a Notice of Penalty. Ecology also notified EPA of the problems and EPA notified BNRR of their involvement in November 1973. BNRR paid a fine to Ecology and, in cooperation with Ecology, began remedial actions to eliminate further discharges to the river. BNRR encountered intense local opposition and a petition was submitted to the City calling for a halt to excavation along West River Drive. No more work was conducted along River Road.

A site hazard assessment (SHA) of the facility was completed by Ecology and Environment, Inc. (E&E) in June 1991 for Ecology. Compounds of concern were identified as total petroleum hydrocarbons (TPH), benzene, lead, polychlorinated biphenyls (PCBs), toluene and pyrene (E&E, 1991). Based on the SHA, Ecology assigned the Site a hazard ranking of one (1) using the Washington Ranking Method (WARM).

In a letter to Ecology dated April 1, 1991, BNRR indicated a desire to initiate an RI/FS in accordance with the Model Toxics Control Act Cleanup Regulation, Chapter 173-340 WAC (MTCA). On September 16, 1993, the Agreed Order to conduct the RI/FS was signed by BNRR and Ecology.

Under the Agreed Order, BNRR implemented an interim remedial action at the Site in addition to an RI/FS. The interim remedial action objective were to provide data to assess the effectiveness of product recovery for the FS and reduce the release of oily seeps to the Skykomish River. Ecology's approval on the *Interim Action Plan for the BNRR Former Maintenance and Fueling Facility* was received in October 1995 after a 30 day public comment period. Installation of the interim action was initiated in October 1995. Installation was completed and system startup was initiated in January 1996. Interim action activities will be briefly discussed in Section 9. Data collected during the interim action will be included in the report as appropriate.

1.2.4 Previous Investigations

BNRR, in cooperation with Ecology, excavated five test pits at the Site during August 1973 and installed three monitoring wells during June 1974. Further exploration or remediation efforts were not conducted during 1974 because of opposition from local residents (GeoEngineers, 1993). BNRR completed two voluntary phases of exploration and analytical testing at the Site from 1990 to 1992. Additionally, two underground storage tanks (USTs) were investigated and removed in October 1992. The results of these investigations and removals are documented in a Phase I Report (GeoEngineers, 1991a), a Phase 2 Report (GeoEngineers, 1992a), and *Report of Geoenvironmental Services: UST Removal* (GeoEngineers, 1992c); both reports were submitted to Ecology. The Phase

I and 2 investigations consisted of drilling 34 borings, installing 32 wells and excavating two (2) test pits. Soil samples were collected from the ground surface, borings and test pits, and groundwater samples were collected from the wells. Most of the wells were screened to intercept the water table interface to evaluate the presence of light non-aqueous phase liquid (LNAPL).

Soil samples were analyzed for at least one of the following: TPH; fuel hydrocarbons; benzene, toluene, ethylbenzene and xylene (BTEX); polynuclear aromatic hydrocarbons (PAH compounds); PCBs; and priority pollutant metals (PPMs). The compounds detected in soil were TPH, fuel hydrocarbons, PCBs and PPMs (primarily lead, arsenic and cadmium).

Groundwater samples were analyzed for at least one of the following: TPH, fuel hydrocarbons, BTEX, volatile organic compounds (VOC), semivolatile organic compounds (SVOC), PCBs and PPMs. The predominant compounds detected in groundwater samples were TPH and fuel hydrocarbons. BTEX, methylene chloride (a common laboratory contaminant), chloroform, 2-methylnaphthalene, phenanthrene, PCBs and PPMs were detected at either low concentrations or infrequently.

LNAPL was detected in several monitoring wells. LNAPL is believed to be present as the result of releases during historic fueling activities at the facility. LNAPL was observed in the former fueling area extending downgradient (northwest) to the South Fork of the Skykomish River.

The UST investigation involved collection of three samples of soils surrounding the USTs prior to tank removals and analysis for PCBs, total metals and TPH. Six samples were collected from excavation walls and base following the tank removals and analyzed for hydrocarbon identification and TPH. One soil sample from a test pit was also analyzed for TPH as diesel and gasoline.

1.3 Regulatory Authority

Ecology has the regulatory authority to identify, investigate and clean up facilities where hazardous substances are present under Chapter 70.105D RCW, Model Toxics Control Act MTCA. This Act is implemented through Chapter 173-340 WAC, the MTCA Cleanup Regulation. The Agreed Order signed by Ecology and BNRR describes how the RI/FS requirements under MTCA are to be implemented.

1.4 Scope of RI

The scope of the RI is described in detail in the RI/FS Work Plan (GeoEngineers, 1993) and the SAP (RETEC, 1993). The scope was a combination of research and field work. Research conducted for this RI included, but was not limited to determination of:

- demographics
- land use (property boundaries, zoning, utilities, structures)
- surficial features
- climatology
- natural and ecological resources

Field work conducted during this RI consisted of:

- drilling 21 borings
- constructing eight shallow and five deep monitoring wells in 13 of the borings
- drilling four borings with a hand auger
- collecting and analyzing 57 subsurface soil samples for at least one of the following parameters: total organic carbon (TOC), TPH, VOC, SVOC, PCBs, and/or metals
- collecting and analyzing 46 surface soil samples for at least one of the following parameters: TOC, TPH, VOC, SVOC, PCBs, and/or metals
- collecting and analyzing seven sediment samples for at least one of the following parameters: TOC, TPH, VOC, SVOC, PCBs, and/or metals
- conducting four quarters of groundwater sampling, (the number of groundwater samples collected per quarter ranged from 24 to 35) and analyzing for at least one of the following parameters: TPH, VOC, SVOC, PAH compounds, PCBs, and/or metals
- collecting and analyzing four product samples for surface tension, interfacial tension, viscosity and specific gravity
- conducting slug tests in four wells
- conducting product baildown tests in three wells

- collecting nine soil samples for permeability and grain size analysis

1.5 Report Organization

This report is organized in 14 sections, as follows:

- Section 1.0 provides an introduction, discusses the purpose and scope of the RI, and provides a description of the Site background and operational history.
- Section 2.0 discusses Site features including demography, land use, surficial features, climatology, and natural and ecological resources in the area.
- Section 3.0 presents the hazardous substance investigation, including identification and characterization of source areas and hazardous substances.
- Section 4.0 discusses methods of field investigation, including the rationale and procedures.
- Section 5.0 presents the soil investigation results, including the geology, soil quality data and a discussion of migration routes.
- Section 6.0 presents the groundwater investigation results, including the hydrogeology, groundwater quality data and a discussion of migration routes.
- Section 7.0 presents the surface water and sediment investigation results, including the surface water and sediment quality data, and a discussion of migration routes.
- Section 8.0 discusses the air quality investigation, including the regional air shed, air quality data, impacts and a discussion of migration routes.
- Section 9.0 discusses the interim action.
- Section 10.0 discusses regulatory classification and standards for waste and specific media.
- Section 11.0 presents the risk assessment.
- Section 12.0 discusses remedial goals and objectives.

- Section 13.0 presents data gaps, conclusions and recommendations
- Section 14.0 presents full citations for references presented in the text.

Appendices of investigation data and supporting information have been compiled to complement this report. A list of historic property owners and the results of a historic title search are contained in Appendix A. Appendix B provides water well logs for the City of Skykomish water wells, as well as other nearby wells. Appendix C contains logs for surface soil samples and wells and borings installed as part of this RI. Laboratory analytical reports and quality assurance/quality control (QA/QC) review of analytical data for soil and sediments are contained in Appendix D. Appendix E contains tabulations of previous soil and groundwater analytical data. Appendix F contains slug test recovery data. Appendix G contains groundwater contour maps, including those generated during previous investigations of the Site, whereas Appendix H contains RI-generated ground and surface water laboratory and QA/QC reports. Product analytical results are presented in Appendix I. Appendix J provides the modeling and estimation methods used to evaluate potential air quality impacts from the Site. Appendix K provides the laboratory analytical report for soil collected during the interim action.

2.0 SITE FEATURES INVESTIGATION

This section provides a description of the Site, defined as the former maintenance and fueling facility and the surrounding areas potentially impacted by former activities at the property. The regional Site setting is also discussed.

2.1 Demography

The City of Skykomish was founded in the late 1800s, primarily to support locomotive fueling and maintenance activities, and was incorporated in 1909. Data from the 1990 U.S. Census reports that the current population is 273. The median age is 34.4 years. The majority of the population is of German descent, followed by English, Irish, Scottish and French. The City experienced a limited growth rate of 2.7% between 1980 and 1990. Major employers of in area are the Skykomish School District and the U.S. Forest Service (U.S. Census, 1990).

2.2 Land Use

The City is considered a rural town and is surrounded by the Mt. Baker-Snoqualmie National Forest. Because of the topography and forest boundary, potential for expansion is limited. The surrounding area offers recreational opportunities such as fishing, hiking and skiing. The City is composed of public, commercial, industrial and residential properties. Figure 2-1 presents the current land use and zoning. The facility is an industrial facility, currently used as a base of operations for track maintenance and snow removal crews. Residential neighborhoods, small businesses and city property (City Hall, the public library, and public school) are located across Railroad Avenue north of the BNRR property (Hedges and Roth Engineering, 1992). Most businesses are located between Third and Sixth Streets.

Property ownership data are presented in Appendix A. BNRR is the current owner and operator of the facility. The property was owned by St. Paul-Minneapolis and Manitoba Railroad Company prior to 1899. The GNR owned and operated the facility between 1899 and 1970, when it merged with four other railroads to become BNRR. In the areas surrounding the facility, all but 69 of the property lots are residential. Forty-four of the nonresidential lots are owned by the City or the Skykomish School District. The remainder of the nonresidential lots are currently involved in nonindustrial activities. The historical property search indicates there have been 20 nonresidential property owners from 1891 to the present in the vicinity of the Site. Past manufacturing activities in the northern portion of the Site have been limited to a brewery (1907), and a small millworks or cabinet making shop (1948 to 1956).

There is no public sewer system in Skykomish; rather, each building/house is serviced by its own septic system. The residents are served by two public supply water wells (Plate 1). Storm drains are located in the streets to direct surface water runoff to the river. Plate 1 shows existing and former structures and utilities in the vicinity of the Site.

2.3 Surficial Features

The City is at an elevation of about 930 feet above mean sea level (msl) and is located in the Skykomish River valley in the Cascade Mountains, about 35 miles from their western foot at Monroe.

The Skykomish River valley is narrow and steep-sided. The Site topography gently slopes northwest toward the river, as shown in Plate 2. The soil type at the Site is classified as Arents (USDA, 1992). These soils are moderately well to excessively drained. Runoff is slow and the hazard of water erosion for these soils is slight. On-site precipitation either quickly infiltrates the soil, or flows into storm drains and the former Maloney Creek channel which eventually drain to the river.

2.4 Climatology

Because of its geographic location, the Site receives a significant amount of precipitation. For example, the mean annual rainfall since 1988 for the Skykomish area is 111.1 inches. Average monthly rainfall for the period beginning January 1988 and ending July 1993 is graphed in Figure 2-2. Precipitation is highest between October and May. Snowfall during this period has averaged 58.4 inches per year; most of it falling between November and April, as shown in Figure 2-2. The maximum 2-year, 24-hour precipitation amount is 4.5 inches (Ecology, 1990).

Temperature data were obtained from the Western Regional Climactic Center (Figure 2-2). The average annual temperature in the Skykomish area is 49.4EF. The average annual daily temperature maximum is 57.7EF; the minimum is 41.0EF. The hottest month is August, with an average daily high of 74.7EF and an average low of 52.7EF. January is the coldest month with a mean high of 39.9EF and a mean low of 30.8EF.

The closest weather station with wind speed and direction data is the Seattle-Tacoma Airport. Data from this station indicates that the average annual wind speed in the area is 8.7 miles per hour (mph). The predominant wind direction from 1984 to 1993 was south-southwesterly. However, the Site's location in an east-west trending river valley is likely the factor controlling wind conditions in the area. It is expected that winds at the Site would occur predominantly in the east-west direction.

2.5 Natural Resources and Ecology

2.5.1 Surface Water

The location of surface water bodies in the Site vicinity was included in Figure 1-2. The Site is located between the former Maloney Creek channel (former creek channel) to the south and the South Fork of the Skykomish River to the north. The former Maloney Creek channel is dry throughout much of the year. Maloney Creek is currently located southwest of the Site, and is a tributary of the South Fork of the Skykomish River, which flows to the west and joins the North Fork at Index. The Skykomish River is a tributary of the Snoqualmie River, which empties into Puget Sound at Everett.

The South Fork of the Skykomish River and its tributaries (Maloney Creek) is a Class AA waterway. According to WAC 173-210A-030, the characteristic uses shall include, but are not limited to:

(I) Water supply (domestic, industrial and agricultural)
(ii) Stock watering
(iii) Fish and Shellfish
(iv) Wildlife habitat
(v) Recreation (primary contact recreation, sport fishing, boating, and aesthetic enjoyment)

The water quality criteria for Class AA waterways is presented in WAC 173-210A-030(1)(c) and discussed in Section 12.

The United States Geological Survey (USGS) currently maintains one gauging station near the Site at Gold Bar. Gold Bar is located approximately 20 miles downstream of Skykomish. At this point, the Skykomish River drains a 535-square-mile area and discharge is much greater than that occurring at Skykomish. However, three gauging stations were previously maintained by the USGS in the immediate area that provide historical discharge data (USGS, 1993), which is more representative of river flow at Skykomish. Two stations are located on the Skykomish River; one is upgradient (east) of the confluence with the Beckler River (gauging station No. 1) and the other is approximately 10 miles downgradient of the Site, near the town of Index (gauging station No. 2). The third gauging station is located on the Beckler River (gauging station No. 3). The confluence of the Beckler and Skykomish rivers, is approximately 1 mile upstream from the Site (see Figure 1-1). Several streams flow into the South Fork of the Skykomish River between Skykomish and Index, including Miller River and Money Creek. Mean annual discharge of the Skykomish River at Index is roughly 50% greater than the combined discharge of the Beckler River and the South Fork upstream of the Beckler River. Therefore, river discharge at Skykomish is best represented by the combined discharge of the Beckler River and the South Fork, as measured at gauging stations Nos. 1 and 3.

Monthly discharge measurements for these two stations are available for a limited period of record as shown in Table 2-1 (USGS, 1984). The average annual discharge for these five years is roughly 1,350 cubic feet per second (cfs) and the maximum annual discharge was 1,700 cfs. Monthly average discharge trends are depicted in Figure 2-3. Discharge is greatest in April, May and June, in correspondence with springtime snowmelt and runoff. Low flow conditions occur in August, or late summer; high flow discharge is greater than 6 times low flow discharge. Annual peak flow at gauging stations Nos. 1 and 3 was available for a 21-year period spanning 1930 to 1931 and 1946 to 1970 (USGS, 1984). The maximum annual peak flow is 25,800 cubic feet per second (cfs) and the average annual peak flow is about 12,000 cfs. The drainage area upstream of the Skykomish River Bridge is 243 square miles (USGS, 1984).

The South Fork of the Skykomish River provides recreational opportunities such as rafting and fishing. Water rights information within 5 miles downstream of the Site were obtained from the Department of Ecology Water Resource Division. Two rights for surface water intakes were identified; both are located more than 3 miles downstream of Skykomish. The use classification for both rights is identified as commercial/industrial.

A King County Flood Boundary Work Map and a Flood Insurance Map (Harper Righellis, 1995 and FEMA, 1989) were obtained for the City of Skykomish. As shown in Figure 2-4, areas within the 100-year flood plain include most of the area north of the railroad tracks and along Maloney Creek.

There are no designated wetland areas present at the Site. A City zoning map identified a small wetland area southwest of the Site, adjacent to Maloney Creek (Hedges & Roth Engineering, 1992). However, no wetlands were identified in the National Wetlands Inventory.

2.5.2 Groundwater

The aquifer underlying the Site and surrounding areas is used as a source of potable water. Groundwater in the area also recharges (i.e., discharges to) surface water. The residents of Skykomish are served by two public water supply wells that are located about 1,100 feet east (upgradient) of Skykomish city limits (Plate 1). The primary well is completed to a depth of 216 feet below ground surface (bgs) and is screened across three intervals between 181 and 216 feet bgs. A backup well is located adjacent to the primary well and is completed to a depth of 219 feet bgs. In addition to the public water supply wells, two additional wells are located within 1.5 miles of the Site. A well was installed north of the river in Sky River Estates development. The well was initially intended for water supply, but instead the development hooked up to the city of Skykomish system and the well was capped and is not used (per communication with Ted Cleveland). A second water well is located 1.5 miles east of Skykomish, and was drilled for Timberlane Village. Logs for area wells are provided in Appendix B. No confining units were observed in the logs for the city water supply wells. According to the logs, the formation consists primarily of sand and gravels, cemented at depth.

2.5.3 Plants and Animal Species

Skykomish is surrounded by the Mt. Baker-Snoqualmie National Forest, which supports a large variety of plant and animal species. The general distribution of vegetation in areas surrounding the Site is shown in Figure 2-5. Wooded areas are located south of town, north of U.S. Highway 2, and in small undisturbed areas between the South Fork Skykomish River and Highway 2 to the east. Riparian zones are located adjacent to Maloney Creek south of town and west of town between Highway 2 and the Old Cascade Highway on both sides of the Skykomish River.

The area of investigation is comprised of industrial, commercial and residential properties,. Therefore, the animal species commonly found in this area is primarily limited to animals that commonly cohabit with humans, such as squirrels, mice, crows, sparrows, song birds, etc.

An extensive search was conducted to identify the key wildlife species present in the vicinity of the Site. Two databases developed by the Washington Department of Wildlife were accessed to obtain this information:

- Nongame Heritage Database contains significant site observations of nongame species of concern, including federal- and state-listed species.

- Priority Habitats and Species is an inventory of key species use areas and key wildlife habitats, including the locations of federal- and state-listed species (threatened, endangered, sensitive, candidate) and other priority nongame and game species.

Data was compiled from these databases for an area encompassing 9 square miles around the Site.

The Nongame Heritage Database identified the following key species within a 9-square-mile area of the Site:

- Spotted Owl - state- and federally-endangered species
- Bald Eagle - state- and federally-threatened species
- Northern Goshawk - state and federal candidate species
- Marbled Murrelet - state- and federally-threatened

The Priority Habitats and Species database search resulted in the identification of two species located within the 9-square-mile search area:

- Harlequin Duck - a federal candidate species
- Mountain Goat

More information regarding ecological resources is presented in Section 11.4.1.

2.5.4 Aquatic Species

The Washington Rivers Information System, a state-wide inventory of all anadromous and resident fish distributions, identified both the South Fork of the Skykomish River and Maloney Creek in the vicinity of the Site as containing fish habitats. Immediately north of the Site, the river is classified as a critical spawning habitat for resident species. This reach of the river and its tributaries also contains anadromous fish runs and listed resident fish runs (Salmon (Chums, Humpies, Coho, Chinook and Sockeye), Cutthroat, Whitefish, Dolly Varden, Bull Trout and/or

Olympic Mud Minnow). Similarly, Maloney Creek is classified as a critical spawning habitat for resident species and contains anadromous and listed fish runs.

2.5.5 Sensitive Environments

Two areas within a 1-mile radius of the Site have been defined as sensitive environments. Both are identified as breeding areas for the Harlequin Duck. Specifically, these areas are:

1. the Beckler River and tributaries Harlequin Duck breeding area
2. the Skykomish River Harlequin Duck breeding area

Other sensitive environments located within the Skykomish and Grotto quadrangles, but outside of the 9-square-mile area, are the Money Creek Harlequin Duck breeding area and the north Skykomish Mountain Goat winter range.

3.0 HAZARDOUS SUBSTANCE INVESTIGATION

This section identifies the source areas at the facility based on operational history, and describes the products and hazardous substances used at the facility.

3.1 Source Areas

There are no active, operating sources of hazardous substances at the Site. Past releases from storage facilities and from former fueling and maintenance activities at the facility may serve as a source of contaminants. Three distinct areas can be defined on the basis of historical structures and known operations. These areas are the maintenance area, fueling area, and the substation and sandblasting area. Referring to the historical facilities and source areas shown in Figure 3-1, railcar and locomotive maintenance activities were conducted at the engine house, turntable, machine and boiler shop, and areas immediately east of these structures. Fueling operations were performed at the fueling stations, concrete oil unloader pits and oil pump house. Finally, transformer pads near the east substation were used to store electrical transformers, and in the 1960s the substation was used as a sandblasting facility. The specific activities performed within each source area and the products used are discussed below.

3.1.1 Maintenance Area

The eastern portion of the facility housed most of the repair and maintenance operations. The roundhouse (labeled as "engine house" in Figure 3-1), with its turntable to the east, was the primary service facility on the Site for steam locomotives during the coal and steam era (approximately 1890s to 1908). Each stall in the roundhouse had a work pit under it to enable a worker to repair or perform maintenance under the locomotive, or to allow for collection of liquids and spillage from the overhauling and maintenance work. The stalls were routinely washed out and cleaned. Other than grease and lubricating oil, the only other major product in use was fortnite oil. The 80-foot-diameter turntable was used to direct engines in and out of the roundhouse stalls and could connect with either of the incoming tracks (Berryman, 1990).

The machine and boiler shop was connected to the roundhouse on the west side, as shown in Figure 3-1. Activities conducted at the shop included metal work using presses, lathes, drills and shapers to construct new parts or repair items damaged during operations. A forge and emery wheel were also located in the building.

3.1.2 Fueling Area

Bunker C oil, diesel fuel, gasoline, fortnite oil and waste oil were used and stored at the facility, primarily within the fueling area in the northern portion of the facility. Bunker C oil was used during the oil and steam era through 1956, after which diesel locomotives were used exclusively. Tank cars brought the Bunker C oil onto the oil spur and under the roof of the oil unloading shed. Bunker C oil was reportedly heated to facilitate transfer into the 100,000-gallon tank shown in Figure 3-1 (Berryman, 1990). A wooden sump was used in this transfer process and was subsequently replaced by a concrete, then steel sump. Engines were fueled very near the oil tank.

Diesel fuel was used as early as the mid-1940s and later replaced both Bunker C oil and electricity. Diesel fueling activities occurred in the same area as prior Bunker C oil fueling (i.e., adjacent to the fueling stations and diesel tank). Diesel fuel was used until 1974 when BNRR discontinued fueling activities at the facility.

3.1.3 Substation Area

Upon electrification of the railroad line east of Skykomish in 1929, a new electrical substation was constructed at the facility (see Figure 3-1). The substation equipment at the Site was located in the southwestern portion of the facility and consisted of:

- one 8,000-KVA frequency set
- three 2,750-KVA-100KV-13KV transformers
- two 5,000-KVA-13.2-KV-44-KV transformers
- one switchboard

This equipment was removed in 1956 when GNR replaced electric- with diesel-powered locomotives. The only activity reported in the substation area after 1956 was use of the substation as a sandblasting facility.

3.2 Estimated Quantity

Petroleum products have been detected in soil and groundwater in the maintenance and fueling areas. There are no available operating records for the facility that could provide information regarding the volume of petroleum product used in fueling operations or maintenance activities over time. Also, there are no reports of releases or spills. Therefore, it is not possible to estimate the quantity of petroleum product which may have been released to soils and groundwater at the facility.

PCBs have been detected in a few samples from the substation area at low levels (i.e., 0.11 µg/L in groundwater and 0.33 mg/kg in soil). Transformers associated with the substation area are the only conceivable source of PCBs previously detected. Because of the low levels of PCB observed, the transformers may have been non-PCB transformers (i.e., <50 ppm PCB) as defined by TSCA (40 CFR, Part 761). However, transformer oil contaminated with PCBs could have resulted in the observed PCB distribution. Although the number and size of transformers have been documented in historic records, information regarding oil composition and volume is not available.

Lead has been detected in shallow soils across the facility. Approximately 100 tons of sandblasting grit containing lead were removed from the former substation building in 1991 and disposed of at the Waste Management, Inc., landfill in Arlington, Oregon, according to hazardous waste manifest forms. GeoEngineers reported that sandblasting grit was evident in backfill material in a former gasoline UST excavation (1993). However, no records regarding this tank or excavation were found. This is the only information available regarding the quantity of sandblasting grit that may have been used at the facility.

3.3 Characteristics and Behavior of Petroleum Products and Hazardous Substances Used at the Site

The following sections describe the physical and chemical properties of the petroleum products (a hazardous substance under the Model Toxics Control Act (RCW 70.105D.020(5)(d))) and other hazardous substances used at the Skykomish facility. These other substances most notably include lead and PCBs. Also presented is information concerning toxicological effects of these products and constituents.

3.3.1 Diesel Fuel

The U.S. Chemical Substances Inventory (under TSCA) defines diesel oil as, "a complex combination of hydrocarbons produced by the distillation of crude oil, having carbon numbers predominantly in the range of C_9 to C_{20} and a boiling point range of 163E to 357EC." This definition encompasses both diesel fuel No. 1 (i.e., marine fuel, kerosene) and diesel fuel No. 2 (i.e., automotive or railroad diesel) (Millner, et al., 1992). Table 3-1 describes the principle chemical components of diesel fuel.

Diesel fuels are often erroneously characterized as containing large percentages of PAH compounds. The boiling point range of diesel fuel largely excludes the presence of benzene and PAH compounds (IARC, 1989) because the majority of carcinogenic PAH compounds distill at temperatures above that required to produce diesel fuel and middle distillates. However, there are minimal levels of PAH compounds and BTEX compounds due to the imperfect manufacturing processes (Griest, 1985).

PAH compounds are a group of unsaturated hydrocarbons having two to six molecular rings and are present in the environment from both natural and man-made sources. PAH compounds are found in crude oil as well as refined petroleum products and are common combustion by-products.

Sixteen individual PAH compounds have been listed as priority pollutants by EPA and standard EPA methods exist for their analysis. Table 3-2 summarizes the characteristics of the 16 compounds. For ease of discussion, the priority pollutant PAH compounds can be separated into two groups: low-molecular weight compounds and high-molecular weight compounds. The low-molecular weight PAH compounds are considerably more soluble in water and have lower organic carbon partition coefficients. This indicates that these compounds will be more mobile in the environment than the high-molecular weight PAH compounds. The low-molecular weight PAH compounds are: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, and pyrene. High-molecular weight PAH compounds are: benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(123-cd)pyrene, dibenzo(ah)anthracene, and benzo(ghi)perylene.

Concern over PAH constituents is related primarily to the known or suspected carcinogenic PAH compounds. These compounds are all high-molecular weight compounds. The low-molecular weight PAH, such as naphthalene, have been shown to be non-carcinogenic and to exert low acute and chronic toxicity.

PAH compounds are subject to adsorption onto organic carbon in soils and sediments and are degraded and transformed by microbes. Processes such as photodecomposition, oxidation and hydrolysis of PAH compounds are not considered significant degradation pathways in soil system. In the aquatic environment, adsorption of PAH compounds onto organic-rich sediments is probably the dominant transport mechanism (Versar, 1979).

In addition to PAH compounds, petroleum products such as diesel fuel have the potential for containing BTEX and other aromatic compounds. Aromatic compounds, by definition, are fairly volatile and often very mobile. However, due to their degradability, they are generally not persistent in the environment. Table 3-3 summarizes the characteristics of several volatile organic compounds.

3.3.2 Bunker C Fuels

The composition of Bunker C fuels is less consistent than that of diesel fuel. Bunker C represents a fuel mixture which generally contains both diesel-range (C_9 to less than C_{24}) and oil-range (C_{20} to greater than C_{32}) hydrocarbons. Two organizations provide chemical standards for Bunker C fuel oil: API and EPA. The API chemical standard weighs heavily in the motor oil range (C_{24} to C_{32}) and the EPA Bunker C chemical standard falls in the C_{12} to C_{24} (diesel) range. Generally, Bunker C fuels are prepared to provide a specific energy content (i.e., BTU value) rather than a specific mixture of diesel and oil-range hydrocarbons. Bunker C fuels are generally classified (for marketing and distribution purposes) based on BTU content and viscosity.

The toxicity of hydrocarbons is generally indirectly proportional to viscosity with products having high viscosity, such as heavy greases and oils, considered to have only limited toxicity (Klaassen, 1986). Bunker C fuels do have higher concentrations of PAH compounds than diesel fuels.

3.3.3 Polychlorinated Biphenyls

PCBs are a family of compounds that were widely used until recently in capacitors and transformers, as well as for other purposes. PCBs were desirable for these uses because of their thermal stability, water insolubility, insulation properties, and resistance to oxidation and chemical transformation. PCBs are highly hydrophobic, and therefore sorb strongly to solids and fats. Because of their stability and slow rate of biotransformation, they are retained in animal tissues, representing a long-term threat to higher trophic-level organisms (i.e., organisms at the upper levels of the food chain).

The most common trade name for commercial products containing PCBs is Aroclor (Monsanto Co.), and there are several Aroclors, denoted by a four-digit number indicating the type of molecule and the weight percent chlorine. There are 210 possible PCB compounds ("congeners"), with up to ten chlorine atoms per molecule, but many have not been found in industrial products. Nevertheless, any commercial product actually contains many different congeners; Aroclor 1254, for example, has up to 69 separate congeners (Hutzinger, et al., 1974).

There is extensive literature on the behavior of PCBs in the environment. Generally, these studies conclude that PCBs tend to sorb strongly to soil and do not migrate readily to groundwater or surface water. The more highly chlorinated isomers tend to adhere more strongly to the soil and they are also less soluble (Table 3-4). Mierure, et al. (1976) show that in general the lower chlorinated isomers are more soluble, more readily vaporized and biodegrade more rapidly than the highly chlorinated isomers.

3.3.4 Lead

Lead is a naturally occurring element and is a major constituent of more than 200 minerals. It exists in the environment in three oxidation states, 0, +2, and +4. Neither metallic lead nor the common lead minerals are soluble but they can be solubilized by some acids. Industrial lead products are sometimes more water soluble than natural lead. Lead has a tendency to sorb to solids (particularly clays) and to form complexes with natural organics (e.g., humic and fulvic acids).

The metabolism of inorganic lead, like that contained in sandblasting wastes from the Site, is closely related to that of calcium (Hodgson, 1987). As such, lead can be deposited in bones and teeth. Lead toxicity is in fact enhanced by deficiencies in calcium and iron (Klaassen, 1986).

4.0 FIELD INVESTIGATION

4.1 Field Investigation Rationale

As was discussed in Section 3.0, petroleum products, metals, and PCBs are present at the Site due to past releases from storage facilities and from fueling and maintenance activities. The results of previous investigations were used to develop the RI scope as detailed in the RI/FS Work Plan (GeoEngineers, 1993). The RI was designed to further characterize the nature and extent of contamination present at the Site. Specifically, the RI was intended to:

- further delineate the extent of metals, including lead, and PCBs in surface soils
- define the extent of LNAPL floating on the groundwater table and the extent of contaminants dissolved in the groundwater
- determine the distribution of metals, PCBs, and petroleum products (including VOC and SVOC) in subsurface soils, sediments and surface water
- characterize the geologic, hydrogeologic and hydraulic conditions that may affect contaminant fate and transport, and determine whether contaminants are being discharged off Site

The ultimate goal of these tasks is to estimate the areas and volumes of Site media that pose a potential risk to human health and the environment so that appropriate remedial action alternatives can be evaluated.

4.2 Field Investigation Procedures

The RI consisted of several field activities including:

- soil sampling to characterize the subsurface stratigraphy and to obtain samples for chemical and physical analysis
- well installation and sampling to characterize hydrogeologic conditions, identify the extent of LNAPL, and characterize groundwater quality

- sediment and surface water sampling in the nearby streams and river to obtain samples for chemical analysis

- sampling and testing to define the physical characteristics of the LNAPL product and to assess its recoverability

Unless noted otherwise, all field investigations were performed in accordance with the SAP (RETEC, 1993) and the project health and safety plan. The methods and procedures used for soil sampling, well construction and development, groundwater sampling, aquifer testing, and LNAPL testing are provided below. All sampling locations were surveyed as presented in Table 4-1.

4.2.1 Soil Sample Collection

Surface and subsurface soils were collected as part of the RI. Subsurface soils were collected from drilled borings or from hand augers. Surface soil samples were collected using a shovel. Surface soil and hand auger sample locations are shown in Figure 4-2. All sample locations were in accordance with the RI/FS Work Plan and SAP except for two hand auger locations which were adjusted due to access restrictions as discussed below.

Soil Sampling from Borings

Prior to drilling, the following utilities were contacted and notified of drilling plans: Sprint, Puget Power, and GTE. The BNRR Utility Locate group and the City were also notified. Sprint owns a major fiber optics cable located along the north shoulder of the Old Cascade Highway. The City utilities (water and storm sewer) are shown on Plate 1. No other utilities were located that would impact the proposed drilling locations.

Drilling services were provided by Cascade Drilling of Woodinville, Washington, in three phases. The initial phase was performed September 27–29, 1993, using a CME-75 hollow-stem auger drill rig. Out of the 11 borings attempted, five were abandoned due to refusal from coarse cobbles and boulders. Based on these problems, BNRR and Ecology decided that air rotary drilling methods would be more effective at accomplishing the investigation goals. Drilling continued using an Ingersoll-Rand T3W air rotary drilling rig from October 18–24, 1993. Fifteen wells and borings were installed during this second phase. An additional boring (B-12) was installed on October 29, 1993, to further define the southern extent of free phase LNAPL. Figure 4-1 shows the location of the RI and the previous wells and borings installed at the Site. Appendix C contains all logs for the surface soil samples, hand augers, borings and wells.

Soil samples were retrieved during drilling using a 2-inch-diameter split-spoon sampler 18 inches in length. Brass inserts were used to collect undisturbed soil samples for physical characterization. Soil samples were collected at 5-foot intervals during hollow-stem auger drilling for lithologic characterization and to screen the samples for evidence of contamination. During air rotary drilling, the lithology and field screening were determined on the cuttings discharged from the cyclone. All soil samples were classified according to the Unified Soil Classification System (USCS). Soil descriptions included the soil name, color, texture, grain size, consistency or compaction, and moisture content. Detailed boring logs with soil descriptions are contained in Appendix C. Field screening for evidence of contamination included visual and olfactory inspection (i.e., visible occluded oil, stained soils, characteristic odor, etc.). Organic vapor concentrations were also obtained for each soil sample using a photoionization detector (PID). The PID readings are included on the boring logs.

Three soil samples were collected from each boring for laboratory analysis. These samples were obtained from each of three soil/aquifer zones: 1) the vadose zone, 2) the saturated contaminated zone, and 3) the saturated clean zone. If there was no evidence of contamination, only two samples were collected. The vadose zone is defined as the unsaturated soils present above the groundwater table. The saturated contaminated zone is below the groundwater table interface and contains field evidence of contamination with petroleum product. Samples obtained for laboratory analysis from the vadose and saturated contaminated zones were the most contaminated soils from that zone as determined by field screening. The saturated clean zone is located below the water table and has no field evidence of contamination. Soil samples for laboratory analysis were removed from the split-spoon sampler, placed into glass jars, labeled, and placed directly on ice in a cooler for shipment to the laboratory.

Surface Soil Sampling

Surface soil samples were collected from 0-0.5 feet bgs at 45 different locations across the Site, as shown in Figure 4-2. These locations include all of the well and boring locations, locations labeled as "SS" (surface sample), and two background locations (BG). A decontaminated trowel, shovel or digging bar was used to loosen and remove the top 6 inches of the soil at the appropriate locations. A shovel was used to remove the soils from the sampling hole onto a clean sheet of visqueen. Soils were then transferred to clean sample jars which were subsequently placed directly on ice in a cooler. Soils were also placed into a plastic bag for headspace screening using a PID. Soil descriptions were recorded in the field notebook or the well or boring log and the remaining soils were returned to the hole. Soil descriptions are contained in Appendix C.

Hand Auger Sampling

Four hand auger samples were collected on privately owned property where drill rig access was constrained. Property owners were contacted prior to sampling, and written access agreements were obtained. Sampling locations HA-3 and HA-4 were moved to alternate locations with Ecology approval due to difficulty in getting the required access agreement at the original proposed locations.

Hand augers were advanced using a 6-inch-long, 4-inch-inner-diameter (ID) bucket attached to a 5-foot-long handle. Hand auger samples were collected by placing a clean sheet of visqueen over the sampling location, and cutting a hole in the center of the visqueen. The decontaminated hand auger was advanced through the hole, and, after each foot of advancement, the bucket was carefully removed from the borehole. Headspace and visual screening were performed on the removed soils. The hand auger was advanced to a total depth of 5 feet bgs or until refusal. Soil samples were selected for laboratory analysis from the most contaminated zone or, in the absence of visible contamination, from the deepest interval. Hand auger logs are presented in Appendix C.

Decontamination

All sampling equipment used in the soil investigation was decontaminated between samples to avoid cross-contamination. In addition, augers and casing were decontaminated between each boring to prevent cross-contamination. Soil cuttings produced during drilling were placed in Department of Transportation (DOT)-approved drums, labeled, and covered. These drums are currently stored on Site pending disposal (See Section 4.3).

Sample Handling and Laboratory Analysis

Soil samples selected for laboratory analysis were sent to ACZ Laboratories of Steamboat Springs, Colorado. Physical soil analyses were conducted by Pacific Testing Laboratories of Seattle, Washington. Samples were shipped for overnight delivery via Federal Express. Standard chain-of-custody documentation was maintained on all samples.

Table 4-2 provides a summary of soil samples collected and submitted for laboratory analysis, including the corresponding depth. Duplicate soil samples were collected as specified in the SAP and shown in Table 4-2. Duplicate split-spoon samples were collected by dividing the full length of the split-spoon into two samples. Duplicate surface soil and hand auger samples were obtained by transferring additional sample volume from the same depth interval into the sample jars.

4.2.2 Monitoring Well Installation and Development

Shallow monitoring wells were constructed in eight of the boreholes; these wells are identified as MW-33 through MW-40 in Figure 4-1. These shallow wells were designed to intercept the water table during all water level extremes to detect LNAPL, if present. Five deep monitoring wells were constructed during this investigation (identified as DW-1 through DW-5 in Figure 4-1). These deep wells were designed to characterize the vertical extent of groundwater contamination. The shallow and deep wells were also used to measure groundwater elevations in order to determine the directions and gradients of the groundwater flow.

All RI monitoring wells were installed in accordance with WAC 173-160, Minimum Standards for Construction and Maintenance of Wells, except where noted below. The wells were constructed of 2-inch-diameter Schedule 40 PVC casing and screen. The screen slot size for the wells was 0.010 inch. The shallow well screens consisted of 15-foot-long sections. In the deep wells, the well screens consisted of a 5-foot section placed between 40 and 45 feet bgs. DW-2 was screened between 38 and 42 feet bgs due to drilling refusal. The bottom of each well was capped with a flush-mount, threaded-end point.

The screen slot size of 0.020 inch proposed in the SAP was apparently overlooked and a 0.010 inch slot size was used in the well construction. This slot size was still appropriate for the sand pack used (10/20). The importance of a sand pack is to limit the amount of fines flowing into the well and the screen is to hold back the sand pack. Since the screen slot size was smaller these objectives were still met. This deviation has no impact on the RI results.

A filter pack of clean 10/20 Colorado silica sand was placed in the annular space around the screens. The filter pack extended a minimum of 1 foot above the top of the well screens. The use of a 1-foot sand extension above the top of the screen, in lieu of the 3-foot minimum specified in WAC 173-160 was approved by Rod Thompson of Ecology (Personal communication, 1993). The filter pack was designed to minimize the potential for fine-grained soils to enter the wells. A minimum 2-foot bentonite seal was placed immediately above the filter pack. The bentonite seal extended to within 2 feet of the ground surface. Concrete was placed from the top of the bentonite seal to the ground surface. A steel, locking, flush-mount well protector was cemented into place at the surface of all but two of the shallow wells (MW-39 and MW-40) and at two of the deep wells (DW-4 and DW-5). Aboveground well protectors with three guard posts were placed around the remaining wells (MW-39, MW-40, DW-1, DW-2 and DW-3). Well construction details are summarized in Table 4-3. Monitoring well logs are contained in Appendix C.

Following installation, wells were developed to restore the natural permeability of the formation adjacent to the borehole and to remove any contamination or formation damage that may have occurred during drilling. Well development commenced on November 1, 1993, and was complete by November 4, 1993, with the exception of MW-40. This well was developed after it was repaired (as discussed in Section 4.2.3, below) on November 8, 1993.

One of two methods were used to develop the newly installed wells. The first method involved surging and pumping using a QED well development pump. The second made use of a weighted polyethylene bailer for surging and a Wilden pneumatic double-diaphragm pump. The total volume to be removed during development, roughly 10 well volumes, was calculated based on the total well depth, depth to water, and casing diameter. Using either development procedure, wells were surged for about 15 minutes and approximately 30% of the required purge volume was pumped from the well. Specific conductivity, pH, and water temperature were measured periodically to ensure that conditions within the well had stabilized. Pumping continued until well conditions were stable, a particulate-free discharge was apparent, or until 10 well volumes were evacuated, whichever occurred later. Well development water was collected in barrels and transferred to a Baker tank for subsequent disposal. Decontamination of the pump and bailer was performed between each well according to the procedures outlined in the SAP (RETEC, 1993).

4.2.3 Well Repair

Throughout the course of the RI, various well repairs were performed as needed. These activities are summarized below.

During well development, it was discovered that MW-40 had developed a bulge in the casing just below ground surface, preventing the well from being developed or sampled. On November 8, 1993, Cascade Drilling removed the concrete well pad, replaced the well casing, and reset the well pad.

On February 23, 1994, well MW-35 was damaged by snow removal equipment. On March 3, 1994, Cascade Drilling mobilized to repair the well and noted that the cast iron well lid had been sheared off, and the well cap (thermos cap) had been knocked out of the well. A small amount of rain water or snowmelt had collected in the annulus of the well monument, but the water level had remained below the top of the casing. The well casing was intact and had not been damaged. The well was repaired by jackhammering out the asphalt pavement and the concrete well pad to a depth of 1 foot. A new flush-mount well protector was cemented into place and the well pad was completed.

On November 10, 1994, Cascade Drilling reset well MW-33. The well monument had risen a few inches above the pavement, creating a potential hazard to snow removal equipment. The concrete around the monument was removed, and the monument was reset flush with the pavement.

4.2.4 Groundwater Sample Collection and Elevation Measurements

Four quarters of groundwater sampling were completed during the RI. Wells were gauged in conjunction with quarterly groundwater sampling and during two separate gauging events. The following paragraphs describe well gauging and groundwater sampling procedures used for the investigation.

Groundwater Elevation Measurements

The well gauging procedures consisted of measuring the depth to water using an electronic water level indicator and evaluating the wells for LNAPL and DNAPL. In wells where LNAPL was suspected or known and drop tubes had not yet been installed, an oil/water interface probe was used to determine product thickness. Review of pre-RI gauging data identified difficulties in obtaining accurate product thickness and water level measurements due to product viscosity. To alleviate this problem, 1-inch drop tubes were placed in all existing wells containing LNAPL in June and July 1993. A drop tube was placed in new well MW-39 in 1994. To evaluate for the presence of DNAPL, a water level indicator was lowered to the total depth of the wells which contained a drop tube or no LNAPL. The presence of DNAPL would be identified by a stained probe. Wells which contain LNAPL could not be evaluated for DNAPL unless a drop tube had been installed because the probe became totally coated by the viscous LNAPL and the sensor would not work.

As per the SAP the wells were to be evaluated for DNAPL during each sampling event. It is not clear from the sampling notes that the wells were evaluated for DNAPL during each event. However, it is clear that the wells were evaluated for DNAPL during the first (November 1993) and second (April 1994) sampling rounds and no DNAPL was detected in any of the wells. All remedial investigation observations support this data, that DNAPL is not present at this site.

The use of the drop tubes allowed direct measurement of the piezometric surface using a water level indicator lowered into the tube. Since typical product thickness measurements were difficult, attempts were made to measure depth to the top of product using a steel tape and oil paste lowered in between the well casing (2-inch ID) and the drop tube. However, product was frequently reported above and below the water table. This is likely a function of product characteristics including viscosity and a specific gravity near 1.0. It is hypothesized that during water table fluctuations, the highly viscous LNAPL simply smears and becomes adhered to the drop tube and well casing. Since space between the drop tube and well casing is limited to a 1-inch annulus, it was difficult to lower the measuring tape without contacting product adhered to the casing and drop tube before reaching the true top of product. Measurements to top of product may reflect this residual product level within the well, rather than the actual product level. All possible attempts were made to accurately estimate product thickness.

Groundwater Sampling

Groundwater samples were collected in November 1993, April 1994, August 1994 and November 1994. In addition to well gauging described above, dissolved oxygen (DO) and wellhead VOC were recorded prior to collection of groundwater samples. These data were recorded on the well gauging record. Groundwater quality samples were not collected from wells that contained a measurable thickness of LNAPL. The collection of LNAPL samples is described below in Section 4.2.7.

Monitoring wells without measurable LNAPL were purged prior to sample collection using a dedicated PVC bailer. Field measurements of pH, specific conductivity, and water temperature were taken to ensure stability of well conditions prior to sampling. Temperature and conductivity were measured using a YSI Model 33 S-C-T meter and pH was measured using an Orion pH meter. A minimum of three well volumes were purged from wells prior to sampling. Purge water was drummed (Section 4.3).

After purging, samples were transferred from the bailer to laboratory provided sample containers. A summary of the groundwater sampling and analysis performed during the RI is presented in Table 4-4. Standard chain-of-custody, labeling, preservation and sample handling techniques were used as detailed in the SAP (RETEC, 1993). Samples were shipped for overnight delivery to the laboratory via Federal Express. The laboratories used were ACZ Laboratories of Steamboat Springs, Colorado, and Analytical Resources, Inc. (ARI), of Seattle, Washington. QA/QC for groundwater sampling consisted of analyzing duplicate samples and field blanks, as summarized in Table 4-4.

Decontamination of groundwater sampling equipment was not necessary because dedicated bailers were used for sampling each monitoring well. The water level indicator and field meter probes were decontaminated between wells as per the SAP (RETEC, 1993).

4.2.5 Aquifer Slug Tests

Rising head slug tests were conducted in the following six wells: DW-1, DW-2, DW-4, MW-5, MW-36 and MW-40 on July 13 and 14, 1994. Well locations were selected to estimate and evaluate variability in hydraulic conductivity across the Site. Deep wells were tested in addition to shallow wells to provide information representative of deeper aquifer zones.

Static water level measurements were obtained from each well prior to beginning the test. Slug tests were performed by securing a pressure transducer connected to a data logger near the bottom of each well. A 1-inch-diameter and 7-foot-long slug (displacing approximately 0.30 gallon) was placed in each well. Each slug was lowered into the well using a clean, dedicated nylon rope and placed at shallow depth to avoid contact with the transducer. The water level was checked periodically and allowed to equilibrate to pretest conditions. The test was then initiated by starting the data logger and simultaneously removing the slug from the well. The data logger recorded water level changes using a preprogrammed standard logarithmic sampling interval. The test was stopped when the pre-existing water level was re-established. This procedure was repeated several times in each well. Recovery data were plotted as semi-log graphs for analysis. The best recovery data (i.e., most data points and best-fit line) from each well were analyzed using Geraghty & Miller's AQTESOLV program to estimate hydraulic conductivity. Well MW-40 did not contain enough water to fully cover the slug, so data from this well was not analyzed.

4.2.6 Surface Water and Sediment Sample Collection

Four quarters of surface water sampling were conducted during the RI as summarized in Table 4-4. Surface water samples were collected in conjunction with each of the quarterly groundwater sampling events. The sampling locations were in Maloney Creek, the Skykomish River, and the former creek channel, as shown in Figure 4-2. Samples were collected in the deepest part of the stream, where possible. Prior to sampling, the pH, specific conductivity, temperature, and DO were measured by placing probes directly into the water. Once readings were obtained, water samples were collected by placing the sample bottle in the stream with the mouth of the sample bottle 1 to 2 inches below the surface. Samples were submitted to ACZ Laboratories for analysis in accordance with the program outlined in Table 4-4.

Stream sediment samples were collected from seven locations on October 7, 1993. The sampling locations were marked with a stake and later surveyed, and a description was made of the general area (see Table 4-1 for survey results). A decontaminated trowel was used to remove sediments from the sampling location to a clean piece of visqueen. A sediment sample was also placed into a plastic bag for headspace analysis with the PID; screening data and sediment descriptions were recorded in a log book and are provided in Appendix C. The laboratory samples were prepared by placing the sediment into clean sample jars. The remaining sediments were returned to the hole. Samples were submitted for analysis as shown in Table 4-2. Decontamination of all sediment sampling equipment was performed between all sample locations to prevent cross contamination.

4.2.7 Product Sampling and Baildown Testing

Product Sample Collection

Samples of the LNAPL product were collected from three wells (MW-22, MW-27, and MW-39) and from a product seep along the south bank of the river (near sediment sampling locations SED-4 and SED-5). The three wells were selected for sampling because they have historically contained the greatest accumulations of LNAPL, or because they would provide data on the variability of visibly different types of LNAPL. For example, well MW-39 contains LNAPL which is darker and visibly more viscous than observed elsewhere at the Site, and therefore, it was deemed important to evaluate this well separately.

Product samples were collected from wells using dedicated PVC bailers. The product sample from the river bank was collected by submerging the bottle in the water and allowing the product to flow into the bottle.

Product samples were submitted for analysis of surface tension, interfacial tension, specific gravity, and viscosity to Hauser Laboratories, Inc., of Boulder, Colorado. Chemical analysis of the product using WTPH-HCID (hydrocarbon identification analysis) was performed by ACZ Laboratories.

Product Baildown Tests

Product baildown tests were performed to confirm the continuous presence of free product in the formation outside of the test well, and to evaluate product recoverability. Product baildown tests were performed on wells MW-17, MW-20, and MW-27 on April 28, 1994. These wells have consistently contained accumulations of LNAPL over time. The test procedure is outlined in detail in the SAP (RETEC, 1993). The basic steps include measurement of static depths to product and water, bailing product from the well, and monitoring depth to product and water during recovery of LNAPL flow into the well.

Due to the high viscosity of the product, accurate thickness measurements were difficult to collect. Product thicknesses were estimated using a bailer. Because of the difficulty in obtaining a quick and accurate depth to water and product thickness measurements, the baildown test was modified so that only the depth to product was measured. Under the modified test procedures, the depth to product was measured and then a decontaminated stainless steel bailer was used to quickly remove product. The depth to product was then monitored until the product returned to the pretest level or adequate recovery data had been obtained.

4.3 Management of Investigation-derived Wastes

Soils produced during drilling operations were placed into 55-gallon drums. Drums were labeled with the date, well number, drum number and waste matrix. A total of 60 drums were used. These drums are currently stored east of well MW-16. A composite sample of drum contents was collected on December 28, 1993, and analyzed for the following parameters in order to determine disposal options:

- metals, VOC and SVOC analysis of TCLP extract (extraction by EPA Method 1311)
- halogenated hydrocarbons and PAH for compliance with Dangerous Waste Regulations
- ignitability by EPA Method 1010
- corrosivity (pH) by EPA Methods 9040 and 9045
- PCBs by EPA Method 8080

Water produced during well installation, development, purging and decontamination was collected initially in drums. Due to the large volumes of water produced, a 4,000-gallon Baker tank was used to collect water generated during the October and November 1993 RI work. The water was characterized and disposed of by Marine Vacuum Services, Inc., of Seattle, Washington.

Purge water collected during subsequent sampling rounds is stored in 55-gallon drums on Site. Nine drums containing purge water are currently stored near MW-16.

5.0 SOIL INVESTIGATION RESULTS

The soils portion of the RI was conducted to further characterize the subsurface conditions at the Site. This effort focused on evaluating the vertical and horizontal distribution, and nature of contamination and the local stratigraphy through soil sampling and analysis. A discussion of the local and regional geology of the Site vicinity is followed by a presentation of the soil analytical and physical testing results.

5.1 Geological Setting

The bedrock geology in the Cascade Mountains is complex, with multiple episodes of deposition and faulting. About 5 miles to the east of Skykomish is the Straight Creek Fault, which generally divides unmetamorphosed and low-grade metamorphic oceanic rocks to the west from medium- to high-grade metamorphic continental rocks to the east. The major movement on this fault was concluded by middle Eocene time (c. 45 million years Before Present [B.P.]). This fault can be traced from the Yakima area north into British Columbia.

The oceanic rocks to the west of the Straight Creek Fault generally consist of metamorphosed oceanic sediments. These rocks consist of accretionary melanges, pillow basalt, limestone, chert, and other oceanic sediments. These rocks were metamorphosed to phyllite, greenstone, greenschist, blueschist, and marble.

The continental rocks to the east of the Straight Creek Fault mostly consist of schist. These rocks make up a distinctive part of the North Cascades crystalline core. The schist was metamorphosed from a thick sequence of sandy to silty sedimentary rocks. The age of formation of these rocks is likely Triassic or Jurassic, with a metamorphic age of late Cretaceous.

A generalized geologic map of the area around Skykomish is presented in Figure 5-1. The oldest rocks exposed in the vicinity of Skykomish consist of small exposures of phyllite and greenschist of the Easton terrain. These rocks are moderately metamorphosed oceanic sediments and volcanic rocks and are interpreted to have been formed in Jurassic time with an early Cretaceous age of metamorphism (c. 130 million years B.P.). Overlying these rocks, in apparent unconformable contact, are volcanics of the Barlow Pass Formation. This unit consists of a thick pile of altered basalt, andesite, and rhyolite, with distinctive sandstone interbeds (Tabor, et al., 1993).

Intruded into the metamorphic rocks in the area of Skykomish is the Grotto batholith. These igneous rocks have been dated at about 25 million years B.P. (Oligocene/Miocene). The intrusion of these rocks has resulted in a distinctive metamorphic overprint to the surrounding rocks. The igneous intrusions and secondary effects have resulted in several mining districts in the area, notably the Index, Monte Cristo and Silver Creek mining districts. Minerals are mined for gold, silver, copper, lead, and zinc.

The Cascade Mountain Range rose in late Miocene and Pliocene times. A broad, roughly even surface along the present-day ridge crests in the area of Skykomish suggests the formation of a former mature erosional surface which predated the uplift of the Cascades. Valleys are excavated within belts of erosional weak rocks which generally trend to the northwest.

During glaciation of the region between 19,000 and 13,000 years ago, large alpine glaciers moved down the river valleys towards Puget Sound, resulting in glacially carved valleys. These glaciers resulted in long, straight valleys and steep, U-shaped valley walls.

Several individual landslide deposits are present. Slide deposits consist of nonsorted nonstratified sediments. A large landslide deposit (about 1 square mile in area) is located immediately southeast of the Site, beyond the turnaround, as shown in Figure 5-1. The age of this slide is thought to be between 3,400 and 450 years old.

The valley floor at Skykomish consists of alluvial deposits comprised of coarse, angular boulder-gravel deposits.

5.2 Local Geology

Local stratigraphic conditions were evaluated during the installation of monitoring wells and borings. In general, the Site is underlain by sand and gravel, with silt and clay lenses. The silt and clay lenses are discontinuous and therefore do not comprise an aquiclude. The sand and gravel are derived from erosion of igneous and metamorphic rocks in the Cascade range and deposited by the river and Maloney Creek.

The distribution and extent of lithologic units observed across the Site are presented in two cross-sections. The cross-sections are located as shown in Figure 5-2. Cross section A-A' (Figure 5-3) runs across the entire facility, parallel to the railroad tracks. Cross section B-B' (Figure 5-4) bisects the Site, extending southeast from the river to beyond the former Maloney Creek channel.

Topsoil material up to 4 feet thick is evident at isolated locations across the Site. The topsoil is loose to medium-dense and consists of gravelly or silty sand with trace organics. Underlying the topsoil, native soils consist primarily of sand and gravelly sand and extend to depths of at least 50 feet bgs (corresponding to total depth of deep borings). The sand is generally medium- to coarse-grained and fairly dense. Gravels were generally as large as 1 foot in diameter; however, during drilling, gravels up to 3 feet in diameter were occasionally encountered. Bedrock was not encountered during drilling.

Discontinuous silt lenses consisted of brown or gray clayey silt or sandy silt and were medium-stiff, very-stiff or hard. The clay lenses are comprised of brown or gray silty clay with some sand. In most cases, these lenses appear to be fairly thin or less than 3 feet thick. However, a fairly large fine grained deposit occurs in the center of the Site which appears to correlate across at least three borings (MW-37, MW-20 and MW-8). This lens is at least 12 feet thick and extends about 300 feet horizontally.

5.3 Soil Quality Data

Soils were sampled for chemical analysis from the ground surface and at depth at several locations throughout the study area (refer to Figures 4-1 and 4-2 for locations). Subsurface samples were obtained from boreholes during drilling and via hand auger as discussed in Section 4.2.1. Soil sampling activities were performed during September and October 1993. One hundred thirty-nine (139) soil samples (including 11 duplicates) were collected and analyzed for a subset of the following analyses:

- TPH
- SVOC and VOC
- metals
- PCBs
- TOC
- physical characterization

Analytical results and spatial analysis for each set of parameters are presented below. Results of previous Site investigations (identified as Pre-RI data) are considered in the data interpretations; these data were tabulated in previous reports (GeoEngineers, 1991a and 1992a) and are presented in Appendix E. All laboratory analytical reports corresponding to RI soil samples are found in Appendix D.

5.3.1 Total Petroleum Hydrocarbons

TPH were analyzed in Site soils using at least one of three Washington analytical methods: 1) WTPH by 418.1, 2) WTPH-D as diesel, and 3) WTPH-G as gasoline. WTPH-418.1 by EPA Method 418.1 is an infrared (IR) spectroscopy method which quantifies all saturated compounds (i.e., alkanes). The method was designed primarily to estimate TPH concentration, and not to identify specific hydrocarbon mixtures. WTPH-D by EPA Method 8015 modified is a gas chromatography (FID) analysis which can be used to quantify diesel-range and beyond hydrocarbons (C_{10} to C_{28}). WTPH-G by EPA Method 8015 modified is a purge and trap method used to measure gasoline-range hydrocarbons (C_6 to C_{10}).

Field observations during the RI identified only small isolated areas of soil contamination with the exception of along the railroad tracks. TPH concentrations measured in Site soils during the RI are presented in Table 5-1. Surface soil samples were analyzed using WTPH-418.1 and concentrations ranged from non-detect to 4,900 mg/kg. Both vadose zone and aquifer soils were analyzed using a combination of the three analytical methods. TPH as gasoline were detected slightly above detection limit in only one of five samples analyzed using this method, indicating an absence of gasoline-range hydrocarbons in the subsurface soils. This result is consistent with products used at the Site historically.

In order to evaluate areal and vertical TPH distribution, several figures were prepared. Figure 5-5 presents the TPH concentration distribution in shallow soils (0–2 feet bgs) based on RI and previous data. Figure 5-6 presents the TPH distribution in vadose soils 2–6 feet bgs. Vadose zone refers to soils residing above the zone of water table fluctuation. Figure 5-7 presents TPH distribution across the Site in aquifer soils, or all soils residing within or below the water table fluctuation zone. The zone of contamination appears to extend to about 17 feet bgs, based on TPH results for confirmation samples (listed as "saturated-clean" in Table 5-1). If data were available for more than one aquifer sample per boring, the highest concentration is given in Figure 5-7. Cross sections showing TPH concentrations versus depth are shown in Figures 5-8 and 5-9, and correspond to the cross section locations given in Figure 5-2.

Figure 5-5 indicates that detectable TPH concentrations in shallow soils occur primarily within BNRR property. The majority of samples have TPH concentrations less than 1,000 mg/kg. The maximum shallow TPH value is 4,900 mg/kg at SS-28, located within the area of historic maintenance activities. The only TPH concentration detected in shallow soils north of the facility was an estimated value of 100 mg/kg at location HA-4. During septic tank excavations between Railroad Avenue and West River Drive, field observations indicate that residual LNAPL (or the smear zone) is not encountered until depths of 3.5 feet or greater bgs. This observation agrees with the conceptual model for the Site which assumes that petroleum product occurs primarily in the zone of water table fluctuation (i.e., floats on groundwater).

TPH distribution at 2–6 feet bgs is limited to the eastern portion of the facility and downgradient areas. TPH concentrations range from non-detect to a maximum of 12,000 or 40,000 mg/kg (WTPH-D and WTPH-418.1, respectively) at sample location B-1 at a depth of 3.5 feet bgs. TPH values exceeding 1,000 mg/kg are observed at four locations outside of BNRR property. These locations occur within 300 feet of the river bank at wells MW-22, MW-23, MW-25 and MW-36. TPH concentrations given by the two analytical methods (WTPH-D and WTPH-418.1) vary by at least one order of magnitude in three of the samples (MW-22, MW-23 and MW-25), indicating either high carbon-range hydrocarbons or other organic matter. TPH measured in the MW-36 sample, however, is consistent based on the two methods. The 3,600 to 4,400 mg/kg TPH concentration occurs at 6 feet below ground surface. This sample depth is likely associated with the upper fringes of the water table zone.

TPH levels measured in aquifer samples are notably higher than TPH in the vadose zone, as shown in Figures 5-7, 5-8 and 5-9. The majority of soil samples with TPH exceeding 1,000 mg/kg, occur within and downgradient of the historic fueling and maintenance areas. Very low to non-detect TPH levels are found elsewhere within the Site. The maximum observed TPH concentration is 12,172 mg/kg (WTPH-D) or 27,000 mg/kg (WTPH-418.1) at DW-4 near the river bank.

There appears to be fairly good correlation between TPH values derived by the two methods, particularly with higher TPH concentration. In general, method WTPH-418.1 measured higher concentrations than WTPH-D.

5.3.2 Semivolatile Organic Compounds

Fifteen soil samples were analyzed for SVOC by EPA Method 8270 during the RI. The analytical results are presented in Tables 5-2A through 5-2C. SVOC, except for phthalates, were not detected in surface soil samples. SVOC detected in soil samples from the vadose and aquifer zones fall into two categories. The first is PAH compounds, and the second is phthalates. The phthalates, which were detected in relatively low concentrations (less than or equal to 300 Fg/kg), are attributed to laboratory contamination. PAH compounds are associated with the petroleum products and were found at concentrations of up to 8,300 Fg/kg (2-methylnaphthalene) and 7,500 Fg/kg (phenanthrene). These maximums were reported in the sample from boring B-4 at 10 feet bgs. Other PAH compounds detected in at least one boring, not including MW-39, were measured at estimated concentrations less than the detection limit and include fluorene, fluoranthene, pyrene, and chrysene. The soil sample from borehole MW-39 at 6 feet bgs, contained ten different PAH compounds at estimated concentrations less than the detection limit. Additional PAH constituents detected only in MW-39 were benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, and benzo(g,h,i)perylene.

2-methylnaphthalene was the most consistently detected PAH. The remaining PAH compounds detected are all considered priority pollutant PAH. Therefore, 2-methylnaphthalene and the sum of the priority pollutant PAH were selected for spatial presentation in Figure 5-10. Detected levels of PAH occur in the vicinity of the historical maintenance facilities.

5.3.3 Volatile Organic Compounds

Twenty-one samples were collected from the vadose zone and analyzed for VOC by EPA Method 8240. Analytical results are presented in Tables 5-3A and 5-3B. Methylene chloride, acetone, 2-butanone, styrene, 1,2-dichloroethane and 1,1,2,2-tetrachloroethane were the only VOC detected. Of these, methylene chloride and acetone were detected in the method blanks and are therefore considered to be the result of laboratory contamination. 2-butanone was detected only in sample B-9 at 7.5 feet bgs at 24 Fg/kg. 1,2-dichloroethane was detected only in sample MW-33 at 5 feet bgs at 9 Fg/kg. 1,1,2,2-tetrachloroethane was detected only in sample MW-37 at 7.5 feet bgs at 23 Fg/kg. Styrene was detected in five samples at concentrations ranging from 16 to 176 Fg/kg, as shown in Figure 5-11. These locations are primarily located within the former maintenance area. Low VOC levels in soils agree with the absence of WTPH-G as discussed above in Section 5.3.1.

5.3.4 Metals

Priority pollutant metals were analyzed in 53 vadose zone samples and in one sample at depth (10.5 feet bgs). Two background samples were included in the analysis. Analytical results are presented in Tables 5-4A and 5-4B.

Arsenic, chromium, copper, lead, nickel and zinc were the metals detected most frequently. Maximum concentrations of beryllium (1 mg/Kg), cadmium (16.6 mg/Kg), and mercury (59 mg/Kg) were reported in sample HA-2-1; this sample is off Site and the source of these metals is unknown. The highest cadmium and mercury concentration other than HA-2-1 were 3.7 and 0.3 mg/Kg, respectively. Beryllium, cadmium, selenium and thallium were generally not detected and when detected, were at concentrations near the detection limit. Silver and was not detected. Antimony concentrations ranged from non detect to 8.8 mg/Kg. Arsenic, chromium and nickel concentrations ranged from non detect to 73 mg/Kg. Copper and zinc concentrations were within the range of 14 mg/kg to 460 mg/kg. Lead concentrations ranged from 3.6 to 3600 mg/Kg. Arsenic and lead were selected to further display metals distribution across the site and are further discussed below.

Arsenic distribution across the Site is presented in Figure 5-12, and is inclusive of data collected prior to the RI (pre-RI data). Approximately 14% of the samples analyzed contained arsenic at concentrations exceeding 20 mg/kg, including one of the background samples (BG-2) collected in a wooded area. Arsenic generally appears to be evenly distributed across the Site and may be indicative of naturally occurring levels. Two area were identified with slightly higher arsenic concentrations the former substation area and the current maintenance building. The statewide 90th percentile for arsenic is 7 mg/kg and the King County natural background arsenic concentration is reported as 7.3 mg/kg (Ecology, 1994b).

Lead distribution across the Site is presented in Figure 5-13 and includes pre-RI data. Elevated lead concentrations (i.e., exceeding 250 mg/kg) occur primarily within facility boundaries, with the exception of samples B-11 and HA-2. The higher lead concentrations appear to be located near the former substation area, in the former railyard, around the current maintenance building and around railroad tracks in the eastern portion of the facility. Sixty-seven percent of the measured lead concentrations are below 200 mg/kg and 89% are below 1,000 mg/kg. Relatively high lead (average concentration of 1,432 mg/kg), was measured in B-11 which is located in the school yard. The source of this lead is unknown.

5.3.5 Polychlorinated Biphenyls

Thirty-nine soil samples were analyzed for PCBs. The analytical results are presented in Table 5-5. Only one sample contained detectable PCB concentrations. PCB Aroclor 1254 was measured at a concentration of 1,200 Fg/kg in sample SS-27. PCBs were measured at estimated concentrations below the method detection limit in eight samples. Aroclor 1254 was detected in seven of these samples, and Aroclor 1260 in two.

Areal distribution of PCBs, including pre-RI data, is shown in Figure 5-14. PCBs are concentrated in three areas of the Site. Sample SS-27, with the maximum PCB concentration, is located just east of the former substation. Six other samples in the vicinity also contain detectable PCBs ranging from an estimated value of 14 Fg/kg to 330 Fg/kg. A small area to the east of the existing maintenance building, including samples SS-16, SS-19 and SS-21 contains total PCBs at up to an estimated concentration of 175 Fg/kg. PCBs occur around the former roundhouse at estimated concentrations of up to 86 Fg/kg.

5.3.6 Physical Characteristics

Physical characterization including laboratory sieve analysis, falling head permeability testing, and moisture content determination was performed on selected samples. Samples were collected at various depths from three locations: B-10, DW-1 and MW-36. Results are presented in Table 5-6. Samples ranged from 69.6% silt and 17.2% clay (clayey silt) in MW-36 at 7.5 feet bgs, to 85.6% gravel and 11.9% sand (gravel with minor sand) in MW-36 at 6 feet bgs. These results concur with lithologies observed during drilling and summarized in Section 5.2. Laboratory-determined hydraulic conductivity ranged from 1.42 x 10^{-4} cm/sec (0.4 feet/day) to 2.79 x 10^{-2} cm/sec (80 feet/day). Hydraulic conductivity derived from falling head tests is usually representative of vertical hydraulic conductivity. Horizontal hydraulic conductivity is typically an order of magnitude greater than vertical conductivity due to compaction of sediments upon deposition. The range of measured hydraulic conductivity values are considered reasonable for the soils observed at the Site.

Natural moisture in the Site soils ranged between 3.2% to 20.1%.

5.3.7 General Chemistry

The general chemistry of Site soils was determined from the analysis of TOC. The data indicate that the TOC content of Site soils ranges from 0.2% to 2.7%. TOC concentrations are presented in Table 5-7.

5.4 Migration Routes in Soil

This section discusses the movement of petroleum product and other hazardous constituents through the unsaturated zone. This discussion focusses on constituents known to be present in Site soils.

5.4.1 Potential and Actual Migration Routes

Migration of contaminants in the unsaturated or vadose zone can occur via infiltration, percolation, evaporation and wind dispersal. Migration routes in the saturated zone are controlled by the groundwater gradient, diffusion, mechanical dispersion, adsorption, retardation and microbial degradation. Migration via groundwater flow is discussed in Section 6. Migration to air via evaporation or particulate dispersal is discussed in Section 8.

The primary factors affecting vadose zone transport are the solubility, partitioning and degradation rate of the compounds of interest. When petroleum products are released to the ground surface, they will tend to travel downward through the unsaturated zone due to gravity. The extent to which the LNAPL will travel depends on the volume of the spill, its solubility in water, partitioning to soil (i.e., the tendency to sorb onto soil particles) and how quickly it is degraded or volatilized. LNAPL can exist in soil both as free-flowing and as residual contamination. For example, as LNAPL moves downward through the soil column, it tends to coat or adhere to soil particles, creating residual product. If sufficient LNAPL moves through the same area, the residual product, or that which is sorbed onto soil particles, will attain a maximum level. At this point, LNAPL will flow through soils previously coated in LNAPL to lower zones. In this manner, LNAPL can eventually reach the water table. Similarly, any soluble components of LNAPL are subject to downward movement with infiltrating and percolating water.

Based on the soil investigation results, it is apparent that LNAPL and specific contaminants have migrated downward through the vadose zone to the groundwater table. In particular, TPH levels measured in the zone of water table fluctuation are notably higher than TPH in the vadose zone. Metals and PCBs, on the other hand, tend to have higher concentrations in the vadose zone than at the water table interface.

5.4.2 Chemical Partitioning

Petroleum hydrocarbons are the predominant hazardous constituents present at the Site. Since TPH are comprised of many constituents, it is difficult to examine partitioning of LNAPL per se. However, individual constituents which may be attributed to petroleum hydrocarbons, or other substances used at the Site can be examined in this context.

Tables 3-2, 3-3 and 3-4 present solubility and soil partitioning coefficients for many of the constituents found at the Skykomish Site. Specifically these include PCB Aroclors 1254 and 1260, several volatile organic compounds (as listed in Table 3-3) and several PAH constituents. The PCBs found in Site soils are considered to be "highly chlorinated" isomers containing 54 and 60% chlorine, respectively. As such, they tend to adhere more strongly to soil and are less soluble, as indicated by the values presented in Table 3-4. The soils data presented in Section 5.3.5 support these conclusions as PCBs occur over a very limited area of the Site at very shallow depths.

PAH constituents detected in Skykomish soils include 2-methylnaphthalene, phenanthrene, fluorene, fluoranthene, pyrene, chrysene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene and benzo(g,h,i)perylene. 2-methylnaphthalene is not identified as an EPA priority pollutant PAH compound; however, it differs from naphthalene only by an additional methyl group. Due to this structural similarity, the solubility and soil partitioning coefficients for naphthalene listed in Table 3-2 are expected to be applicable to 2-methylnaphthalene. It is therefore not surprising that 2-methylnaphthalene would be the most consistently detected PAH compound in Site soils. Other PAH compounds are detected less frequently, which can be attributed to low initial PAH concentrations in petroleum products used at the Site and also the low solubility and high K_{OW} values associated with these compounds. PAH compounds were detected at depths up to 12 feet bgs, indicating that these constituents have moved downward through the vadose zone soil. A contributing factor to this movement is relatively low fractions of organic carbon in the Site soil (Table 5-7).

Several VOC were detected in Site soil samples. The factors affecting fate and transport of these compounds are presented in Table 3-3. All of the VOC are fairly soluble and mobile. However, due to the low concentrations and limited extent of VOC at the Site, any migration of these compounds would be negligible.

6.0 GROUNDWATER INVESTIGATION RESULTS

Data concerning hydrogeologic conditions, groundwater quality, and free-phase NAPL occurrence were collected during the RI to further characterize the horizontal and vertical distribution of dissolved contaminants and free-phase product. RI information was also used to define factors controlling the fate and transport of contaminants.

6.1 Regional Hydrogeology

The Site is located within the Skykomish valley, a relatively steep-sided bedrock valley that has been partially filled with glaciofluvial sediments. The bedrock in the area consists of marine metasedimentary and metaigneous rocks overlain by volcanic and sedimentary rocks. As such, the bedrock has relatively low permeability. The glaciofluvial sediments filling the valley consist mainly of poorly- to moderately-sorted sand, gravel and cobbles. The base of the sediments appears to be located 200 to 250 feet bgs at the Site based on information obtained from logs of nearby water wells (GeoEngineers, 1993).

The direction of regional groundwater flow is westerly, in a downslope direction coincident with the slope of the floor of the valley. Locally, groundwater has a component of flow towards the Skykomish River.

6.2 Local Hydrogeologic Conditions

Local hydrogeologic conditions at the Site have been defined during the RI by observing borehole samples, physical testing of aquifer soils, conducting slug tests in several wells, and collecting water table elevation data. A total of 45 wells and 12 borings have been installed at the Site. Well locations are shown on Figure 4-1.

6.2.1 Aquifer Properties

The Site is situated on glaciofluvial sediments and is bordered on the north by the river. Across the river from the Site are bedrock cliffs. South of the Site, the valley of Maloney Creek is cut into the bedrock hillsides and extends southward from the central portion of the Site.

The aquifer at the Site is unconfined and extends from the water table (5 to 15 feet bgs) to the total depth of exploration (47 feet bgs). The upper 10 to 15 feet of the aquifer consist predominantly of gravelly sand to sandy gravel which locally contains a trace to some silt. Sandy silt and silty clay beds are present in the gravelly sand beginning at depths of 15 to 30 feet bgs. Beds are generally 3 to 5 feet thick but range up to more than 12 feet thick. These silty or clayey beds can commonly be traced between nearby wells, but are not extensive across the Site. Lithologic characteristics of the aquifer are discussed in more detail in Section 5.2.

Static water levels have been measured in Site monitoring wells periodically from October 1, 1990, to November 7, 1994. Gauging data is summarized on Table 6-1. All groundwater elevations are referenced to USGS benchmarks (National Geodetic Survey Datum [NGVD] 1929). Groundwater elevation data has either been collected through drop tubes, or has been corrected for the presence of product as indicated on Table 6-1.

Groundwater occurs at a shallow depth beneath the Site (generally 5 to 15 feet bgs). During the period of measurement, groundwater elevations across the Site have ranged from 917.49 to 931.81 feet msl. Elevations are highest at the southeast corner of the Site and decrease northwestward toward the river. Within a single well, the seasonal variation in groundwater elevation ranges from about 4 to 7 feet. Groundwater elevations are generally lower in the summer and early fall (June to early November) and higher during late fall, winter and spring (November to April). Maximum groundwater elevations have been measured in late November when rainfall is at a maximum.

Figure 6-1 shows hydrographs for wells MW-10, MW-19, MW-24 and MW-28 and includes rainfall data. The hydrographs demonstrate that variations in groundwater elevations in wells across the Site follow a similar pattern. Well 24, which is located adjacent to the river, follows a similar pattern to wells located further inland, suggesting that the river does not control groundwater elevations. In addition, changes in groundwater elevations correlate closely with monthly rainfall. Groundwater elevation response to rainfall is relatively rapid.

The hydraulic conductivity of aquifer materials at the Site were evaluated using laboratory and field tests. As discussed in Section 5.3.6, the grain size distribution and hydraulic conductivity of several borehole samples were analyzed in the laboratory. Two of these samples were from the aquifer. The sandy gravel to gravelly sand sample from a 12.5-foot bgs depth in borehole B-10 had a hydraulic conductivity of 79 ft/day (2.79×10^{-2} cm/sec) and a clayey silt sample from a 7-foot bgs depth in MW-36 had a hydraulic conductivity of 0.4 feet/day (1.42×10^{-4} cm/sec).

Hydraulic conductivities were estimated in the field using rising head slug tests. Slug tests were conducted in shallow wells MW-5, MW-36, and MW-40 and deep wells DW-1, DW-2, and DW-4. Well MW-40 did not contain sufficient water to fully cover the slug, so the data was not used for the hydraulic conductivity calculations. The recovery in each well was very rapid and, as a result, limited data points were recorded for each slug test. Several tests were conducted in each well and the best recovery data (i.e., most data points and best-fit line) from each well was analyzed using Geraghty & Miller's AQTESOLV program. AQTESOLV uses Bouwer and Rice's method (1976) for evaluating slug tests. The program constructs a recovery plot of groundwater elevation change versus time on a semi-log graph and a straight line is fitted to the plotted points. Pressure transducer data used to construct the recovery plots, input parameters, and recovery plots are included in Appendix F.

The hydraulic conductivities calculated from slug test results are summarized in Table 6-2. Recovery plots indicate that the best-fit data were collected from wells DW-1, DW-2 and MW-5. The calculated conductivities for these wells range from 41 to 84 feet/day and average 64 feet/day. Literature values for the corresponding aquifer material (sandy gravel to gravelly sand) support these results.

Slug test results from wells DW-4 and MW-36 are not considered representative of the Site. The plots for these wells were not the ideal straight-line plots for a slug test, and the literature values do not agree with the values calculated from these plots. The data from well DW-4 were very erratic and a line did not fit well through the data points for any of the runs. The calculated hydraulic conductivity of 9.4 feet/day is low for the aquifer material, a gravelly sand. One potential explanation for the erratic data is that the slug was not able to clear the transducer wire in this well and the transducer was disturbed each time the slug was removed. Additionally, this well was a flush-mount completion and it was difficult to secure the transducer cord. In the plot for well MW-36, a double straight-line effect was observed. Typically when this occurs, the first line is attributed to drainage of the gravel pack while the second line is more indicative of flow from the aquifer. Therefore, the second line is used to calculate the aquifer hydraulic conductivity. However, the calculated hydraulic conductivity (3.9 feet/day) is lower than expected based on literature values for a fine sand with a layer of gravelly sand (as described in the well log). This result may be a local heterogeneity of the aquifer or related to the interbedded nature of the aquifer.

6.2.2 Aquifer Flow Characteristics

Groundwater contour maps have been compiled using recent and historical gauging data. Groundwater contour maps constructed using previous data and miscellaneous gauging events during the RI are included in Appendix G. Maps constructed during the quarterly RI monitoring events are included as Figures 6-2 through 6-5. In general, the groundwater flow is to northwest, down the valley and towards the Skykomish River. The flow direction is commonly northwesterly in the eastern and northwestern portions of the Site and west-northwesterly in the southwestern portion of the Site. During some gauging events, a ridge of locally higher groundwater extends from the former creek channel northwards toward wells MW-27 and/or MW-21. Locally, flow is northeastward on the northeastern side of the ridge; however, flow is diverted northwestward again before reaching the river. The ridge is very pronounced and linear during periods of high groundwater (i.e., April and November 1994) and more subdued or nonexistent during periods of lower groundwater elevations (i.e., November 1993 and August 1994). Differences in geology (zones of preferential flow) and recharge from the former creek channel are most likely responsible for the fluctuations in groundwater gradient and flow direction.

Minimum and maximum groundwater elevations during the RI were recorded on August 1, 1994, and November 7, 1994, respectively. During the August gauging event, the net horizontal groundwater gradient was 0.0083 foot/foot and the gradient was relatively consistent across the Site. During high water conditions in November, the net horizontal groundwater gradient for the Site as a whole was 0.0074 foot/foot. The gradient and flow direction varied from 0.0085 foot/foot north-northwestward in the eastern portion of the Site to 0.0174 foot/foot northwestward in the western portion of the Site.

Vertical gradients within the aquifer are relatively low and vary in direction from downward to upward. Vertical gradients were estimated using well pairs DW-2/MW-40 and DW-3/MW-30 and are summarized on Table 6-3. The well pair DW-2/MW-40 is located immediately adjacent to one another and provide high quality vertical gradient data. The gradient at DW-2/MW-40 ranged from 0 (no vertical gradient) to 0.074 foot/foot downward. The highest downward gradients occurred during periods of high groundwater levels (heavy rainfall), and the lowest gradient occurred when water levels were low (low rainfall). This variation in vertical gradient magnitude suggests that rainfall infiltration is a major factor recharging groundwater at the Site. Well pair DW-3/MW-30 is located approximately 100 feet apart; therefore, horizontal gradients between these wells will mask the vertical gradient measurements. Nevertheless, the vertical gradient data is considered worthwhile. At well pair DW-3/MW-30 gradients varied from 0.014 feet/foot downward to 0.029 feet/foot upward and averaged 0.017 feet/foot upward.

The groundwater velocity at the Site can be estimated using the hydraulic conductivities and gradients and the following relationship:

$$V = \frac{Ki}{n_e}$$

where: K = the hydraulic conductivity
I = the horizontal groundwater gradient
n_e = the effective porosity

The average groundwater gradient is 0.0079 feet/foot and the effective porosity is assumed to be 20% for a sand and gravel mix. The average hydraulic conductivity of the gravelly sand to sandy gravel which comprises much of the upper aquifer is 64 feet/day. Based on these values, the groundwater velocity is 2.5 feet/day. In siltier areas, groundwater velocities will be somewhat lower. The clayey silt bed sampled in MW-37 had a hydraulic conductivity of 0.4 feet/day and provides a low-velocity endpoint. The calculated groundwater velocity for the clayey silt is 0.015 feet/day.

The nature of groundwater interaction with the river and the water noted in the former creek channel was addressed during the RI. All data collected to date show Site groundwater recharging or in equilibrium with the river. None of the data collected to date have indicated that the river recharges the Site. The hydrographs support this conclusion; the well adjacent to the river has a similar hydrograph pattern and the magnitude of changes are similar to wells located further inland. A few inches of water have been noted in the former creek channel during wet months when groundwater elevations are high. Surface and groundwater elevations suggest groundwater is recharging the former channel during these periods. During drier periods, the former channel is dry.

6.3 Groundwater Quality Data

Groundwater quality was assessed in the RI through four quarters of groundwater sampling. Samples were collected from selected wells and submitted for analysis of TPH, SVOC, VOC, metals and PCBs. Analytical parameters and the wells sampled varied from quarter to quarter; wells sampled and the parameters analyzed for are summarized on Table 4-4. The selection of wells and analytical parameters was done in consultation with Ecology and considered numerous factors. When selecting the wells to be sampled, the location of each well relative to potential sources and receptors and to other wells was considered along with the past sampling results from that well or from nearby wells. The selection of analytical parameters for a given well considered the potential sources near that well and the past groundwater and soil samples from the well location and from adjacent areas. Following this process, the most wells were sampled for the most parameters in the initial RI sampling round. This first round was used to confirm pre-RI data and to establish an initial understanding of groundwater quality at new well locations. Subsequent sampling rounds were more focused and involved fewer wells and fewer analytical parameters.

Prior to the RI, groundwater samples were collected from all existing wells without product during four sampling events between October 1990 and March 1992. Samples were analyzed for TPH, BTEX, SVOC, metals and PCBs. Groundwater from wells MW-1 through MW-27 were tested for TPH and BTEX four times and total metals once. Wells MW-28 through MW-32 were tested for TPH, BTEX, metals and PCBs during one sampling event. The previous data are presented in Appendix E and the analytical laboratory reports generated during the RI are included in Appendix H. The data collected during the RI generally supports previous data, with the exception of one PCB detection during previous work, which was not confirmed during the RI. As such, the following discussion focuses on the data generated during the RI.

6.3.1 Total Petroleum Hydrocarbons

During the first RI quarterly sampling event (November 1993), groundwater from 35 Site wells was analyzed for TPH using the Washington State analytical known as Method WTPH-D Extended. This analytical method uses the gas chromatography procedure described in EPA Method 8015 to quantify hydrocarbons in the C_{10} to C_{32} range (diesel and motor oil). During subsequent quarters, the number of wells sampled was reduced and the groundwater samples were analyzed using a modified version of Method WTPH-D Extended. This modified method is also based on use of EPA Method 8015 and quantifies hydrocarbons in the range of C_9 to C_{36}.

Hydrocarbon identification (HCID) analyses performed in January 1994 on various hydrocarbon samples obtained from the Site indicate a bell-shaped curve with a predominant hydrocarbon range from C_{10} to C_{28} with thin tails to C_{32} or C_{34}. Therefore, the modified WTPH-D Extended analysis (C_9 to C_{36}) fully encompasses the range of Site product hydrocarbons. The WTPH-D Extended method (C_{10} to C_{32}) used for groundwater Round 1 rather than the modified WTPH-D Extended also encompasses the vast majority of the hydrocarbons in the Site product. Therefore, use of WTPH-D in round 1 is considered to be valid and acceptable for the RI. Note that the initial laboratory reports (Appendix H) incorrectly refer to a hydrocarbon range of C_{10} to C_{28}; this reference was corrected in later lab reports.

TPH concentrations in groundwater for the four quarterly RI sampling events are presented in Table 6-4. The locations of the dissolved TPH groundwater plume and areas of free product for each quarter are shown on Figures 6-6 to 6-9. During the RI, Site-wide TPH concentrations ranged from less than 0.02 to 6.5 mg/L with one exception. A TPH concentration of 37 mg/L was measured in well MW-11 during the November 1994 sampling event. A consistent seasonal variation in TPH concentrations is not apparent. However, concentrations in several wells vary with changes in the prevailing groundwater flow direction.

TPH concentrations correlate closely with areas where free product has been detected. TPH concentrations exceeded 1.0 mg/L only in wells where free product has been detected (as discussed in Section 6.4.1). The two exceptions to this trend are wells MW-13 and MW-14. TPH concentrations in groundwater from MW-13 ranged from less than 0.020 to 6.5 mg/L and in MW-14 concentrations ranged from less than 0.2 to 1.4 mg/L. These wells are located within 40 feet of one another and are downgradient of the former creek channel. Under some flow conditions, these wells are also downgradient of MW-39 which contains a viscous product. TPH concentrations in all other wells where free product has never been noted are less than 1 mg/L. TPH was not detected in the deep wells.

Historic TPH data (Table 6-4 and Appendix E) were evaluated to determine any trends in TPH concentrations. TPH concentrations have been measured periodically since 1990. Prior to the RI, samples were analyzed primarily by EPA method 418.1, while RI samples were analyzed by Washington methods WTPH-D and WTPH-D extended. Due to the different method the results can not be correlated directly. Yet the historic and RI data are generally consistent. The exception is the first pre-RI sampling period (October 1990). TPH was detected one to two orders of magnitude higher than any subsequent sampling events in five wells. As these anomalously high results have not been confirmed in any wells, they are attributed to a sampling or analytical problems and are not considered representative.

One historic sample was analyzed by a method similar to those used in the RI. In November 1991, the TPH concentration in well MW-28 was evaluated by EPA Method 418.1 and modified EPA Method 8015 for diesel and for gasoline. The average of two duplicate samples for these analyses were 150, 160 and 6.5 mg/L, respectively. The WTPH-D method used for analysis of the RI samples is based on use of the modified EPA Method 8015. Measured TPH concentrations in well MW-28 during the RI ranged from 1.5 to 6.4 mg/L. As discussed above, seasonal and long term trends in the TPH data are not evident. However, concentrations do appear to vary with the prevailing groundwater flow direction. This is believed to be the case for MW-28. Concentrations were high in November 1991 and in November 1994, product was detected in the well. Groundwater levels were high during both of these sampling periods. During intervening groundwater sampling events, groundwater concentrations were lower and product was not detected.

6.3.2 Semivolatile Organic Compounds

During the first three quarters of groundwater sampling, 24 wells were analyzed for SVOC or PAH compounds. SVOC analyses were not completed during the fourth quarter. During the first quarterly sampling event, groundwater samples were analyzed for SVOC using EPA Method 8270; during the second quarter, EPA Methods 8270 and 8310 were both used to determine PAH concentrations. Method 8310 was used during the third quarter. SVOC results are presented on Table 6-5 and the wells with detectable concentrations are highlighted on Figure 6-10.

Total PAH concentrations ranged from below detection to 18 µg/L with the exception of well MW-11 which had total PAH concentrations ranging from 53 to 234 µg/L. Carcinogenic PAH compounds were detected in wells MW-9, MW-11 and MW-28; concentrations ranged from 1 to 5 µg/L. The carcinogenic PAH compounds detected were chrysene and benzo(a)anthracene. With the exception of MW-37, free product has been detected in all wells containing detectable PAH compounds. Although free product has not been detected in well MW-37, this well is surrounded by wells where free product has been detected. Gravelly sands encountered during drilling of this well were reported to have an oily sheen.

Other SVOC detected include bis(2-ethylhexyl)phthalate, di-n-octyl phthalate and 2-methylnaphthalene. The phthalates were estimated at concentrations below the method detection limit and are attributed to laboratory contamination. 2-methylnaphthalene was detected at concentrations of 89 to 200 µg/L in well MW-11. Well MW-11 has had the highest PAH and TPH concentrations at the Site and has contained free-phase product.

SVOC were not detected in the deep wells.

6.3.3 Volatile Organic Compounds

Over the first two quarters, sixteen wells were sampled for VOC. During the first quarter, VOC were analyzed by EPA Method 8240; during the second quarter, EPA Method 8020 was used to analyze BTEX concentrations. Results of VOC analyses are summarized on Table 6-6 and wells with detectable concentrations are highlighted on Figure 6-10.

Methylene chloride and acetone were detected in several of the VOC samples and blanks. Chloroform was detected in one sample and a blank, and chloromethane was detected at concentrations below the method detection limit in one sample and a field blank. Methylene chloride, acetone and chloroform are commonly used in laboratory analysis. The presence of these compounds in groundwater samples is attributed to cross-contamination in the laboratory or during handling and transport. Data quality and the presence of these compounds in blanks and samples are discussed in data validation reports for each quarterly sampling event (Appendix H).

With the exception of compounds attributed to cross-contamination, VOC were detected only in wells MW-11, MW-36 and MW-37. Product has been detected in wells MW-11 and MW-36. As discussed above, MW-37 is located within the free-product pool. In MW-11, 1,1-dichloroethene and benzene were detected at concentrations below the method detection limit. The maximum toluene, ethylbenzene and total xylene concentrations in MW-11 were 1, 5, and 22 µg/L, respectively. In well MW-36, toluene and total xylenes were detected at concentrations above the method detection limit (1 and 5 µg/L, respectively). Xylenes were the only VOC detected in well MW-37; the concentration was 5 mg/L.

6.3.4 Metals

Metal concentrations in groundwater were analyzed in 22 shallow wells and two deep wells during the four sampling quarters. Based on the results of the first quarter, the list of metals analyzed was reduced to arsenic, chromium and lead. During the first sampling quarter, samples were not filtered prior to analysis and therefore, the resultant concentration included both dissolved metals in groundwater and metals adsorbed to sediment particles. Both filtered and unfiltered samples were analyzed during the second quarter. For the third and fourth quarters, only the dissolved (filtered) concentrations were evaluated. During the second, third and fourth quarters, total suspended solids concentrations (TSS) were measured to show the relationship between sediment volume and metals concentrations. Results of the metals and TSS sampling are presented on Table 6-7.

During the first quarter, samples were analyzed for total PPMs. Silver, beryllium and thallium were not detected. Cadmium was detected in three wells at a maximum concentration of 0.0003 mg/L; antimony and selenium were detected in one well at maximum concentrations of 0.002 mg/L and mercury was detected in four wells with a maximum concentration of 0.0007 mg/L. Copper and zinc were each detected in eight wells at maximum concentrations of 0.32 and 0.52 mg/L, respectively. All these concentrations are below applicable drinking water standards. Nickel was detected in five wells; only the concentration in DW-2 exceeded the drinking water standard maximum contaminant level (MCL) of 0.1 mg/L. Groundwater samples from DW-2 had elevated TSS concentrations. During the first and second quarter, arsenic was detected in 18 wells and the concentration exceeded the MCL of 0.05 mg/L in four of the wells. Lead was detected in 16 wells in the first two rounds. The MCL for lead is under EPA review; an action level of 0.015 mg/L lead has been established by EPA. Site groundwater samples exceeded this action level in eight wells. Chromium was detected in 11 wells in the first two rounds and concentrations exceeded the MCL of 0.05 mg/L in six of the wells. Based on these results, the list of metals for analysis were reduced to arsenic, chromium and lead.

During the second quarter, the validity of total metals concentrations was assessed. Two metal samples were collected from each well, one sample was filtered in the field and the other was not. The unfiltered sample was also analyzed for TSS to evaluate the correlation between TSS and metal concentrations. The results of sampling showed that samples with high TSS reported high metal concentration in the unfiltered samples. Unfiltered samples with low TSS concentrations and filtered samples contained metal concentrations near or below the detection limit. In addition, unfiltered metal results were erratic across the Site. Well MW-2, which is upgradient of most of the historic activities at the Site, contained some of the highest concentrations of arsenic and lead. Well MW-40 is near the former substation and contained high concentrations of metals, while adjacent wells MW-15 and MW-7 contained levels of arsenic and lead near or below the detection limit. Wells downgradient of the substation, MW-19 and MW-37, have had metals concentrations near or below the detection limit. Therefore, dissolved metals concentrations were found to be more representative of actual groundwater concentrations and only dissolved samples were collected during subsequent quarters.

During the three quarters of dissolved metals sampling, chromium was detected at low concentrations in one well and lead was detected at low concentrations in two wells. However, the chromium detection and one of the lead detections occurred on days when the respective metals were found in the laboratory blank. The lead detection not attributed to blank contamination was in well MW-36 and the concentration was 0.002 mg/kg. Arsenic was detected in seven wells, one of which was attributed to blank contamination. Maximum arsenic concentrations were reported in samples from wells MW-5, MW-9 and MW-36. Arsenic concentrations ranged from 0.006 to 0.011 mg/L in MW-9 and MW-36; where free-phase product has been detected. In MW-5, the maximum reported concentration was 0.009 mg/L. Residual product was noted during drilling of MW-5.

6.3.5 Polychlorinated Biphenyls

Groundwater from 13 wells was analyzed for PCBs during the quarterly sampling events. The wells analyzed were in the vicinity of PCB detections in soils or other areas of potential concern. Three of the wells were deep wells. PCBs were not detected in any wells. PCB data is presented on Table 6-8. Prior to the RI, PCBs were detected in well MW-32 at a concentration of

0.11 µg/L (Aroclor 1254). Groundwater samples from MW-32 were tested for PCBs during two quarters of the RI sampling and PCBs were not found at detection limits of 1.0 µg/L and 0.05 µg/L.

6.3.6 General Chemistry

The pH, conductivity and temperature of groundwater has been measured in the field during groundwater sampling events. In addition, the DO was measured in the field during the November 1993 sampling event. General chemistry data is summarized on Table 6-9. The pH varied from 5.57 to 7.56 and the conductivity varied from 19 to 550 µmhos/cm. Temperature varied from 5.1E to 16.3EC and averaged 8.7EC. This distribution of DO concentrations is shown on Figure 6-11. In general, DO concentrations were highest in wells distant from the TPH plume (2.5 to 5.5 mg/L) and low within the product and dissolved TPH plumes (1.3 to 3.0 mg/L). DO concentration in wells adjacent to the TPH plume were more variable. In deep wells, the DO ranged from 5.8 to 8.5 mg/L.

6.4 NAPL Occurrence

The distribution and character of the free-phase NAPL in the subsurface was investigated as part of the RI. Wells were evaluated for LNAPL and DNAPL, only LNAPL was observed. Information on the presence and thickness of free-phase product in wells was collected. Product samples were analyzed for physical and chemical analysis. In addition, product recovery tests were completed. After completion of the RI, four product recovery wells were installed as an interim action. The operation of the wells was initiated in January 1996 and the data obtained from the recovery wells will be used in the feasibility study to more fully evaluate product recoverability. The following discussion of LNAPL occurrence is based primarily upon the RI data but includes observations made during interim action recovery well installation.

6.4.1 LNAPL Distribution

LNAPL is present at the Site as residual contamination coating soil particles and as free-phase product floating on the saturated zone. Residual product is generally found in source areas and the zone of groundwater table fluctuation (smear zone) at and surrounding areas of free-phase product. Areas of residual product are defined by elevated TPH concentrations and an oily luster noted in boring logs. The distribution of residual product is discussed in more detail in Section 5.3.1. The following discussion focuses primarily on the distribution of free-phase LNAPL.

Table 6-10 identifies all of the Site groundwater monitoring wells and the well gauging events that were completed during the RI. Interim action recovery well data is not included because of the limited amount of data available at this time. Data on the measured thickness of product or other observed evidence of product in a well is provided for each gauging event. Product data is also included on the gauging table (Table 6-1). Table 6-1 indicates when groundwater levels have been higher than the screen such that free product may not be detected. The water level has extended above the screen during periods of high water in several wells. However, all shallow wells have been constructed such that product would have been detected during several gauging events if it were present. Areas where free-phase product has been detected on an intermittent and frequent basis and areas of residual product are shown on Figure 6-12. Figure 6-12 considers observations made during interim action recovery well installation and during local septic tank replacement projects undertaken
by area residents.

Product has been detected at least once in 20 of the 45 groundwater monitoring wells installed at the Site. Ten of the 20 wells that have been reported to contain product have had relatively consistent detections of product over time; these wells are: MW-6, MW-8, MW-15; MW-17; MW-20; MW-21; MW-22; MW-25; MW-27 and MW-39. Wells MW-11, MW-26, MW-28 and MW-36 have had sporadic detections of measurable LNAPL; these wells have been conservatively incorporated into the areas of LNAPL product occurrence on Figure 6-12. Another eight wells have never had a measurable LNAPL product thickness but have had one or two instances when droplets of LNAPL were reported to be present. These eight wells are: MW-7, MW-9, MW-12, MW-19, MW-23 and MW-24. These wells have been incorporated into the area of intermittent product occurrence. A sheen has been reported on wells MW-3 and MW-4; however, actual product has never been observed and these wells were not included in the area of free-phase product. Although product has not been detected in well MW-37 during the year of monitoring, it has been included within the area of intermittent product occurrence. Sediments from the water table had an oily luster and the well is surrounded by wells with intermittent or continuous product observations. Over a longer monitoring period, product may be detected in this well.

The distribution of free-phase and residual product suggest that three main pools of free-phase product are present at the Site. The largest product pool extends from the facility in a downgradient (west-northwest) direction towards the river. Product seepage along a portion of the river bank has been observed under low river stage (i.e., at SED-4 and SED-5 in the late fall). The river bank seepage occurs at a distance of about 650 feet downgradient of the facility. Two other smaller and discrete areas of product occurrence are located within the immediate area of the facility. The product pool in the vicinity of MW-39 is located in the southern portion of the facility near a former oil pump house location. This area is thought to be very small in extent. Neither product nor a sheen have been noted immediately downgradient in the former creek channel during periods of high water. The third product area encompasses about 1 acre and is in the southeast portion of the facility surrounding wells MW-11 and MW-17 and the former engine house location. In addition, a small amount of product was detected in MW-28 during the fourth quarterly monitoring event. This data indicates that a small pool of free-phase product may also be present in this area.

As discussed in Section 4.2.4, accurate measurement of product thickness is difficult at the Site due to the viscous nature of the product. The data that has been collected indicate that product thicknesses typically have been less than 0.5 foot (Table 6-1). The maximum product thickness was measured in wells MW-17 and MW-20, at about 2.5 feet. Other wells with measured product thickness of greater than or equal to 0.5 foot are wells MW-8, MW-21, MW-22, MW-25 and MW-27. Product thickness within a well varies from one gauging event to another. The timing of maximum product thickness measurements does not correlate from well to well or with a particular time of year.

The observed variability in product occurrence and thickness is related to the various factors controlling product occurrence. The elevation of the water table and whether the water table was rising or falling at the time of measurement will affect product thicknesses. Migration of product in response to variations in groundwater flow directions affects both the occurrence and thickness of product over time. Subsurface heterogeneities appear to affect the continuity of the pool; product may be trapped above or below fine-grained lenses as the water table fluctuates and lateral product migration may be enhanced or inhibited by textural changes.

6.4.2 LNAPL Characteristics

Product characteristics were determined by laboratory analysis of four product samples collected at the Site. Samples were obtained from the river seep near SED-4/SED-5 and from wells MW-22, MW-27 and MW-39. Samples were analyzed for physical parameters including specific gravity, viscosity, surface tension and interfacial tension. Samples were also submitted for a TPH screening analysis. The analytical results are provided in Table 6-11 and Appendix I. Specific gravity and viscosity are both very temperature-dependent parameters. The samples were evaluated at 45EF to reflect the *in-situ* characteristics of the LNAPL; the temperatures measured in the aquifer range from 42E to 55EF. An increase in temperature would result in a decrease in specific gravity and viscosity. The other two parameters, surface tension and interfacial tension, are not as temperature-sensitive and were analyzed at room temperature.

The specific gravity of a liquid is defined as the ratio of the weight of a given volume of the liquid at a given temperature to the weight of the same volume of water at a given temperature. Most petroleum hydrocarbons have a specific gravity of less than 1. The specific gravity for the LNAPL samples at the Site range from 0.9676 (well MW-27) to 1.0054 (well MW-39). Three of the four samples were between 0.9676 and 0.9818. The value of 1.0054 implies that the sample is heavier than water. However, actual examination of a product sample shows that the product does not sink in water, but rather that it floats. Since it was not possible to filter the sample, it is probable that small particles of sediment were mixed with the sample and caused the erroneous reading. Another LNAPL sample was collected from well MW-39 for retesting and was reported to have a specific gravity of 0.9922.

The viscosity of a liquid is a measure of the forces that work against movement or flow when a shearing stress is applied. In other words, viscosity is a measure of the resistance of a liquid to flow. Viscosity is commonly measured in units of centipoise (cP). Water has a viscosity of 1 cP at 20EC (Lyman, 1982). Viscosity values from the LNAPL samples from the Site at 7.5EC (45EF) range from 1,035 cP (well MW-27) to 95,350 cP (well MW-39). Typical values of viscosity range from 3.3 cP in automotive diesel fuel up to about 22,000,000 cP for Bunker C fuel (No. 6 fuel oil) at 7.5EC (API, 1989). From the viscosity measurements obtained, the LNAPL product samples collected at the Site are probably a mix of diesel and Bunker C fuel. The LNAPL product in well MW-39 is comprised primarily of Bunker C fuel with little, if any, diesel.

Surface tension affects the extent of spreading of a liquid when spilled. It is also important with respect to the adsorption of the liquid onto solid surfaces. The surface tension causes the liquid to contract to a minimum area consistent with the mass of the material and the containing surface. The surface tension is defined as the force per unit length (dynes/cm) in the plane of the surface. The surface tension for most organic liquids is between 25 and 40 dynes/cm at room temperature. The surface tension of water is 72 dynes/cm at 25EC (Lyman, 1982). The values of surface tension for samples from Skykomish range from 33 dynes/cm (well MW-22) to 39 dynes/cm (the river seep).

The interfacial tension between an organic liquid and water affects such processes as the formation of stable emulsions, the resistance to flow through orifices, and the dispersion of droplets. When two immiscible or partially miscible liquids are brought into contact, the interface between them possesses free energy, the value of which is the interfacial tension. The value of the interfacial tension will be less than the greater of the two surface tensions of the two individual liquids. The units of interfacial tension are the same as for surface tension, namely, dynes/cm. Interfacial tensions of organic liquids with water range from zero for completely miscible liquids up to the surface tension of water (72 dynes/cm at 25EC). Values of interfacial tension for the samples collected at the Site range from 25 dynes/cm (MW-39) to 81 dynes/cm (MW-27). The value of 81 dynes/cm appears to be an overestimate as it exceeds the surface tension of water at 72 dynes/cm.

The nature of the hydrocarbons in the samples was evaluated using Washington Method WTPH-HCID. This method uses a gas chromatograph and flame ionization detector to determine the carbon range of the hydrocarbons in the product. In samples with higher concentrations, the actual concentration can be estimated. In all four samples, hydrocarbons were found from C_9 to C_{32}. In product samples from the river and wells MW-22 and MW-27, hydrocarbon compounds were quantified in the diesel range (C_{12} to C_{28}) at concentrations of 430,000 to 490,000 mg/kg. The diesel range concentration in well MW-39 was 210,000 mg/kg. Hydrocarbons in the gasoline range ($>C_6$ to C_{12}) and the heavy oil range ($>C_{28}$) were not found at concentrations above the detection limits of 10,000 and 50,000 mg/kg, respectively.

Physical and chemical testing suggest that the product at MW-39 is markedly different than the product in the main pool. The specific gravity of the product at MW-39 is greater than the rest of the samples and the viscosity is an order of magnitude higher than the other values. In addition, the product from MW-39 contains approximately 21% hydrocarbons in the diesel range while samples from the main pool contain 43% to 49% hydrocarbons in the diesel range.

Product flow characteristics were evaluated by conducting product baildown tests in wells MW-17, MW-20 and MW-27. These wells were tested because the greatest measured LNAPL thicknesses have been reported in these wells. Due to the high viscosity of the product, accurate thickness measurements were difficult to collect. Product thickness was estimated using a bailer. The initial product thickness measurements ranged from approximately 0.01 to 0.04 foot in MW-20 to 0.2 foot in wells MW-17 and MW-27. Because of the difficulty in obtaining quick and accurate depth-to-water or product thickness measurements, the baildown test was modified so that only the depth to product was measured. Under the modified test procedures, the depth to product was measured and then a decontaminated stainless steel bailer was used to quickly remove the product. The depth to product was then monitored until the product returned to the pretest level or adequate recovery data had been obtained.

Due to the limited initial product thickness in MW-20, attempts to bail down the product were unsuccessful. No product was recovered from the well during bailing and no product recovery information was obtained from this well. In well MW-27, where the initial product thickness was 0.2 foot, the depth to product was lowered by 0.07 foot by bailing. One hour after bailing, the depth to product returned to within 0.03 foot of the original level, a recovery of almost 60%. Well MW-17 also initially had approximately 0.2 foot of product. Approximately 0.0625 gallon of product was removed from the well by bailing. In a 2-inch well, 0.2 foot of product equals 0.032 gallon. Therefore, approximately twice the initial measured volume was removed from the well during baildown. The product level returned to the pre-baildown level in less than 30 minutes.

In summary, two wells contained sufficient product to conduct useful baildown tests. The recovery rates of the product in each well varied. One well fully recovered shortly after baildown (MW-17), while the product recovery in the other well (MW-20) was much slower with about 60% recovery in an hour.

6.5 Migration Routes in Groundwater

This section reviews the fate and transport of fuel released to the subsurface and its constituents. Site-specific controls on migration are also discussed. Migration in the unsaturated zone was discussed in Section 5.4. This discussion will focus on migration in the saturated zone.

6.5.1 Potential Migration Routes

Hydrocarbons released to the subsurface migrate primarily downward through the unsaturated soils. Assuming that all the hydrocarbon released is not immobilized in the unsaturated zone as a residual phase, the product flows downward until it reaches the water table. Being less dense than water, the product accumulates on the water table and spreads under capillary forces. As more product accumulates, it begins flowing in the downgradient direction of the water table. Hydrocarbon constituents in the product pool then begin partitioning into the groundwater or soil vapor. In addition, the product pool moves up and down as the groundwater table fluctuates seasonally, coating the soils across this zone of water table fluctuation (the smear zone). As the water table fluctuates upward across the smear zone, more hydrocarbons are available for dissolution. Additionally, the water table responds to seasonal fluctuations more readily than the product and therefore, product becomes temporarily incorporated into the upper portions of the water table.

Once dissolved in the groundwater, hydrocarbons will migrate with the groundwater flow by advection, interacting with the rock or soil medium. Migration rates will depend on the hydraulic gradient and hydraulic conductivity of the soils and on the amount of contaminant retardation associated with adsorption and degradation. Hydrocarbon constituents will adsorb on soil particles, particularly external and intraparticle surfaces coated with soil organic matter. The adsorption of constituents will cause a net retardation in velocity of movement of the compounds relative to that of groundwater. Organic contaminants can be degraded by biological or chemical processes, further decreasing the rate of contaminant transport.

Rates of free-phase product migration are also dependent on the hydraulic gradient and hydraulic conductivity of the soils as well as the density and viscosity of the product. Product will preferentially flow downgradient through more permeable lenses and beds in the aquifer.

6.5.2 Actual Migration Routes

The groundwater table at the Site is relatively shallow and much of the product released has reached and accumulated on the groundwater table. Hydrocarbon constituents have partitioned in the groundwater. Partitioning of hydrocarbons into the air phase at the Site is considered negligible due to the nature of the product. The dissolved constituents are migrating with groundwater; however, the rate of migration is slower than the 2.5 feet/day estimated for groundwater. The product migration is slowed by retardation and biodegradation. DO data from the Site indicate that biodegradation is occurring in the vicinity of hydrocarbon plumes because DO concentrations are much lower in these areas as compared to upgradient concentrations.

Dissolved constituents have migrated downgradient from source areas. The lateral boundaries of the dissolved hydrocarbon plume are in close proximity to the product pool. The upper portion of the aquifer is permeable and consists predominantly of sandy gravel to gravelly sand. Therefore, the groundwater plume has not been dispersed laterally by preferential flow through more permeable zones. The vertical gradient at the Site is somewhat variable, but averages being downward. Hydrocarbons have not been detected in deep wells, suggesting that vertical transport is minor.

Migration of product from source areas and dissolved plumes originating from areas of free-phase and residual product are dependent on the type of product and the prevailing hydraulic gradient. As such, the three main pools at the Site are discussed separately in the following paragraphs. Through the years, product released from the fueling area has migrated northwestward toward the river, forming the main product pool and acting as a source of hydrocarbons to groundwater. Migration of product and dissolved constituents has primarily been controlled by the prevailing groundwater gradient. Due to the homogeneous nature of the aquifer and consistent groundwater flow direction in this area, lateral spreading has been minimal. Despite the homogeneous nature of the aquifer, some variation in product occurrence is thought to be associated with siltier zones within the sandy gravel. For example, product is present upgradient and cross-gradient to wells MW-23 and MW-24; however, product has been detected in these wells only once.

The product pool at MW-39 has not experienced the migration similar to the pool associated with the fueling area. The viscosity of the product at MW-39 is one to two orders of magnitude higher than the main product pool and therefore, migration is limited by the high viscosity of the product. Fluctuations in groundwater flow direction in this area and local fluctuations in groundwater flow associated with the former creek channel influence transport of dissolved constituents in this area. During high water table conditions a north-south to northwest-southeast trending ridge is formed on the water table. The ridge is located either coincident with or immediately east of this area and therefore, flow direction can vary from west to northwest and on rare occasions, northeastward. Dissolved constituents thought to be associated with the product at MW-39 have been detected in MW-5, MW-12, MW-13 and MW-14, depending on the prevailing groundwater flow direction. The local flow conditions associated with the channel contribute to the changes in the magnitude of the dissolved plume. Measurements indicate that the former creek channel is recharged during periods of high water. During periods of high water, when flow from both sides of the creek are towards the channel, northward migration of dissolved constituents is limited. During dry periods, when groundwater is low, the former creek channel does not influence groundwater flow and dissolved constituents are detected at the higher concentrations in downgradient wells (i.e., MW-12).

The product pool at MW-17 has also not experienced the migration similar to the pool associated with the fueling area. The smaller overall volume of this pool has limited migration. Local variations in groundwater gradient have also limited the migration of product and groundwater in this area. The only well surrounding MW-17 to have product lies to the north (MW-11). In addition, well MW-34 (located north of the plume) contained detectable TPH concentrations during two of the four quarters while wells MW-10 and MW-18 (situated west northwest of the MW-17 pool) generally do not contain hydrocarbons. The pool at MW-17 lies on the east side of the groundwater ridge that has been noted extending northward from the former creek channel to wells MW-21 or MW-27. When this groundwater ridge is present, flow is locally diverted eastward and northward before turning back northwestward. During lower flow periods, the gradient is more directly to the northwest. The intermittent presence of this groundwater ridge and the variable flow directions associated with the ridge are thought to decrease the net transport of product and groundwater in this area.

6.5.3 Chemical Partitioning

Chemical partitioning of constituents from soils and product to groundwater and from groundwater back to soils is complex. Where uncontaminated groundwater migrates into areas of residual contamination or free product, hydrocarbons will partition from the product or soils into the groundwater. Factors controlling the rate of partitioning into the groundwater from soils include the types of constituents adsorbed to the soils, the organic carbon content of the soils, the residence time of groundwater in contact with the soils, and the initial concentrations of the constituents in the groundwater. When the groundwater contacts the product, hydrocarbons will dissolve from the product into the groundwater. The solubility of the product will be substantially less than the solubility of any one constituent of the product, and the solubility will also depend on the initial hydrocarbon concentration of the groundwater. Finally, when the contaminated groundwater reaches soils which have not been previously impacted, hydrocarbons will partition out of the groundwater and onto the soils.

The actual composition of the hydrocarbons in the soils and product will vary somewhat across the Site. Heavier-end hydrocarbons will preferentially be adsorbed to soils, leaving the mobile product with a slightly different composition as compared to the original product. Biodegradation will also cause variations in the composition of adsorbed hydrocarbons and those in the dissolved plume.

Groundwater quality data indicate that few compounds have partitioned from the LNAPL into the groundwater. TPH concentrations are non-detect within short distances of LNAPL. No TPH or other organics were detected in deep groundwater samples.

7.0 SURFACE WATER AND SEDIMENT INVESTIGATION RESULTS

Surface water flow data was presented in Section 2 of this report. As described in Section 6, the Site groundwater recharges the two surface water bodies in the study area; the South Fork of the Skykomish River and Maloney Creek. This section presents the results of the RI sampling of surface water and sediments within these two water bodies and discusses the fate and transport of contaminants present in these streams.

7.1 Surface Water Quality Data

Surface water samples were collected from seven locations on four occasions during the RI. Figure 4-2 shows each of the surface water sampling locations. Sample locations SW-1, SW-2 and SW-3 are located along the current Maloney Creek channel. SW-1 is the upstream sample location, SW-2 is located near the confluence of current and former Maloney Creek channels, and SW-3 is located near the confluence of Maloney Creek and the South Fork of the Skykomish River. Sampling locations SW-4, SW-5 and SW-6 are along the river. Location SW-4 is the upstream sampling location, SW-5 is located near the previously observed oily seeps, and SW-6 is located just upstream of the confluence with Maloney Creek. Location SW-7 is in the former Maloney Creek channel.

In November 1993, surface water samples were collected from SW-1 through SW-6 for analysis of a full suite of compounds including SVOC, PPMs, TSS and TPH. No surface water sample was collected from location SW-7 in November 1993 because the former creek channel was dry at the time of the sampling event. No VOC analyses were planned because these compounds are rapidly volatilized from flowing surface water. No PCB analysis was planned because of the low water-solubility of these compounds and the distance from any potential PCB source area to surface water.

In subsequent sampling rounds, both the number of sampling locations and the analytical parameter list were reduced. Specifically, sampling locations furthest from the Site were eliminated from some sampling rounds and parameters with no previously detectable concentrations were eliminated. Sampling details and analytical results for each parameter are presented below. Laboratory analytical reports are contained in Appendix H.

7.1.1 Total Petroleum Hydrocarbons

During late summer and early fall when the river is low, seeps of oily groundwater have been noted along the banks of the Skykomish River; these seeps have been observed at the locations shown in Figure 6-12. Some petroleum sheen has been observed on the surface of the river water near these seeps.

Surface water samples were analyzed for TPH in each sampling quarter. The November 1993 samples were analyzed for TPH by WTPH-418.1 and the subsequent surface water samples were analyzed using the WTPH-D Extended method. Table 7-1 provides the TPH results for the surface water samples.

Sample locations SW-3, SW-5, and SW-6 were sampled in each of the four quarterly events. Location SW-7 was not sampled in November 1993 as discussed above, but was sampled in each of the remaining three events. Samples were collected from locations SW-1, SW-2 and SW-4 in the first sampling event only. The only locations with any reported detectable TPH in surface water were SW-5 and SW-6. Each of these sample locations had an estimated TPH concentration of 0.1 mg/L during the August 1994 sampling event. No other TPH concentrations were reported for surface water samples.

7.1.2 Semivolatile Organic Compounds

The six surface water samples collected in November 1993 (SW-1 through SW-6) were analyzed for SVOC by EPA Method 8270. In April and August 1994, samples were collected from SW-5 for analysis of PAH by EPA Method 8310. This location was selected for PAH analysis because of its proximity to the oily seeps previously observed along the river bank.

SVOC results are provided in Table 7-2. The only SVOC detected in the November 1993 surface water samples was bis(2-ethylhexyl)phthalate from location SW-6; the reported concentrations were 23 and 180 Fg/L in the sample and duplicate, respectively. Phthalates are considered a laboratory contaminant and the presence of this compound is not indicative of any surface water contamination from the Site.

The only PAH compound detected in surface water samples was fluoranthene. It was reported present at an estimated concentration of 0.4 Fg/L in SW-5 in the August 1994 sample.

7.1.3 Metals

Surface water samples were collected from six locations in November 1993 and were analyzed for 13 PPMs. In April 1994, samples were collected from SW-3, SW-5, SW-6 and SW-7 for analysis of both total and dissolved arsenic, chromium and lead. In August 1994, samples were collected from SW-3, SW-5 and SW-6 for analysis of total arsenic, chromium and lead. No metals analysis was conducted on the November 1994 surface water samples.

Table 7-3 presents the results of the metals analysis of surface water samples. No metals were detected during any of the sampling events. Arsenic was detected at 0.001 mg/L in the April 1994 field blank.

7.1.4 Field Measurements

Surface water temperature, pH, DO and conductivity were collected as part of the RI sampling and are present in Table 6-9. These data indicate that the water in both the South Fork of the Skykomish River and Maloney Creek is neutral to basic (6.6 to more than 10 su), has relatively low conductivity (22 to 338 µmhos/cm) and is well oxygenated (greater than 9 mg/L DO). The highest conductivity values were obtained during low stream flow conditions in August 1994. No significant differences were noted between the river readings and those from the creek. Surface water temperatures ranged from a low of 5.3EC in November 1993 to more than 15EC in August 1994.

7.2 Sediment Quality Data

Sediment samples were taken from seven sampling locations on October 7, 1993. Five of the sample locations were along the south bank of the river west of the Fifth Street Bridge. Two of the sample locations were in the former creek channel. Sediment samples were analyzed for TPH (WTPH Method 418.1), SVOC (Method 8270), VOC (Method 8240), metals (Method 6010/7060), and PCBs (Method 8080). One pre-RI sediment sample (SKY-1) was collected. Its approximate location was in the Skykomish River north of monitoring well MW-23. This sample was analyzed for TPH using EPA Methods 418.1 and 8015. Results are discussed below for each parameter. Figure 7-1 depicts the sediment sampling locations and presents the reported concentrations of select indicator parameters. Laboratory reports are presented with soil data in Appendix D. Pre-RI data is presented in Appendix E.

7.2.1 Total Petroleum Hydrocarbons

Table 7-4 presents the results of the TPH analysis of sediment samples. TPH was detected in sediment samples SED-4, SED-5, SED-6 and SED-7. The maximum TPH concentration (6,900 mg/kg) was reported in the SED-4 sample, which was collected from the oil saturated sands at the location of an oil seep. SED-5, also from the oil seep, had a reported TPH concentration of 990 mg/kg. Other samples from the river (SED-1, SED-2 and SED-3) contained no detectable TPH. The two samples from the former creek channel, samples SED-6 and SED-7, had estimated TPH concentrations below the detection limit of 97 and 99 mg/kg, respectively.

7.2.2 Semivolatile Organic Compounds

SVOC were not detected in any sediment samples (Table 7-5).

7.2.3 Volatile Organic Compounds

Table 7-6 presents the VOC results for the RI sediment samples. All of the sediment samples were reported to contain methylene chloride and five of the seven sample locations had reported concentrations of acetone. Methylene chloride and acetone are common laboratory solvents and were also detected in the laboratory method blanks. These compounds are therefore believed to be an artifact of laboratory contamination.

Styrene, the VOC compound detected most frequently in Site soils (see Section 5.3.3) was not detected in any of the sediment samples. The VOC compound 2-hexanone was detected in samples SED-4 and SED-5 at 320 and 20 Fg/kg, respectively.

7.2.4 Metals

The results of sediment metals analysis are provided in Table 7-7. Silver, beryllium, cadmium, and antimony were not detected in any of the sediment samples. Selenium, thallium and mercury were each detected in one or two sediment samples at concentrations equal or slightly above the analytical detection limit for those metals.

Copper, nickel, zinc, arsenic, chromium and lead were detected in all of the sediment samples. For most of these metals, the concentrations reported in the former Maloney Creek channel sediments were greater than those reported in the river sediments. For example, copper ranged from 10.9 to 15.7 mg/kg in the river and was reported at more than 34.6 and 36.4 mg/kg in the former creek channel sediments. This difference in creek sediments may reflect difference in organic and/or mineral composition. The river sediment data were examined to determine if metals were elevated near the observed oil seeps at SED-4 and SED-5. The maximum reported concentrations of metals were not in either the SED-4 or SED-5 samples near the oil seeps.

7.2.5 Polychlorinated Biphenyls

None of the sediment samples contained detectable concentrations of PCBs (Table 7-8).

7.2.6 Total Organic Carbon

Sediment samples were analyzed for TOC concentrations. The data indicate that the TOC content of the river sediments ranges from 0.3% to 0.8%. This relatively low TOC is in agreement with the observed sandy, gravely nature of the river bottom and with the seasonally high stream flows that occur in the river. The sediments of the former creek channel contain a significantly higher TOC with reported concentrations of 2.1% and 3.1%. The former creek channel sediments contain a higher TOC due to contributions from decaying organic matter such as leaves and other vegetation. The low stream flows in the creek do not scour or otherwise remove these organic deposits, allowing them to accumulate. The TOC sediment data were reported with the soil TOC values in Table 5-7.

7.3 Migration Routes in Surface Water and Sediments

7.3.1 Actual and Potential Migration Routes

Surface water and sediments receive runoff and groundwater recharge from the Site. Contaminants may be discharged to Maloney Creek from Site runoff that drains or groundwater that discharges to the former creek channel. These same mechanisms can also result in the release of contaminants to the river. Site runoff can enter the river via storm drains and groundwater discharges to the river. The release of petroleum product from seeps located along the south bank of the river has been observed on a seasonal basis. This seepage results in the formation of petroleum sheens and a release of contaminants to surface water and sediments. Based on the RI results discussed above, there is evidence that groundwater discharges of oily water have a measurable impact to river sediments.

Petroleum sheens on the water surface and contaminants dissolved in the surface water are subject to downstream transport, biological degradation, photo-oxidation and adsorption onto sediments. Contaminants present in sediments may be degraded, desorb into surface water or be transported downstream as suspended sediments. Given the overall high quality of the surface water and sampling results, there appears to be minimal occurrence of additional contaminant migration via surface water.

7.3.2 Chemical Partitioning

Both surface water and sediment samples were collected from similar locations in the river (SW-5 and SED-4) and in the former creek channel (SW-7 and SED-7). Review of these data were conducted to evaluate the site-specific partitioning between sediments and surface water. The only compound detected in both surface water and sediments was TPH. The SED-4 sample from the river was reported to contain 6,900 mg/kg while the nearby surface water contained at maximum of 0.1 mg/L. These data indicate a ratio of 10,000 to 1 for sediment and surface water partitioning. This relatively high partition coefficient may be due, in part, to the fact that the flow water does not have ample time to reach equilibrium with the underlying sediments. Even stronger partitioning onto sediments would be expected in the former creek channel because these sediments have a higher TOC concentration than the river sediments. However, the slower water flow in Maloney Creek may provide more time for dissolution and desorption which could counter the impact of the high TOC.

8.0 AIR QUALITY INVESTIGATION

8.1 Air Shed

The term air shed denotes a geographic area which, because of topography, meteorology and climate, shares the same air. The air shed associated with the Site is defined by the boundaries of the Skykomish Valley. The elevation at the Site is less than 1,000 feet above msl; elevations in excess of 2,000 feet above msl lie within 1 mile north or south of the Site. The valley trends east-west and defines the predominant wind direction at the Site. Local meteorological data are limited in terms of actual wind-speed and direction statistics (see Section 2.4).

The local air quality complies with ambient air quality standards such that the area is designated as an attainment area. The Skykomish area is not a designated Class I area pursuant to §§ 162 or 164 of the Federal Clean Air Act.

8.2 Air Monitoring

Air monitoring was performed at the Site during field activities to ensure worker safety and to gather information on volatile organic emissions. A PID was used for both health and safety monitoring and to obtain total organic vapor measurements. This instrument is designed to measure organic vapor levels in the range of 0 to 2,000 parts per million (ppm) on a volume basis. As a contingency, benzene monitoring, using Drager tubes, was to be performed during the RI if PID readings exceeded 1 ppm over a 5-minute period.

The following field activities included air quality monitoring using the PID:

- hollow-stem auger drilling
- well installation
- surface soil sampling
- sediment sampling
- hand auger sampling
- air rotary drilling

For these activities, readings were obtained at ground level and in the breathing zone (5 to 6 feet off the ground). During air rotary drilling, readings were additionally obtained from the cyclone exhaust and at the top of the well casing while drilling the borehole. For surface soil and sediment sampling, the instrument was passed several times over the excavated area to obtain a reading. Additional air monitoring was performed in conjunction with well gauging events. PID readings were obtained at the wellhead immediately upon opening the well cover. The PID was calibrated daily, prior to use. Measurements were conducted in accordance with RETEC Standard Operating Procedure #320 presented in the SAP (RETEC, 1993).

Air monitoring results obtained during drilling and soil sampling activities are presented in Table 8-1. Total volatile organics concentrations in the breathing zone were consistently non-detect, with the exception of one reading of 0.5 ppm during sediment sampling. As a result, benzene air monitoring was never required. Volatile organics were only detected at appreciable levels during hollow-stem auger drilling of boring B-10, and from the top of the casing during air rotary drilling of boring B-7.

Instantaneous PID readings taken upon opening well covers are listed in Table 8-2. These values ranged from below background to 28 ppm. In most cases, detected values correspond to wells with measurable LNAPL accumulations.

8.3 Soil to Air Model

Under typical conditions at a site, the surface soil can release compounds of interest into the air via volatilization and through fugitive dust emissions. This section describes the procedures used to estimate emissions from volatilization and fugitive dust. These estimated emissions were then combined in a box dispersion model to yield estimated Site air concentrations.

The methodology used is suited to estimating long-term (i.e., chronic) air concentrations immediately above the areal soil source due to long-term emissions from surface soils. The methodology can also be used to estimate air concentration at the perimeter of the areal source due to emissions from surface soils.

8.3.1 Volatile Emission Estimates

The average rate of volatile emission from soils depends on the properties of the chemical, the depth of contamination, and the time over which the emission rate is averaged. The analysis conducted for the Site is based on a model developed by Clark Allen of Research Triangle Institute (the RTI model as presented in EPA, 1989a). This model assumes that volatile emissions from the surface of the soil mixture are limited by the diffusion of vapors through the pore spaces in the soil mixture. The model further assumes an equilibrium concentration of organic vapors exists at all times within the soil pore spaces. Appendix J provides further detail on the model assumptions and equations used.

8.3.2 Fugitive Dust Emission Estimates

The average rate of fugitive dust emissions from the soil is determined by estimating the rate at which dust is blown into the air. Soil characteristics including grain size and moisture content impact the rate of dust generation. The rate of dust emissions for the Site was estimated using the fugitive dust emissions model of Cowherd (1984) (as described in GRI, 1988). Appendix J contains the details on the model input and assumptions.

8.3.3 Box Dispersion Model

The nearfield box dispersion model of Pasquill (1975) was used to estimate concentrations of compounds of interest in the air from surface emissions of volatiles and particulates. The model assumes a box exists above the areal source and it mixes the emissions within this box to generate an air concentration (Appendix J).

8.3.4 Calculated Air Concentrations

The above analyses were conducted using surface soil quality data from the railyard (South Site) and using surface soils quality data collected from non-railyard locations (North Site). Further discussion of the basis for separating the Site into these two areas is provided in Section 11. Table 8-3 presents the soil concentrations for each of the PPMs, the two detected PCB congeners and the SVOC and VOC detected most frequently in soils. The calculated air concentrations for each compound is then presented for volatiles, fugitive dust and total emissions. These results indicate that the air quality impacts from the Site are negligible. Only four compounds have estimated air concentrations that total more than 0.00001 mg/kg. These four compounds are: mercury, 2-methylnaphthalene, butyl benzyl phthalate and xylenes.

8.4 Migration Routes

8.4.1 Actual and Potential Migration Pathways

Section 8.3 and Appendix J describe how compounds can migrate from soils to air as vapors or as particulates. Contaminant migration in air is controlled by wind direction and speed, cloud cover, air temperature, and other factors including the formation of inversions and the presence of fog.

Based on the health and safety air monitoring conducted during the RI and on the analysis discussed in Section 8.3, there do not appear to be any significant actual migration pathways. Future excavation of contaminated soils could result in a potential increase in emissions and in the migration of contaminants via this pathway.

8.4.2 Chemical Partitioning

A detailed discussion of the factors that influence or control chemical partitioning from soil to air is provided in Appendix J.

9.0 INTERIM REMEDIAL ACTION

This section describes the LNAPL recovery system that was installed at the BNRR facility. The interim remedial action objectives were to provide data to assess the effectiveness of product recovery for the FS and reduce the release of oily seeps to the Skykomish River.

Ecology approval of the Interim Actions Plan was received in October, 1995. Construction of the interim action was initiated in October. Installation was completed and system startup was initiated in January 1996.

As discussed in previous sections, an LNAPL mixture of diesel and Bunker C fuels is present beneath the facility and adjacent properties, and oily seeps have been noted on a seasonal basis along a portion of the bank of the river. Recovery wells installed along West River Drive will facilitate recovery of petroleum product and reduce the amount of product reaching the river (Figure 9-1). The recovery wells were installed in areas believed to have floating product based on the RI. Hydrocarbon belt skimmers were installed in each recovery well to recover LNAPL. An additional monitoring well was installed to facilitate monitoring system performance. The new and existing monitoring wells will be used to detect the presence of product and gauge water levels to help monitor system performance.

9.1 Basis of Design

The following factors were considered in design of the LNAPL recovery system:

- The wells must be designed in a flexible manner to allow potential future use as dual pump recovery wells.
- The recovery wells must be screened to intercept the zone of water table fluctuation and to allow potential pumping of groundwater.
- The equipment and materials for the system must be compatible with diesel and Bunker C hydrocarbons.
- The hydrocarbon recovery system must be effective for highly viscous product.
- The system will accommodate a possible decrease in product recovery during the winter due to increased product viscosity.

- The native soils range from sand to gravel.
- The implementation plan should be staged in order to determine recovery rates and remote storage needs.

9.2 Rationale for Recovery and Monitoring Well Locations

Recovery Wells

Figure 9-1 illustrates the area of product occurrence at the Site and the recovery well locations. As presented in Section 6.4, monitoring well data indicate a continuous area of LNAPL flowing west-northwest towards the South Fork of the Skykomish River. LNAPL seepage along portions of the river bank has been observed under low river stage during the fall. LNAPL is also encountered in wells MW-23 and MW-24 sporadically, and in MW-25 consistently. Based on these observations, the recovery wells were located as indicated on Figure 9-1. The wells were placed in areas known to contain LNAPL; wells are not located in areas where product has not been consistently observed (e.g., MW-23 and MW-24).

Monitoring Well

As shown in Figure 9-1, recovery well R-4 was located within 20 feet of monitoring well MW-25. In order to evaluate system performance in the western portion of the recovery system, an additional monitoring well (MW-41) was installed adjacent to existing DW-4 and R-2. This well was screened across the water table to detect LNAPL, if present, as well as provide information regarding vertical gradients in combination with DW-4.

9.3 Well Design

The recovery and monitoring wells were constructed in accordance with WAC 173-160, Minimum Standards for Construction and Maintenance of Wells.

Recovery Wells

The recovery wells were designed to recover LNAPL using a belt skimmer. Therefore, the recovery wells were constructed to intercept the water table at all times based on gauging data for the area. The wells were constructed using stainless steel casing and screen. The wirewrap well screens were each 15 feet in length with 0.020-slot size. A 10/20 filter pack was placed in the annulus around the screens. A 2-foot sump was installed below each screen to act as a sediment trap. The wells were enclosed in 3 foot by 4 foot vaults. The well logs are provided in Appendix C.

<u>**Monitoring Well**</u>

Monitoring well MW-41was also designed to screen across the water table at all times. This well will assist in evaluating recovery system performance (specifically near well R-2) and will also be used with existing monitoring well DW-4 to assess vertical gradients. The monitoring well was constructed of 4 inch diameter Schedule 40 PVC screen and casing. The well screen was 15-feet in length with 0.020-inch slots and extended from 4 to 19 feet bgs. A standard, flush-mounted well monument was place around the well. The well log is provided in Appendix C.

9.4 Findings

During drilling, hydrocarbon-saturated soils were observed at the water table in the recovery wells and the monitoring well. The observation of hydrocarbon-saturated soils in well boring R-1 required additional borings. As per the Interim Action Plan, two additional step out boring were installed to evaluate the horizontal extent of contamination to the west. The borings (SO-1 and SO-2) were drilled at approximately 50-foot spacings to the west of R-1 (Figure 9-1) to define the western LNAPL plume boundary. The borings were drilled to the water table and a soil sample was collected from the water table zone and submitted for a modified WTPH-D extended analysis (C_9 to C_{36}). The borings were then backfilled with bentonite to the surface. Boring logs are provided in Appendix C.

No evidence of contamination was observed above the water table. The analytical result of the 2 samples were:

- SO-1 - collected at 5 feet bgs contained 1,400 mg/Kg TPH as diesel and 1,300 mg/Kg TPH as motor oil.
- SO-2 - collected at 6.5 feet bgs contained 590 mg/Kg as diesel and 68 mg/Kg as motor oil.

The laboratory analytical report for these samples are presented in Appendix K.

To install the vaults around the recovery well, 3 foot deep excavation were required. The soils in these excavation were visually evaluated for evidence of contamination. No contaminated soils were observed in these excavations.

At the same time the interim action installation was occurring, local residents were replacing a septic tank. The houses are located along west side of Fifth Street south of West River Drive. During excavation, groundwater was encountered at approximately 5 feet 7 inches bgs. Once the sediment had settled the groundwater was clear and only a limited number of very small (1 to 2 inches in diameter) petroleum sheens were observed in the excavation. No LNAPL was present at this location.

10.0 REGULATORY CLASSIFICATION AND STANDARDS

No waste generation is currently associated with operations at the facility. Investigation-derived wastes (e.g., soil cuttings and purge water) are currently stored in drums at the Site; these wastes have been sampled and determined to be non-hazardous under RCRA and Washington Dangerous Waste regulations.

Additional wastes may be generated as part of Site cleanup measures. Such wastes could include contaminated soils, recovered LNAPL and contaminated groundwater. Based on the RI, neither soils nor groundwater would be considered hazardous waste under RCRA or Dangerous Waste regulations. Recovered LNAPL destined for disposal could be considered a dangerous waste due to persistence or aquatic toxicity. Recycle and reuse opportunities exist for recovered LNAPL, however, such that disposal of this material is not anticipated.

11.0 RISK ASSESSMENT

11.1 Scope of the Risk Assessment

This section of the RI report evaluates potential human health and ecological effects associated with exposure to chemicals of interest detected in soil, groundwater, surface water, and sediment at the Site. The elements of the risk assessment include:

- identification of chemicals of interest (Section 11.2)
- assessment of human health exposure (Section 11.3)
- assessment of ecological exposure (Section 11.4)
- summary of human health and ecological risk assessments

This format complies with the MTCA Cleanup Regulation (Chapter 173-340 WAC), MTCA Cleanup Levels and Risk Calculations (CLARC II) Update (Ecology, 1994), and current EPA guidance for conducting a human health evaluation, *Risk Assessment Guidance for Superfund* (EPA, 1989b and 1991).

11.2 Identification of Chemicals of Interest

The previous section of this report presented analytical results for numerous chemical compounds that were analysis in soil, groundwater, surface water and/or sediment samples. The purpose of this section is to review all these applicable data and ensure that the analysis of potential risks is focused on the appropriate chemicals. WAC 173-340-708 (2) allows for the selection of indicator hazardous substances when defining site cleanup levels. Because this is a similar application, the WAC requirements are reviewed below. WAC 173-340-708 (2)(b) lists the following factors that need to be considered when eliminating hazardous substances from further evaluation:

C the toxicological characteristics of the chemical relative to its concentration at the site
C the persistence and mobility of that chemical in the environment
C natural background levels of the chemical
C the thoroughness of testing for that chemical
C the frequency at which the chemical has been detected
C the degradation by-products of the chemical

This section reviews each of the above factors in two phases. First, the natural background levels, the thoroughness of testing and the frequency of detection are examined to identify the chemicals that are likely to be Site-related and to determine whether or not the analytical data are of acceptable for use in the risk assessment. The result of this initial evaluation is a list of chemicals of interest (COI) that will be used in a quantitative risk assessment. The second phase, the qualitative risk assessment, examines the toxicity of that chemical relative to its concentration at the site, discusses the persistence and mobility of that chemical in the environment and reviews available data regarding potential degradation by-products.

This procedure also complies with current EPA guidance (EPA, 1989b) which specifies completion of the following detailed steps:

- Segregate the analytical data into data sets by medium. The data are evaluated separately for each medium since different analytical procedures were used for each medium (e.g., soil, sediment, groundwater, and surface water).

- Evaluate the analytical methods for each data set for their suitability for risk assessment.

- Evaluate the detection limits for each analytical method and each data set.

- Evaluate qualified or coded data to determine data useability in the risk assessment.

- Compare sample results to results of field and laboratory blanks to determine whether or not detected chemicals are due to Site conditions or result from activities that occurred during sampling and analysis.

- Compare sample results to results of available background samples to determine whether or not detected chemicals result from activities at the Site or are related to ambient (background) conditions.

EPA guidance (EPA, 1989b) then recommends a final screening at the conclusion of the data evaluation procedure. The purpose of this final screening is to eliminate chemicals that are common laboratory contaminants, are detected at very low concentrations, and/or are detected in only one or a few samples (i.e., low detection frequency). These chemicals are not considered relevant for estimating potential risks. The outcome of this procedure is a list of COI for soil, sediment, groundwater, and surface water for use in the quantitative risk assessment. Figure 11-1 presents a schematic of the data evaluation process.

Numerous soil, groundwater, surface water, and sediment samples were collected during the RI and previous Site investigations. These samples were obtained over a large area, including the former maintenance and fueling facility as well as adjacent properties. Based on these factors, the Site was divided into two study areas to facilitate the assessment. The North Site includes soil and sediment samples collected north of Railroad Avenue. The South Site includes soil and sediment samples collected on or south of Railroad Avenue which are likely to be associated with the facility activities. Because the groundwater associated with the Site originates from the same aquifer, all groundwater data was summarized together in the risk assessment. The surface water samples collected from the South Fork of the Skykomish River, Maloney Creek, and the former channel of Maloney Creek were also summarized together for the risk assessment.

11.2.1 Soil Data

Review of soil quality data for risk assessment purposes is typically limited to soil samples collected from above the depth of groundwater. This is because those soils present the greatest potential for human exposure to chemicals from direct contact or inhalation. Soils that are present within the groundwater zone can also contribute to risks by the leaching of chemicals from soil to groundwater followed by contact or ingestion of groundwater. Because Skykomish is not the site of a recent spill (i.e., sufficient time has passed to allow chemicals that might leach to groundwater to do so), actual groundwater quality data will be used to assess the potential risk associated with chemicals leaching from soil. As was presented in Section 6, the depth to groundwater at the Site is relatively shallow (e.g, 5 to 15 ft bgs). In addition, MTCA requires that soil cleanup levels based on human exposure via direct contact be applied to the soil within the upper 15 feet (WAC 173-340-740(6)(c)). For these reasons, all soil data collected from 0 to 15 feet bgs were included for evaluation in this risk assessment. Table 11-1 is a summary of the soil and the associated parameters analyzed.

Following the detailed EPA guidance, the first step in the data evaluation process is the evaluation of analytical methods implemented on soil samples collected at the Site. The analytical methods listed in Table 11-1 are all EPA- or Ecology-approved methods. Tables 11-2 and 11-3 provide a summary table of the analytical data for soil samples collected from 0 to 15 feet bgs at the North Site and South Site areas, respectively. The summary includes the number of samples, the number of positive hits per chemical in the samples, the number of samples below detection limit (BDL), the minimum and maximum detection limits, the minimum and maximum concentrations in the sample, and the location of the maximum concentration. Metals, TPH, and VOC were detected in the North Site samples. Detected in the South Site samples were metals, PCBs (Aroclor 1254 and 1260 only), SVOC, TPH, and VOC.

The second data evaluation step involves evaluation of sample analytical detection limits. Sample analytical detection limits refer to the specific detection limits reported by the laboratory for a specific chemical and sample. The analytical detection limits for the soil samples ranged from:

North Site

- 0.02 to 2.4 ppm or mg/kg for metals
- 346 to 13,953 parts per billion (ppb) or µg/kg for SVOC
- 101 to 119 ppm for TPH (418.1)
- 5 to 26 ppm for TPH as diesel
- 5 to 52 ppb for VOC

South Site

- 0.02 to 10 ppm for metals
- 80 to 200 ppb for PCBs
- 330 to 33,000 ppb for SVOC
- 5 to 133 ppm for TPH (418.1)
- 5 to 30 ppm for TPH as diesel
- 5 to 6 ppm for TPH as gasoline
- 5 to 500 ppb for VOC

Detection limits for the North Site SVOC were high in two of the four samples (i.e., HA3-1 and HA4-0). However, TPH detection limits were acceptable and no TPH were detected in the two samples with high SVOC detection limits. Therefore, the SVOC normally associated with diesel and/or bunker C fuel are not expected in these two samples as indicated by no TPH detection. The detection limits for all other soil samples are considered acceptable for the risk assessment.

The third evaluation step includes review of qualified or coded data. The soil samples were qualified with standard EPA qualifiers of B and J in the reports obtained from the laboratory. A qualifier of B indicates a parameter was also detected in the lab blank; a J qualifier indicates an estimated value less than the sample detection limit. J values were considered valid results for analysis of COI (EPA, 1989b). Concentrations that were below the detection limit were signified with a U qualifier.

The fourth evaluation step in the data validation process involved comparing the field sample data with field and laboratory blanks. Comparison of concentrations detected in the blanks with concentrations detected in the samples is common procedure and ensures that only Site-related data are used in the risk assessment. Methylene chloride and acetone, common laboratory contaminants, were found in the laboratory blanks associated with almost all the soil samples analyzed for VOC.

MTCA defines natural background as "the concentration of hazardous substance consistently present in the environment which as not been influenced by localized human activities: (WAC 173-340-200). The Site is located in a geologic region in which there are several naturally occurring chemicals in the soil and groundwater. EPA guidance (EPA ,1989b) suggests the elimination of COI if the maximum concentration detected in a particular medium is less than or equal to the background concentration in that medium. Two background surface soil samples (BG1-0 and BG2-0) were collected and analyzed as summarized in Table 11-4. Table 11-4 includes data compiled by Ecology on natural background concentrations of metals in soil throughout Washington State (Ecology, 1994b). A comparison of these background concentrations to the maximum detected concentrations in North and South Site soils is presented in Table 11-5. Thallium in the South Site is the only chemical eliminated as a COI because its maximum detected concentration is less than (or equal to) the natural background concentration.

The *Risk Assessment Guidance for Superfund* document (EPA, 1989b) allows further reduction of the list of chemicals of interest following the initial data evaluation process. EPA guidance (EPA, 1989b) suggests eliminating chemicals if:

- the chemical is a common laboratory contaminant
- the chemical has a low detection frequency
- the chemical is detected at low concentrations

MTCA also specifies the detection frequency as a factor in selecting indicator hazardous substances (WAC 173-340-708(2)(b)(vi)). Under MTCA, low concentration is also a factor if it considered in light of the toxicity of the compound (WAC 174-340-708 (2) (b)(I)). The purpose of reducing the COI list based on these criteria is to focus the risk assessment on those chemicals associated with the majority of potential risk from specific areas of the Site. Where appropriate, risk screening was conducted using MTCA Method A values for residential soil. Where MTCA Method A values were not provided, EPA Region III Risk Based Concentrations (RBCs) for residential direct contact with soils was utilized (EPA, 1995). Listed below are the chemicals that were eliminated as soil COI and the associated basis for elimination:

<u>North Site</u>

- methylene chloride (common laboratory contaminant, detected at 56B ppb)

- acetone (common laboratory contaminant, detected at 88B ppb)

- benzene (detected 1/9 at 51 ppb; the detected concentration is below the MTCA Method A risk based value of 500 ppb)

- xylene (detected 1/9 at 35 ppb; below the MTCA Method A risk-based value of 20,000 ppb)

South Site

- fluorene (detected 1/11 at 110J, non-carcinogenic PAH of relatively low toxicity)

- di-n-butyl phthalate (common laboratory contaminant detected at 115J ppb)

- fluoranthene (detected 2/11 at 200J ppb; non-carcinogenic PAH of relatively low toxicity)

- butylbenzylphthalate (common laboratory contaminant detected at 300J ppb)

- pyrene (detected 2/11 at 300J ppb, non-carcinogenic PAH of relatively low toxicity)

- benzo(a)anthracene (detected 1/11 at 110J ppb; detected concentration below the MTCA method A risk based value of 1,000 ppb)

- bis(2-ethylhexyl)phthalate (common laboratory contaminant detected at 337J ppb)

- chrysene (detected 2/11 at 330J ppb; detected concentration below the MTCA Method A cleanup level of 1,000 ppb)

- di-n-octyl phthalate (common laboratory contaminant detected at 337J ppb)

- benzo(b)fluoranthene (detected 1/11 at 260J, detected concentration below the MTCA Method A cleanup value of 1,000 ppb)

- benzo(k)fluoranthene (detected 1/11 at 80J ppb; detected concentration below the MTCA method A cleanup value of 1,000 ppb)

- benzo(a)pyrene (detected 1/11 at 130J ppb; detected concentration below the MTCA Method A cleanup level of 1,000 ppb)

- indeno(1,2,3-cd)pyrene (detected 1/11 at 130J ppb; detected concentration below the MTCA Method A cleanup level of 1,000 ppb)

- benzo(g,h,i)perylene (detected 1/11 at 170J ppb; non-carcinogenic PAH of low toxicity)

- methylene chloride (common laboratory contaminant detected at 38B ppb)

- acetone (common laboratory contaminant detected at 109B ppb)

- 1,2-dichloroethane (detected 1/12 at 9 ppb; detected below EPA Region III residential soil RBC of 7 ppm)

- 2-butanone (common laboratory contaminant detected at 24 ppb)

- benzene (detected 1/29 at 93 ppb; reported concentration less than the MTCA method A cleanup level of 500 ppb)

- 1,1,2,2-tetrachloroethane (detected 1/12 at 23 ppb; detected below EPA Region III residential soil RBC of 25 ppm)

- styrene (detected 5/12 at 176 ppb; detected below EPA Region III residential soil RBC of 16000 ppm).

The final list of North and South Site soil COI to be evaluated in the risk assessment is presented in Table 11-6.

11.2.2 Sediment Data

Six sediment samples were collected along the southern bank of the South Fork of the Skykomish River (North Site sediment samples). In addition, two samples were collected in the former channel of the Maloney Creek, a seasonally dry creek bed that runs through the southern portion of the Site. These two samples are considered South Site sediment samples for the risk assessment due to their location near the facility.

Table 11-7 is a summary of the sediment samples collected and the associated parameters analyzed. The analytical methods listed in Table 11-7 are all EPA- or Ecology-approved methods.

Tables 11-8 and 11-9 provide a summary table of the analytical data for sediment samples. Metals, TPH, and VOC were detected in the samples.

The second data evaluation step involves evaluation of sample analytical detection limits. The analytical detection limits for the sediment samples ranged from:

- 0.02 to 1.5 ppm for metals
- 85 to 232 ppb for PCBs
- 365 to 47,210 ppb for SVOC
- 106 to 145 ppm for TPH (418.1)
- 5 to 58 ppb for VOC

The detection limits for SVOC compounds were elevated for several of the sediment samples. The two sediment samples from the former channel of Maloney Creek (SED-6 and SED-7) were reported to contain very low levels of TPH (less than 100 mg/kg). Because SVOC, and PAH compounds in particular, are associated with the petroleum products used at the facility, the absence of elevated TPH supports the non-detected status of the SVOC in the sediments. However, two of the samples from the Skykomish River (SED-4 and SED-5) were collected near oily seeps and contain elevated TPH (6,900 and 990 mg/kg, respectively). Given the elevated TPH, it is not possible to preclude the potential presence of PAH compounds. However, per Ecology request, PAH compounds will be addressed in the ecological risk assessment (Section 11.4).

The third evaluation step includes review of qualified or coded data. The sediment samples were qualified with standard EPA qualifiers of B and J in the reports obtained from the laboratory. Concentrations that were below the detection limit were signified with a U qualifier. The J-qualified data are acceptable for use.

The fourth evaluation step in the data validation process involved comparing the field sample data with field and laboratory blanks. Methylene chloride and acetone, common laboratory contaminants, were found in the laboratory blanks associated with almost all the sediment samples analyzed for VOC.

The fifth step in the data evaluation is further reduction of the list of chemicals of interest if the chemical is a common laboratory contaminant, has a low detection frequency, and/or the chemical is detected at low concentrations. The following chemicals were eliminated as sediment COI:

- methylene chloride (common laboratory contaminant detected at 28BJ ppb)

- acetone (common laboratory contaminant detected at 44B ppb)

- 2-hexanone (common laboratory contaminant detected at 320 ppb)

Further reduction of the COI is allowed if the maximum detected concentrations are lower than background concentrations. No sediment background samples were collected so further reduction can be performed. The final list of sediment COI to be evaluated in the risk assessment is presented in Table 11-10.

11.2.3 Groundwater Data

Four quarters of groundwater samples have been collected at the Site as part of the RI. All of the groundwater samples collected during the RI were included in the risk assessment to provide a comprehensive data set. Because the groundwater in the vicinity of the Site originates from the same aquifer, all groundwater samples are summarized together. Table 11-11 is a summary of the groundwater samples collected and the specific parameters analyzed for each sample. The analytical methods listed in Table 11-11 are EPA- or Ecology-approved methods.

Table 11-12 presents a summary of the groundwater data for the Site. Metals (dissolved and total), SVOC, TPH, and VOC were detected.

The second step in the data evaluation involves the analysis of detection limits for each parameter. The analytical detection limits for all groundwater samples ranged from:

- 0.001 to 0.01 ppm or mg/L for dissolved metals
- 0.0001 to 0.4 ppm for total metals
- 0.05 to 1 ppb for PCBs
- 0.02 to 250 ppb for SVOC
- 0.02 to 0.3 ppm for TPH (418.1)
- 0.5 to 10 ppb for VOC

The groundwater samples from well MW-28 had elevated detection limits (50 to 250 ppb) in the November 1993 sampling round; subsequent samples from that were had lower detection limits such that the data are considered acceptable. The remaining detection limits for groundwater samples are also considered acceptable for the risk assessment.

The third evaluation step includes review of qualified or coded data. The groundwater samples were qualified with standard EPA qualifiers of B and J in the reports obtained from the laboratory. Samples that were below the detection limit were signified with a U qualifier. The J-qualified data are considered acceptable for use.

The fourth evaluation step in the data validation process involved comparing the field sample data with field and laboratory blanks. Comparison of concentrations detected in the blanks with concentrations detected in the samples is common procedure and ensures that only Site-related data are used in the risk assessment. Methylene chloride and acetone were detected in four trip blanks associated with groundwater samples at concentrations of 4 to 24 µg/L and 8 to 20 µg/L, respectively. According to *Risk Assessment Guidance for Superfund* (EPA, 1989b), a chemical should be considered lab contamination if the concentration in the samples is less than 10 times that found in the blank for common lab contaminants such as methylene chloride and acetone.

The fifth step in the data evaluation is further reduction of the list of chemicals of interest if the chemical is a common laboratory contaminant (as previously discussed), has a low detection frequency, and/or the chemical is detected at low concentrations. Drinking water standards are provided where applicable for comparison to detected concentrations; in the absence of a drinking water standard a MTCA cleanup level or a general statement of relative toxicity is provided to support the elimination of a compound. Where MTCA Method A values were not provided, EPA Region III Risk Based Concentrations (RBCs) for residential ingestion of tap water was utilized (EPA, 1995). The following chemicals were eliminated as groundwater COI:

- naphthalene (detected 1/37 at 32 ppb; this non-carcinogenic PAH is relatively non-toxic)
- 2-methylnaphthalene (detected 1/24 at 200 ppb; no toxicity data are available for this compound)
- acenaphthene (detected 2/37 at 28 ppb; this non-carcinogenic PAH is relatively non-toxic)
- dibenzofuran (detected 1/24 at 19 ppb; no toxicity data exist for this compound)
- phenanthrene (detected 2/37 at 110 ppb; this non-carcinogenic PAH is relatively non-toxic)
- pyrene (detected 1/37 at 3.9 ppb; this non-carcinogenic PAH is relatively non-toxic)

- bis(2-ethylhexyl)phthalate (common laboratory contaminant detected at 3J ppb)

- di-n-octyl phthalate (detected 1/23 at 3J ppb; phthalates are common lab contaminants)

- indeno(1,2,3-cd)pyrene (detected 1/37 at 0.2 ppb; this concentration is equal to the drinking water standard established for the most potent carcinogenic PAH - benzo(a)pyrene)

- dibenz(a,h)anthracene (detected 1/37 at 0.08 ppb; this concentration is less than the drinking water standard established for the most potent carcinogenic PAH - benzo(a)pyrene)

- chloromethane (detected 1/13 at 2J ppb; detected below EPA Region III residential water RBC of 1.4 ppb)

- methylene chloride (common laboratory contaminant detected at 12B ppb)

- acetone (common laboratory contaminant detected at 10 ppb)

- chloroform (common laboratory contaminant detected at 6B ppb)

- benzene (detected 2/20 at 1J ppb, this is less than the drinking water standard of 5 ppb)

- ethylbenzene (detected 2/20 at 5 ppb, this is less than the Method A value of 30 µg/l)

Further reduction of the COI is allowed if the maximum detected concentrations are lower than background concentrations. No groundwater background samples were collected so further reduction is not necessary. The final list of groundwater COI to be evaluated in the risk assessment is presented in Table 11-13.

11.2.4 Surface Water Data

Surface water samples were collected from the South Fork of the Skykomish River (SW-4, SW-5, and SW-6), Maloney Creek (SW-1, SW-2, and SW-3), and the former channel of the Maloney Creek (SW-7). Table 11-14 is a summary of the chemicals analyzed in these samples. The analytical methods listed in Table 11-14 are EPA- or Ecology-approved methods.

Table 11-15 presents a summary of the surface water data for the Site. Chemicals were detected in only two surface water samples (SW-5 and SW-6). The only chemicals detected in those two samples were fluoranthene, TPH (as diesel), and bis(2-ethylhexyl)phthalate, a common laboratory contaminant.

The second step in the data evaluation involves the analysis of detection limits for each parameter. The analytical detection limits for all groundwater samples ranged from:

- 0.001 to 0.01 ppm for dissolved metals
- 0.0002 to 0.01 ppm for total metals
- 0.02 to 50 ppb for SVOC
- 0.02 to 1 ppm for TPH (418.1)
- 0.2 ppm for TPH as diesel

The detection limits for surface water samples are considered acceptable for the risk assessment.

The third evaluation step includes review of qualified or coded data. The surface water samples were qualified with standard EPA qualifiers of B and J in the reports obtained from the laboratory. Samples that were below the detection limit were signified with a U qualifier.

The fourth evaluation step in the data validation process involved comparing the field sample data with field and laboratory blanks. Methylene chloride and acetone were detected in four trip blanks associated with surface water samples at concentrations of 4 to 24 μg/L and 8 to 20 μg/L, respectively.

The fifth step in the data evaluation is further reduction of the list of chemicals of interest if the chemical is a common laboratory contaminant (as previously discussed), has a low detection frequency, and/or the chemical is detected at low concentrations. The following chemicals were eliminated as surface water COI:

- bis(2-ethylhexyl)phthalate (common laboratory contaminant detected at 23 ppb)

- fluoranthene (low toxicity, non-carcinogenic PAH detected 1/9 at 0.4 ppb)

Further reduction of the COI is allowed if the maximum detected concentrations are lower than background concentrations. No surface water background samples were collected so further reduction is not necessary. The only surface water COI retained for the risk assessment is TPH.

11.2.5 Summary of Site COI

The COI at the Site are chemicals that are associated with historical use of the Site, have been detected in at least one environmental media, and have undergone the data evaluation and screening process described above. Table 11-16 is a summary of the COI in groundwater, surface water, and North and South Site soil and sediment.

11.3 Exposure Assessment

The purpose of the exposure assessment is to identify all potential receptors that could be exposed to COI in soil, groundwater, surface water, and sediment at the Site. The exposure assessment identifies pathways by which humans are potentially exposed to Site COI and estimates the magnitude, frequency, and duration of actual or potential human exposures. Exposure pathways are routes whereby chemicals of interest could be assimilated by a potential receptor. Exposure pathways require the existence of a receptor, the presence of COI in a medium that the receptor contacts, and an intake route associated with the receptor. Since exposure pathways require the presence of a receptor, these pathways depend upon uses of the Site and the surrounding areas.

In the exposure assessment, reasonable maximum estimates of exposure are developed for both current and future land use scenarios. Estimates of current exposures are used to determine whether adverse health effects could arise based on the present land use of the Site. Estimates of future exposures are used to evaluate the potential for future effects and include a rationale for the likelihood that such exposures would actually occur. MTCA guidance determines the current and future land use scenarios according to the Site's current/future use and the use of the properties adjacent to the Site (i.e., industrial, residential, etc.). In order to be classified as "an industrial site" under MTCA (Ecology, 1993), all of the following criteria must be met:

- the facility must be zoned for industrial use
- the facility must be currently used for industrial purposes and has a history of industrial use
- adjacent properties must be currently used for industrial purposes
- the facility must be expected to be used for industrial purposes for the foreseeable future
- institutional controls must have been implemented in accordance with MTCA (WAC 173-340-440)

Because the adjacent properties to the BNRR maintenance and fueling facility include residential property, small businesses, and city property (i.e., public school), the Site cannot be defined as an industrial site under MTCA. Based on MTCA classifications, the residential site use must be used for the Skykomish project to represent the most reasonable maximum exposure. However, the BNRR property is clearly an industrial facility and is anticipated to remain in use as industrial facility in the future. It is inappropriate to consider residential use of the BN property due to the presence of the active, mainline railroad tracks. Thus, this analysis is inherently conservative because it is based on residential site use.

11.3.1 Scope of the Exposure Assessment

This exposure assessment has the following elements as per current MTCA (Ecology, 1993) and EPA guidance (EPA, 1989b):

- identification of potential migration pathways and receptor-specific exposure pathways
- toxicity assessment
- MTCA intake assumptions
- estimation of exposure point concentrations

A site conceptual model (Figure 11-2) was developed for the Site as a visual tool for the exposure assessment. The site conceptual model is intended to include every possible exposure to human and ecological receptors and is therefore a conservative analysis. The depiction of an exposure on this figure does not indicate that such exposures are currently occurring or that they will likely occur in the future.

The following sections discuss migration and exposure pathways and potential receptors at Skykomish, present toxicity data for the chemicals of interest, describe the intake assumptions presented in MTCA for various exposure pathways. The RI data are then used to present estimated exposure point concentrations. In a full risk assessment, the exposure point concentration would be combined with the toxicity data and intake assumptions to develop quantitative estimates of risk. Ecology has requested that this analysis not be completed for Skykomish, however, so the final risk calculations are not provided. The primary use of this analysis will be as a decision making tool in the overall remedy selection process.

11.3.2 Potential Migration Pathways and Receptor-specific Exposure Pathways

As shown in Figure 11-2, the primary sources of Site impacts resulted from historical operations at the former facility involving sandblasting activities and petroleum spills and leaks from tanks, sumps, rail cars, piping, and releases from transformers. The consequence of these activities resulted in the transfer of petroleum and other chemicals to soil, surface water and sediment (via groundwater). Potential routes whereby these chemicals could migrate from source areas in soil to other environmental media and to subsequent receptors are discussed in the following paragraphs.

Soils

Surface soils impacted by sandblasting operations and by spills or leaks of petroleum products or transformer fluids could serve as a potential source for volatiles and fugitive dusts in the ambient air. Metals and PCBs were the primary COI detected in surface soils (0-2 feet) and some petroleum stains are evident in surface soils, especially along railroad tracks. These compounds have low volatility such that the generation of organic vapors is minimal, if it occurs at all (see Section 8). Subsurface soils (2 to 15 feet bgs) could act as a potential source areas for volatile and fugitive dust emissions into the ambient air if they were exposed (i.e., during construction or excavation activities).

Site workers, area residents, and Site visitors could all potentially be exposed to COI in soils via incidental ingestion and/or inhalation of dust or volatiles. It is not likely that soil exposure would include subsurface soils unless excavation or construction activities were in progress. However, this risk assessment follows MTCA guidance, which conservatively assumes equal exposure to all soils from 0 to 15 feet bgs.

Groundwater and LNAPL

LNAPL and COI in surface and subsurface soils could serve as a potential source of groundwater contamination. COI in soil can impact groundwater via infiltration and percolation. The LNAPL is a source of groundwater contamination via dissolution and dispersion. Transport of LNAPL and other Site-related chemicals through soil to groundwater could result in the migration of these chemicals to off-Site groundwater and to nearby sediments and surface water (South Fork of the Skykomish River and Maloney Creek). Groundwater monitoring wells were installed at the Site to collect data at various depths within the groundwater plume. These monitoring wells confirmed the detection of COI and the flow of groundwater from the former maintenance and fueling facility to the South Fork of the Skykomish River. Migration of LNAPL in groundwater to the river has been observed; this discharge can be a source of surface water and sediment impacts.

Installation of interim action recovery wells to recover LNAPL near the river was completed in early 1996.

Groundwater investigations for the RI included quarterly sampling through August 1994 to characterize the extent of groundwater impacts. In order for there to be a potential risk, an exposure pathway must exist from the groundwater to a receptor (i.e., the receptor must contact the groundwater via dermal contact, ingestion, and/or inhalation of the volatiles while showering/bathing).

As was discussed in Section 2.5, the residents of Skykomish are served by two public supply water wells that are located about 1,100 feet east (upgradient) of the Skykomish city limits. These wells are completed at depths of more than 180 feet bgs and it is unlikely that COI could migrate from Site monitoring wells to the public water wells. However, this exposure assessment will conservatively assume that the impacted groundwater collected from the shallow monitoring wells is the same water used by the residents of Skykomish for drinking, cooking, and showering/bathing.

<u>Surface Water and Sediment</u>

The primary source of COI to surface water and sediments is via the discharge of groundwater and oily seeps. The surface water and sediment potentially impacted would be the South Fork of the Skykomish River and Maloney Creek. Stormwater runoff could also serve as a potential release mechanisms for impacted soils. Storm sewers throughout the City of Skykomish channel stormwater directly to the river and some runoff from the former maintenance and fueling facility flows toward Maloney Creek.

The only potential human receptors to surface water and sediment COI are recreational users of the river (i.e., people swimming, rafting, wading, fishing, etc.). These people could incidentally ingest surface water and sediments during the recreational activities. An additional exposure pathway is the consumption of fish which may have been impacted by surface water or sediment COI. MTCA (Ecology, 1993) evaluates this pathway by incorporating a bioconcentration factor (BCF). The BCF is the ratio of the COI concentration in fish tissue to the COI concentration in the ambient water in which the fish resides.

11.3.3 Toxicity Assessment

The purpose of a toxicity assessment is to weigh available evidence regarding the potential for chemicals of interest to cause adverse health effects in exposed individuals and to provide, where possible, an estimate of the relationship between the extent of exposure to a chemical and the increased likelihood or severity of the adverse effect. A toxicity assessment considers:

- the types of adverse health effects associated with exposures to chemicals of interest
- the relationship between the magnitude of exposure and the adverse effects

The toxicity assessment for the Site was accomplished in two steps: hazard identification and dose-response assessment. The first step, hazard identification, is the process of determining whether exposure to an agent can cause an increase in the incidence of an adverse health effect. Hazard identification also involves characterizing the nature and strength of the evidence of causation. The second step, dose-response evaluation, is the process of quantitatively evaluating toxicity information and characterizing the relationship between the dose of the contaminant administered or received and the incidence of adverse health effects in the exposed population. From this quantitative dose-response relationship, toxicity values are derived to estimate the incidence of adverse effects occurring in humans at different exposure levels. It should be emphasized that the dose-response values discussed in this section are based on methodology that is consistent with MTCA (Ecology 1993 and 1994) and EPA risk assessment guidelines (EPA, 1989b), and is intended to be conservative and therefore, health-protective.

Toxicity Information for Noncarcinogenic Effects

The degree of toxicity of noncarcinogenic chemicals is based on the ability of organisms to repair and detoxify after exposure to a chemical. Exposure to low levels of chemicals may cause no damage as these chemicals may be readily eliminated. Higher doses of a chemical may result in cell damage that is readily repaired. This implies that a threshold exists where exposures from just above zero to some finite value can be tolerated by the organism without an appreciable risk of adverse effects. When the mechanisms of repair and detoxification are exceeded by some critical concentration, an adverse health effect(s) is manifested.

Toxic affects for noncarcinogenic chemicals are based on the reference dose (RfD) and hazard quotient (HQ). The RfD is an estimated daily dose of a chemical where no appreciable risk of chronic effects is expected to occur. The hazard quotient (HQ) is the ratio of the actual or predicted dose or intake, as calculated in the exposure assessment, and the RfD and is represented by the equation:

$$HQ \text{ ' } \frac{I}{RfD}$$

where: I = amount of medium ingested or inhaled per day or intake (mg/kg/day)

RfD = Reference Dose (mg/kg/day)

The hazard index (HI) is the sum of the hazard quotients:

$$HI = HQ_1 = HQ_2 = HQ_3 ... HQ_n$$

The HI approach assumes that simultaneous subthreshold exposures to several chemicals could result in an adverse health effect. It also assumes that the magnitude of the adverse effect will be proportional to the sum of the ratios of the subthreshold exposures to acceptable exposures.

RfDs are expressed primarily according to the length of exposure being evaluated and the intake pathway. A chronic RfD is an estimate of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of damaging effects during a lifetime. Chronic RfDs are specifically developed to be protective of long-term exposure to a chemical (generally associated with exposure periods between seven years and a lifetime). A subchronic RfD accounts for noncarcinogenic effects associated with shorter term exposures.

Uncertainty factors are used in calculating an RfD. These factors reflect scientific judgement regarding the various types of data used to estimate RfD values. An uncertainty factor of 10 is generally used to account for variations in human sensitivity. An additional 10-fold factor is generally used for each of the following extrapolations: from long-term animal studies to humans, from a LOAEL (the lowest observed adverse effect level) to a NOAEL (the no observed adverse effect level), and from subchronic studies to a chronic RfD. In order to reflect professional assessment of the uncertainties of the study and database not explicitly addressed by the above uncertainty factors, an additional uncertainty factor or modifying factor ranging from greater than 0 to less than or equal to 10 is applied. The default value for this modifying factor is one (HEAST, 1994).

Toxicity Information for Carcinogenic Effects

Cancer is the end result of a multistage process in which a large number of biological and environmental factors interact, simultaneously or in sequence, to disrupt normal cell growth and division (Rich, 1990). For chemicals which potentially cause or increase cancer incidence, the results of high-dose animal studies are extrapolated to low-dose human exposure scenarios using mathematical models. The EPA has chosen a linear, multistage risk assessment model, which assumes that if any dose of a toxic substance increases one's risk for cancer, then every dose can increase the cancer risk in equal proportion. This model assumes safe exposure levels do not exist for carcinogens. This is contrary to the traditional approach to toxic chemicals, in which finite thresholds are said to exist, below which the toxic effect will not occur because humans possess protective biological mechanisms. This traditional approach is still applied to noncarcinogenic chemicals and because of the differing approaches, the risks associated with carcinogenic effects are generally much higher than those associated with the noncarcinogenic effects.

Based on available data, the EPA uses a weight-of-evidence approach to classify the likelihood of a chemical to cause cancer. The EPA carcinogen classification system uses the following sources as criteria in their determination of potential carcinogens: data from studies on the association between human cancer incidence and exposure; long-term animal studies conducted under controlled laboratory settings; short-term tests for genotoxicity, metabolic, and pharmacokinetic properties; toxicological effects other than cancer; structure-activity relationships; and physical/chemical properties of the chemical (EPA, 1986b). The weight-of-evidence classification and cancer slope factor are the toxicity data most commonly used to evaluate potential human carcinogenic risks. The carcinogenic potential of a chemical is classified into one of the following classes, according to the weight-of-evidence from epidemiological and animal studies:

- Class A — Human carcinogen
- Class B — Probable human carcinogen (B1 - limited evidence of carcinogenicity in humans; B2 - sufficient evidence of carcinogenicity in experimental animals with inadequate or lack of evidence in humans)
- Class C — Possible human carcinogen (limited evidence of carcinogeni- city in experimental animals or lack of human data)
- Class D — Not classifiable as to human carcinogenicity (inadequate or no evidence)
- Class E — Evidence of noncarcinogenicity for humans (no evidence of carcinogenicity in adequate studies)

At low doses, the probability of contracting cancer in a lifetime is assumed to be proportional to the cumulative lifetime dose. The coefficient relating dose to risk is called the cancer slope factor (CSF) or the cancer potency factor (CPF). Thus, if the dose or intake is represented by I and the cancer potency factor by CPF, then the risk (R), is given by the equation:

$$\text{Risk} = CPF \cdot I$$

The intake has units of mg/kg-day and represents the average daily intake over the lifetime of the exposed individual. The cancer potency factor is actually the upper bound value based on fitting a mathematical model to experimental dose-response data. The cancer potency factor is used to estimate an upper-bound lifetime probability of an individual developing cancer as a result of exposure to a particular chemical. Cancer potency factors, which have units of $(mg/kg\text{-}day)^{-1}$.

Summary of Toxicity Data for Chemicals of Interest

Table 11-17 is a summary of the noncarcinogenic reference doses (RfDs), the carcinogenic cancer potency factors (CPFs), and the bioconcentration factors (BCFs) for the COI at the Site. These toxicity values were obtained from MTCA guidance (Ecology, 1994). Most of these toxicity values were derived from IRIS, HEAST, ECAO (EPA's Environmental Criterion and Assessment Office), EOTS (EPA's Office of Toxic Substances), or EPA Region X.

There are several COI for which noncarcinogenic and carcinogenic toxicity data are currently not available. These chemicals were denoted with "ND" in Table 11-17 and include the following chemicals:

- lead
- 2-methylnaphthalene
- phenanthrene
- TPH

11.3.4 MTCA Intake Assumptions

This section describes the assumptions used for calculating the intake by potential receptors at the Site. These intake assumptions consider the number of times a receptor is expected to contact a particular medium, the duration of the contact, and the mechanisms that enable the chemical to be potentially assimilated by the receptor. The intake assumptions presented in this section are intended to approximate reasonable maximum exposures (RMEs) and are based on the MTCA guidance (Ecology, 1993 and 1994). The intake assumptions vary according to the classification of the Site (industrial or residential) and the MTCA method used to calculate the cleanup level (Method A, B, or C). MTCA provides three methods for establishing site-specific cleanup levels:

- Method A defines cleanup levels for 25 common site chemicals and is designed for routine cleanups.

- Method B determines cleanup levels at sites (unless Method A or Method C is more appropriate) using a site-specific risk assessment with risk levels established at 10^{-6} for individual carcinogens and 10^{-5} for total site risk.

- Method C determines cleanup levels for specific site uses (i.e. industrial) using site-specific risk assessment when Method A and B levels are technically impossible to achieve (using 10^{-5} risk levels for both individual carcinogens and total site risk).

Method A does not apply to the Site because groundwater cleanup is not considered to be a "routine cleanup" as defined by MTCA (WAC 173-340-130). Method B and Method C apply to this Site. These methods are similar with the exception of risk level and various media-specific intake assumptions. Method B carcinogenic risk levels are one in a million or 10^{-6}, whereas Method C carcinogenic risk levels are one in 100,000 or 10^{-5}. The intake equations and assumptions are presented for each method by media:

- Soil Method B - Table 11-18
- Soil Method C - Table 11-19
- Groundwater Method B - Table 11-20
- Groundwater Method C - Table 11-21
- Surface Water Method B - Table 11-22
- Surface Water Method C - Table 11-23
- Air Method B - Table 11-24
- Air Method C - Table 11-25

MTCA guidance does not provide risk-based cleanup levels for sediment, however, the ecological risk assessment (Section 11.4) does evaluate sediment COI.

11.3.5 Exposure Point Concentrations

Exposure point concentrations are used in risk assessment to define the concentrations of COI in various media that receptors can be exposed to. Procedures for developing exposure point concentrations have been developed in detail by EPA. These procedures include use of direct measurement at a point of contact and/or modeling of chemical release and transport to the point of contact (exposure point). This risk assessment will use direct measurements at the point of assumed contact for exposure to soil, groundwater, surface water, and sediment. A simple model was also used to estimate the concentration of COI in air due to particulate emission and volatilization of soil COI (see Section 8 and Appendix J). It is conservatively assumed that the exposure point concentrations are constant in all media for the duration of exposure. This means that the natural physical, chemical, or biological processes which reduce chemical concentrations over time and space are not considered. Consequently, using only the measured concentration of the chemical in a particular medium to calculate potential risks is highly conservative.

Exposure point concentrations were estimated for COI in soil, groundwater, surface water, and sediment by using the lower of either the 95% upper confidence level on the arithmetic mean or the maximum detected concentration (EPA, 1989b). The statistical analysis takes into consideration hot spot concentration while recognizing that long-term, exposures (e.g. those defined by MTCA under the residential land use scenario) would not be limited exclusively to those hot spots. Tables 11-26 through 11-31 summarize the soil (North and South Site), sediment (North and South Site), groundwater, and surface water exposure point concentrations (the "normal source concentration" in the tables). Table 11-32 is a summary of the calculated air concentrations using the models discussed in Section 8 and Appendix J.

11.4 Ecological Evaluation

Ecological risk assessment is defined as "a process that evaluates the likelihood that adverse ecological effects are occurring or may occur as a result of exposure to one or more stressors." A stressor, as defined by EPA, is "any physical, chemical, or biological entity that can induce an adverse ecological response." An ecological risk assessment attempts to establish the causal link between site COI and specific adverse ecological effects (EPA, 1992).

This assessment will focus on potential adverse effects of Site COI in sediment and surface water to aquatic and benthic organisms associated with the South Fork of the Skykomish River and the Maloney Creek. Literature data were reviewed and a site walk-through was conducted with Ecology representatives to help define the appropriate scope of this assessment. No other field work was conducted solely for the purpose of the ecological assessment. Note that recovery wells were installed in late 1995 to reduce the migration of petroleum product in groundwater to the South Fork of the Skykomish River. The impact of this interim action recovery system has not been considered in this evaluation.

The ecological risk assessment approach used in this section follows EPA's *Framework for Ecological Risk Assessment* (EPA, 1992) and includes the following subsections:

- Actual and Potential Receptors (11.4.1)
- Actual and Potential Exposure Pathways (11.4.2)
- Risk Characterization (11.4.3)

This ecological risk assessment is primarily a qualitative screen of the potential risks to ecological receptors from chemicals of interest (COI) detected in the sediment and surface water samples at the Site. Metals and TPH were the only COI detected in surface water and sediments. Although not detected, PAH were conservatively added to the ecological evaluation as sediment COI due to high detection limits in several samples. Site soil data were examined to help assess the potential for PAH to be present in river sediments. PAH were detected in soil samples from four locations. One compound (phenanthrene) was identified in boring B-4, three were identified in B-6 and DW-2 and nine were identified in MW-39. Based on these data, an artificial sediment PAH was derived for the purpose of ecological analysis using the PAH concentrations detected in soil from location MW-39. This location was selected for this purpose because it had the greatest number of individual PAH compounds detected. Further, this sample had the highest total PAH of the three samples with multiple compounds detected. Table 11-33 is a summary of these PAH concentrations in addition to the surface water and sediment COI exposure point concentration (i.e., the 95% upper confidence limit on the arithmetic mean or the maximum detected concentration, whichever is lower).

11.4.1 Actual and Potential Receptors

An important step in the ecological risk assessment process is the identification of key species and habitats. These may include economically important species, species that have special regulatory status (such as threatened or endangered species), or ecologically critical species and their associated habitats.

An extensive search was conducted to identify the key species present in the vicinity of the Site. Three databases developed by the Washington Department of Wildlife were accessed to obtain this information. The following three databases provide comprehensive information on the locations of important fish and wildlife:

- Nongame Heritage Database contains significant site observations of nongame species of concern, including federal and state listed species.

- Priority Habitats and Species is an inventory of key species use areas and key wildlife habitats, including the locations of federal and state listed species (threatened, endangered, sensitive, candidate) and other priority nongame and game species.

- Washington Rivers Information System is a statewide inventory of all anadromous and resident fish distribution, including priority, federal, and state listed species.

Data was compiled from these three databases for an area encompassing nine square miles around the Site in an attempt to focus the information search. The following paragraphs discuss the results of the database search. Although the search was narrowed to nine square miles surrounding the Site (i.e., search area), it is not likely that the key species identified would be located at the Site in the City of Skykomish when the Mt. Baker - Snoqualmie National Forest surrounds the town. This is in fact the case, as none of the sensitive species or habitats identified by the Washington Department of Wildlife databases (and summarized below) were located within the Site boundary.

The Nongame Heritage Database identified the following key species within a nine square mile area of the Site:

- Spotted Owl - state and federally endangered species
- Bald Eagle - state and federally threatened species
- Northern Goshawk - state and federal candidate species
- Marbled Murrelet - state and federally threatened

The Priority Habitats and Species database search resulted in the identification of two species and their associated habitats located within the nine square mile search area. The Harlequin Duck, a federal candidate species, is one of these species whose breeding ground is located within the search area. The specific breeding areas were Skykomish River, Money Creek, and Beckler River. Skykomish River North was identified as a priority habitat because it is the wintering range of the Mountain Goat.

The Washington Rivers Information System database classified the South Fork of the Skykomish River and the Maloney Creek as:

- critical spawning habitats for resident species
- anadromous fish runs
- listed resident fish runs

Because these classifications pertain to surface water bodies adjacent to the Site (i.e., South Fork of the Skykomish River and Maloney Creek), fish inhabiting these water could potentially be exposed to surface water and sediment COI. Benthic invertebrates and aquatic organisms (other than fish) inhabiting these waters could also be included as potential receptors in the ecological risk assessment.

11.4.2 Actual and Potential Exposure Pathways

It is important to identify complete exposure pathways prior to evaluation of toxicity to focus the assessment only on those COI that can reach ecological receptors. A complete exposure pathway is one in which the chemical can be traced from the source to the receptor being evaluated. If receptors cannot be exposed to a COI, the exposure pathway does not need to be evaluated. In this section, potential exposure pathways for ecological receptors are identified for surface water and sediment.

Previous Site investigations have identified the presence of petroleum product seeping into the South Fork of the Skykomish River. Because there is a measurable LNAPL thickness on the groundwater at the facility, it is likely that LNAPL and impacted groundwater from historical facility operations migrated downgradient to the river.

Groundwater that carries LNAPL and COI may be discharged to surface water and, depending on the pattern of groundwater flow, this may occur near or far from the source of the COI. Most of the groundwater from the facility flows toward the South Fork of the Skykomish River, so this pathway could lead to exposure of aquatic or benthic organisms in the river. These environmental receptors may contact it directly or via the sediment. Surface water and sediment samples were collected from the South Fork of the Skykomish River, Maloney Creek, and the former channel of the Maloney Creek (Section 7.0). Metals and TPH were the only COI detected in these samples. PAH were not detected in sediments but were included in the ecological risk assessment. Petroleum sheens have been observed near the location of oily seeps that have been identified under low river flow conditions (Figure 6-12).

11.4.3 Risk Characterization

The purpose of the risk characterization step is to determine if potential risks are or could be occurring to ecological receptors exposed to Site COI in sediment and surface water. Concentrations of the sediment and surface water COI are compared to benchmark concentrations which are concentrations of chemicals that result in no adverse effects to ecological receptors. The ecological risk is determined by the simple ratio (the exposure effects ratio or EER) of the COI exposure point concentration to the benchmark concentration.

$$EER = \frac{CONC}{BENCH}$$

The EER does not consider variability in either exposure (CONC) or effects (BENCH) and thus does not represent a statistical probability of occurrence of adverse ecological effects. It is strictly a screening tool used to decide if there is no significant risk or that further evaluation may be required.

Menzie, et al. (1993) suggested EER be interpreted in the following manner:

- EER < 1 indicates no significant risk
- 1 < EER <10 indicates small potential for ecological effects
- EER >10 indicates some potential for ecological effects
- EER >100 indicates ecological effects very probable

Environmental Benchmarks

Environmental benchmarks are typically determined by using ARARs (applicable or relevant appropriate requirements). These include EPA's National Ambient Water Quality Criteria (NAWQC) for the protection of organisms in freshwater or marine water bodies or Sediment Quality Criteria (SQC) for the protection of organisms in sediment associated with those water bodies. Ecology has published a *Summary of Criteria and Guidelines for Contaminated Freshwater Sediments* (Ecology, 1991); however, none of the sediment or surface water COI from the Site were included in the summary. Other published benchmarks (NAWQC and SQC) were available for most sediment COI. The focus of the remainder of the ecological risk assessment will therefore be receptors exposed to COI (metals and PAH) in sediment.

Sediment benchmark concentrations for metals were determined based on the review of sediment toxicity tests by Long and Morgan for the National Oceanic and Atmospheric Administration (Long and Morgan, 1990). The reports, *The Potential for Biological Effects of Sediment-sorbed Contaminants Tested in the National Status and Trends Program* (Long and Morgan, 1990) and *Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments* (Long et al., 1994), are a review of chemical and biological data from over 200 sites nationwide assessing the relative likelihood or potential for adverse effects to occur due to exposure of biota to chemicals in sediment. These reports have been used by the EPA and several state and regional agencies to derive sediment quality criteria.

For each chemical, data from the appropriate studies (Long et al., 1994) were arranged in ascending order of concentration and distributions of the effects data were determined using percentiles. Two values were derived for each chemical:

- Effects Range-Low (ER-L): the lower 10th percentile of the effects data
- Effects Range-Median (ER-M): the 50th percentile of the effects data

These two values represent three concentration ranges for each chemical. The concentrations below the ER-L value represent a minimal-effects range or a range intended to estimate conditions in which effects would be rarely observed. Concentrations equal to and above the ER-L, but below the ER-M in sediment, represent a possible-effects range within which effects would occasionally occur. And concentrations equal to or above the ER-M value represent a probable-effects range or a range in which effects would frequently occur. The ER-L and ER-M values for the COI are compared to the exposure point concentrations of sediment COI in Table 11-34. ER-M values are more appropriate benchmark concentrations since the objective of the benchmark concentration is to estimate a chemical concentration at or above which possible effects occur as opposed to effects which would rarely be observed. Apparent effect threshold (AET) criteria was included for sediments. An AET concentration is the sediment concentration of a selected concentration of a selected chemical above which statistically significant biological effects always occur. Ecology used the sediment quality triad approach to develop AETs to derive sediment quality criteria. These AET sediment values are summarized in Table 11-34.

Also included (at the request of Ecology) were lowest effect levels for sediment COI. The lowest effect level is the level at which actual ecotoxic effects become apparent. These criteria were developed by the Ontario Ministry of the Environment (1990) and are included in Table 11-34.

Exposure Effects Ratio

The ecological risk in this screening level assessment is determined by a simple ratio of the exposure point concentration (estimated exposure) to the benchmark for toxicity for each sediment COI. This ratio is termed the exposure effects ratio (EER). If the ratio of predicted exposure to benchmark toxicity (the EER) is less than one (exposure is less than the toxicity benchmark), then no significant ecological risk is inferred. If the exposure equals or exceeds the toxicity benchmark, then the screening level assessment cannot exclude the possibility that there is a potential ecological risk from that COI.

As noted previously, aquatic and benthic communities are the focus of this assessment because these were identified as the receptors potentially exposed to impacted sediment in the South Fork of the Skykomish River and Maloney Creek. Food chain impacts, i.e., considering impacts on predators of aquatic and benthic organisms, were not considered in this assessment. However, the benchmarks chosen reflected multiple species and community responses, and are therefore protective of these species.

Tables 11-35 and 11-36 summarize the North Site sediment exposure effects ratios (exposure point concentrations from the South Fork of the Skykomish River and Maloney Creek sediment COI compared to their benchmark concentrations) for total metals and TPH (Table 11-35) and hypothetical PAH (Table 11-36). No sediment quality criteria is available for TPH, so an EER could not be developed for that COI. For total metals in the North Site sediments (Table 11-35) all of the EERs for ER-M and AET values were less than 1, indicating no significant ecological risk exists from the concentrations of metals in sediments. Arsenic, chromium, copper, lead, and nickel EERs exceeded 1 (but were less that 10) for the ER-L and lowest effect level criteria, indicating that there is a small potential for ecological effects. There were no EERs greater than 1 for the hypothetical PAH in the North Site sediments (Table 11-36), signifying no potential for ecological risk.

Table 11-37 is a summary of the EERs for total metals and TPH in South Site sediments. No COI EERs exceeded 1 for the ER-L and AET criteria. EERs for only three metals (arsenic, chromium, and nickel) exceeded 1 for ER-L and lowest effect level criteria. However, all of these exceedances were less than 10, indicating that a small potential for ecological effects exists from these COI.

12.0 REMEDIAL GOALS AND OBJECTIVES

MTCA provides the framework for evaluating and selecting cleanup actions. This framework includes threshold requirements that must be met by all cleanup actions. The threshold requirements for remedial actions are defined at WAC 173-340-360(2) as follows:

> "All cleanup actions...shall protect human health and the environment; shall comply with cleanup standards; shall comply with applicable state and federal law; and shall provide for compliance monitoring."

Other requirements for cleanup actions, as identified in WAC 173-340-360(3), are to use permanent solutions to the maximum extent during the public comment practicable, to provide for a reasonable restoration time frame and to consider public concerns raised on the draft cleanup action plan.

Where a cleanup action results in leaving contaminants in place at levels that exceed cleanup standards, institutional controls and monitoring are required under MTCA, WAC 173-340-410, -440. Institutional controls are measures taken to limit or prohibit activities that may interfere with a cleanup action, and they include such measures as deed restrictions. If necessary, BNRR will develop appropriate deed restrictions for property that it owns. Deed restrictions on property not owned by BNRR would be subject to the property owner's discretion.

The purpose of this section of the RI report is to develop cleanup standards for the Site that are protective of human health and the environment and to define the state and federal laws that are applicable to the Site or to potential cleanup actions that may be taken at the Site. Under MTCA, determination of cleanup standards requires that both cleanup levels and points of compliance be defined. Each of these is discussed below, followed by presentation of the cleanup standards and applicable state and federal laws. The feasibility study (FS) report will identify and evaluate alternative means of achieving Site cleanup. The FS will address the permanency of various alternatives, discuss restoration time frames and present any public concerns identified during the overall RI/FS process.

12.1 Cleanup Levels

Cleanup levels under MTCA are defined as the concentrations of hazardous substances that are protective of human health and the environment under specified exposure conditions. The relevant hazardous substances were identified in Section 11 of this RI report for soil, sediment, groundwater and surface water. Section 11 also discussed the specific exposure conditions associated with two of the cleanup options available for the Site (MTCA Methods B and C). The third cleanup option, Method A, consists of tabulated values and is appropriate for routine cleanup actions or for sites with only a few hazardous substances (WAC 173-340-700(3)(a)). Method A does not apply to the Site because groundwater cleanup (underway as interim action) is not considered to be a routine cleanup action (WAC 173-340-130(7)(c)).

The Method B and Method C approaches to developing cleanup levels are similar but they use different "acceptable" risk levels and slightly different exposure assumptions. Under MTCA, Method B is the standard method and is applicable to all sites. The applicability of Method C is limited to sites where one or more of the following conditions exist (WAC 173-340-706):

1. Method A or Method B cleanup levels are below the area background concentrations

2. attainment of Method A or Method B cleanup levels has the potential to pose a greater risk than attainment of Method C cleanup levels

3. attainment of Method A or Method B cleanup levels is not technically possible

4. the Site is defined as an industrial site under MTCA

The first two conditions are not applicable to the Site. The latter two conditions could be to determined to be applicable during development of cleanup levels and/or preparation of the FS. For this reason, both Method B and Method C cleanup levels will be developed for the hazardous substances at the Site.

MTCA also requires that the Method B and Method C cleanup levels for each media be at least as stringent as the concentrations established under applicable state and federal law. The applicable standards for each media will be identified in the following sections.

12.1.1 Groundwater

Several aspects of groundwater use must be considered to ensure that the selected cleanup levels are protective of human health and the environment. Cleanup levels that protect people who use groundwater as their routine drinking water supply can be calculated using MTCA Method B or Method C and can be evaluated by considering the drinking water standards established by EPA and the state Health Department. For sites where groundwater discharges to surface water, MTCA also includes procedures for calculating cleanup levels that are protective of humans who may eat fish caught from the surface water. These procedures are the MTCA Method B and Method C surface water cleanup levels. EPA has also established ambient water quality criteria to protect humans who eat fish or shell fish. Finally, both EPA and Ecology have established standards and criteria that are designed to protect aquatic life. Selection of groundwater cleanup levels for this Site will consider both groundwater as a potable supply source and groundwater as a source of recharge to surface water.

Table 12-1 summarizes Site groundwater quality data (exposure point concentration from Chapter 11) and provides drinking water standards, the Method B and Method C cleanup levels for groundwater based on potable use, EPA ambient water quality criteria to protect aquatic life and to protect people who eat fish and shellfish, the state surface water standards to protect aquatic life and the Method B and Method C surface water cleanup levels based on protection of human health. The final column of Table 12-1 is the lowest of the various standards and criteria for each compound - the lowest level is the selected cleanup level in accordance with MTCA requirements.

Site groundwater quality data was then compared to these cleanup levels to define those compounds in groundwater that exceed cleanup levels. Note that the Site groundwater quality data for a few metals (arsenic, chromium and lead) includes both total and dissolved concentrations. The remaining metals were measured as totals only. The total concentrations are obtained from laboratory analysis of unfiltered groundwater samples that contain solids. The dissolved concentrations are obtained from laboratory analysis of samples that were filtered to remove solids before analysis. The Site data shows that metal concentrations in groundwater are reduced significantly (by greater than 95% on average) when the solids are removed. Therefore, analytical results for total (unfiltered) samples reflect metals that are associated with the solids in addition to the metals that are actually dissolved in groundwater.

When dissolved metal concentrations are considered, only one metal, arsenic, exceeds MTCA cleanup levels. Dissolved arsenic is above the Method B and C cleanup levels for both groundwater and surface water. However, dissolved arsenic does not exceed the drinking water standard. When total metal concentrations are considered, the Site groundwater concentrations of seven metals exceed cleanup levels. These are metals are arsenic, chromium, copper, lead, mercury, nickel and zinc. Five of these metals (chromium, copper, lead, mercury and zinc) exceed the ambient water quality criteria or the surface water standards. However, none of these metals were even detected in actual surface water samples collected from the Site. Therefore, although the Site groundwater contains some metals above protective levels for surface water and hence has the *potential* to adversely impact surface water quality, no such impact has been measured. Because the Site conditions have been stable for some period of time (i.e., railyard facility operations ceased about 20 years ago), it is unlikely that groundwater impacts to surface water quality will increase in the future.

Two semivolatile organic compounds were detected in groundwater above MTCA Method B and C cleanup levels for groundwater and surface water. These compounds, benzo(a)anthracene and chrysene, are both carcinogenic PAHs and were detected infrequently. The detected concentrations of benzo(a)anthracene and chrysene also exceed the proposed MCL for these compounds. TPH concentrations in groundwater at the Site exceed the only available standard or criteria - the MTCA Method A value of 1 mg/l. This value is not a risk-based value but was developed to protect the aesthetics of a water supply (i.e., to prevent objectionable taste or odor; WAC 173-340-720 (2)(a)(I) v). One volatile organic compound, 1,1-dichloroethene, was detected in a groundwater sample at a concentration above the MTCA Method B and C groundwater cleanup levels. The detected concentration is below the drinking water standard established for this compound.

12.1.2 Soil

Soil cleanup levels serve a dual function under MTCA. First, the soil cleanup levels define the concentrations that are protective of humans who may be in direct contact with those soils. Second, because compounds can leach from soil and impact groundwater, MTCA also includes procedures for defining soil cleanup levels that are protective of groundwater quality.

Table 12-2 presents Site soil quality data (exposure point concentrations from Chapter 11), natural background concentrations, residential cleanup levels for soil using MTCA Methods A, B and C and soil cleanup levels based on groundwater protection. As defined in MTCA, Method A values "provide conservative cleanup levels for sites undergoing routine cleanup actions or those sites with relatively few hazardous substances." Method A cleanup values are not considered by BN to be applicable to Skykomish but are included in Table 12-2 at the request of Ecology. Method B and C cleanup levels are calculated using conservative assumptions selected by Ecology to be protective of human health under a residential land use scenario. Table 12-2 includes soil cleanup levels calculated in accordance with MTCA by multiplying the groundwater cleanup levels specified in Table 12-1 by a factor of 100. The intent of this step is to ensure that the selected soil cleanup levels are protective of groundwater because constituents can leach from soil into groundwater. The last column of Table 12-2 presents the selected soil cleanup levels for the Site.

MTCA acknowledges that it is not feasible to achieve cleanup levels that are below the natural background concentration. MTCA therefore specifies that when Method A or B cleanup levels are below background, then either the background concentration or the Method C concentration is the appropriate cleanup level (WAC 173-340-706 (1)(a)). All of the soil cleanup levels for metals that were determined by multiplying the groundwater cleanup level by 100 were found to be below the natural background concentration. Since it is not possible to clean up soil to values less than background concentrations, this approach for development of soil cleanup levels is not applicable to metals at the Site. Therefore, Method B cleanup values for metals in soil will be used. However, the Method B cleanup levels for arsenic, beryllium and cadmium are also below the natural background concentration. In accordance with MTCA procedures, the cleanup levels for these metals have been set equal to the Method C cleanup value.

No Method B or C cleanup levels can be calculated for lead because of the lack of toxicity data for this metal. Ecology has established Method A cleanup levels for lead at 250 mg/kg for residential land use and 1,000 mg/kg for industrial land use. EPA (1994b) has established a soil action level of 400 mg/kg lead for residential property. As shown in Table 12-2, the Site soils exceed the Ecology Method A cleanup level for lead in residential soil. Neither the Method A cleanup level for lead in industrial soil nor the EPA action level for lead are included in Table 12-2 but they are referenced herein as potential action levels.

Soil cleanup levels for organic compounds are either equal to the Method B (PCBs) or Method A (TPH and volatile organics) values. Note that the Method A values for TPH in soil are based on 100 times the Method A groundwater cleanup level (if the TPH is in the form of gasoline) or 200 times the groundwater cleanup levels (for diesel and other fuel oils). In doing this, Ecology recognized that diesel fuel was less mobile and less water soluble than gasoline. No cleanup levels can be developed for the two semivolatile organics that were selected as constituents of interest in soil; there is insufficient data with which to calculate Method B or Method C values, Method A values have not been designated by Ecology and groundwater cleanup levels were not applicable to these two compounds.

Comparison of Site soil quality data to cleanup levels indicates that lead, PCBs and TPH are the constituents present in soil above cleanup levels.

12.1.3 Sediment

MTCA does not yet include provisions for determining sediment cleanup levels under methods A, B or C. Cleanup levels are therefore not tabulated as they were for groundwater and soil. The ecological assessment presented in Section 11.4 indicated that the compounds detected in the RI sediment samples are present in concentrations that are protective of aquatic life. No PAH were detected in the RI sediment samples. However, a hypothetical sediment PAH was evaluated based on measured soil PAH concentrations. This conservative analysis did not indicate that sediments would assumed to be present at one-half the maximum reported detection limit, then a potential adverse impact could be realized. Ecology develops sediment cleanup levels on a case-by-case basis; BN does not consider sediment cleanup levels to be necessary for Skykomish because of the low risks associated with the detected metals and the lack of detectable PAH. Measures to prevent or reduce the seasonal seepage of LNAPL to the river will be evaluated in detail in the feasibility study .

12.1.4 Surface Water

One of the surface water samples collected during the RI contain a detectable compound - TPH. There is no basis from which to calculate surface water cleanup levels for TPH and no numeric surface water standards or criteria have been established by EPA or Ecology specifically for TPH. For these reasons, surface water cleanup levels are not tabulated for Skykomish. As was mentioned above, the feasibility study will evaluate measures to prevent or reduce the seasonal seepage of LNAPL to the river.

12.1.5 Air

Table 12-3 presents the calculated air cleanup levels using Method B and Method C. There are no applicable state or federal standards for the concentrations of these compounds in ambient air. The calculated air concentrations based on potential air emissions from soil (see Section 8 and Appendix J) are included in Table 12-3 for comparison. All estimated site concentrations are below cleanup levels.

12.1.6 Summary and Delineation of Areas above Cleanup Levels

MTCA requirements and Ecology guidance was followed to develop cleanup levels for groundwater, soil and air at the Site. Surface water and sediment cleanup levels could not be established within this framework given the available data. Samples of soil and groundwater collected from the Site exceed some of these cleanup levels. Figure 12-1 depicts the areas where cleanup levels are exceeded and delineates the boundaries of the Skykomish “Site”.

12.2 Points of Compliance

Points of compliance for the Skykomish Site are described below for soil and groundwater. Points of compliance are the locations where cleanup levels will be applied. No points of compliance are presented for sediment, surface water or air because: 1) no sediment cleanup levels are available using MTCA methods, 2) there is no basis for establishing surface water cleanup levels for TPH, the only compound that was detected in the surface water samples, and 3) the estimated air concentrations are below the applicable cleanup standards.

12.2.1 Soils

WAC 173-340-740(6) provides the factors to be considered in establishing a point of compliance for soil. The point of compliance for soil can vary depending on the basis for the soil cleanup levels. For soil cleanup levels based on protection of human health via direct contact, the point of compliance is defined as the upper 15 feet of soil throughout the Site. Ecology believes that this represents a reasonable estimate of the maximum depth at which soils could be excavated and placed at the surface. Given the relatively shallow depth to groundwater at Skykomish, this represents a very conservative point of compliance for the Skykomish Site.

When soil cleanup levels are based on protecting groundwater quality, MTCA defines the point of compliance as all of the soil at the Site. Because all of the soil cleanup levels based on protection of groundwater were below background concentrations, these values were not used in selected soil cleanup levels for Skykomish. The selected Skykomish soil cleanup levels are either based on Method B or C values for protection of human health or are published Method A cleanup levels (lead and TPH). Because groundwater is encountered within the upper 15 ft at the site, use of a 15 ft compliance depth is protective of groundwater and is in accordance with MTCA. Extending the point of compliance beyond 15 ft (i.e., to depths well below the depth of groundwater) would not provide additional protection.

12.2.2 Groundwater

MTCA defines the point of compliance for groundwater at cleanup site as "throughout the site from the uppermost saturated zone extending vertically to the lowest most depth which could potentially be affected" (WAC 173-340-720(6)(b)). MTCA also states that where hazardous substances will remain at a cleanup site, a "conditional point of compliance" may be established. A conditional point of compliance is to be located as close as practicable to the source of the hazardous substance and should not exceed the property boundary.

The LNAPL at Skykomish is defined as a hazardous substance under MTCA. The LNAPL is a recognized source of the groundwater contamination at the Site. Removal of all of the subsurface LNAPL is considered to be technically impossible due to: 1) the presence of permanent structures over most of the area of LNAPL occurrence and 2) the relatively viscous nature of the LNAPL. Therefore, some residual LNAPL will be remain at the Site indicating that a conditional point of compliance is appropriate.

The proposed conditional point of compliance for groundwater at the Skykomish Site is the defined as the area that extends from the LNAPL plume to the outer boundary of the dissolved plume. This point of compliance is as close as practicable to the source in accordance with WAC 173-340-720(6)(c). Existing monitoring wells that lie within this defined point of compliance include downgradient or cross-gradient wells MW-16, MW-19, MW-37 to the west of the LNAPL and MW-35 and DW-5 to the east of the LNAPL.

Because groundwater discharges to the Skykomish River and oily seeps have been noted at some locations along the river bank, an additional groundwater point of compliance can be established within the river. As per WAC 173-340-720(6)(d), such a point of compliance should be established as close as technically possible to the point where groundwater flows into the surface water. The surface water sampling locations used in the RI meet that definition and will be retained as additional points of compliance.

12.3 Cleanup Standards

The cleanup standards for the Skykomish Site are now developed by assigning cleanup levels to points of compliance. These standards are provided in Table 12-4 for soil and groundwater.

12.4 Other Regulatory Requirements

Cleanup actions under MTCA must demonstrate compliance with other state and federal laws that are applicable to the Site or to the cleanup actions that are proposed. The requirements of these laws are applicable for several different reasons. Some laws may be applicable because the law regulates the concentrations of the hazardous substances present at the Site (e.g., MCLs). These are referred to as chemical-specific requirements and were presented with the discussion of media specific cleanup levels in Tables 12-1 through 12-3. Other laws may be applicable because they establish standards for the type of cleanup action that may be implemented (e.g., water discharge requirements) or for the general Site setting (e.g., wetland protection requirements). These latter items are referred to as action-specific and location-specific requirements. Table 12-5 provides a list of potentially applicable location- or action-specific laws and identifies those that are or may be applicable to this project.

13.0 IDENTIFICATION AND DISCUSSION OF DATA GAPS

The distribution of contaminants in soil, groundwater, surface water and sediment is presented in detail in earlier sections of this report. The combination of previous investigations and the RI have resulted in a comprehensive database for the Site including analytical, physical, stratigraphic and hydrogeologic data. These data, along with the upcoming interim product recovery activities, are adequate to enable the identification and evaluation of remedial alternatives for the Site during the FS. These remedial alternatives will be selected and assessed in terms of their ability to satisfy the remedial goals and objectives as outlined in Section 12.

Through the data evaluation and reporting process of the RI, a few items were identified which may warrant additional work prior to implementation of a final cleanup remedy at the Site. These items are discussed individually below.

13.1 Background Metals in Groundwater Quality

Background concentrations of metals in groundwater quality was not evaluated as part of the RI. It is proposed that additional groundwater samples be collected from monitoring well MW-29, located upgradient of the former railyard activities. These samples should be analyzed for both for total and dissolved metals. The sampling should encompass both high groundwater (winter) and low groundwater (summer) conditions to evaluate potential seasonal fluctuations. These data are needed to further assess whether or not all of the metals identified as being above cleanup levels in Section 12.1 are indeed Site-related. The existing data are not sufficient to support the design or evaluation of active measures to control or otherwise limit concentrations of metals in groundwater.

13.2 Western Extent of TPH

Work conducted during installation of the interim measures revealed the presence of petroleum impacted soils further west along West River Drive than had been anticipated. Plans for any additional remedial measures within this area will include means to confirm the westernmost extent of the impacted soil and groundwater. Remedial plans can be developed with sufficient flexibility to account for this data gap.

13.3 Toxicological Data for TPH and Lead

Toxicological data are currently unavailable for TPH and lead. Therefore, MTCA cleanup levels based on protection of human health using Method B or Method C cannot be developed at this time. It is our understanding, however, that Ecology is in the process of evaluating TPH cleanup levels and the risk associated with TPH. If this process results in toxicological data or methods for calculating risk-based TPH cleanup levels before implementation of a final remedy at the Site, the TPH cleanup levels presented herein would be revised accordingly. Similarly, EPA is reviewing the toxicological data for lead and may develop data that could be used to calculate a lead cleanup level under MTCA Method B or C.

13.4 Method Detection Limits for SVOC

A few soil and sediment samples had high detection limits for SVOC. This means that low level SVOC concentrations cannot be completely ruled out at the Site - in fact, the analysis of ecological risks was conducted using a hypothetical PAH distribution. The soil samples and one of the sediment samples with high detection limits were also analyzed for TPH and had no or low levels of TPH. Because both SVOC and TPH analysis can detect the presence of diesel and Bunker C fuel oils, it is believed that the absence of some low level SVOC data does not adversely impact the overall Site characterization. However, further analysis of sediment PAH may be warranted with the close laboratory coordination to ensure that the lowest achievable detection limits are reported.

13.5 Sources of Off-site Metals

The maximum reported concentrations of beryllium, cadmium and mercury were reported in sample HA-2-1; this sample is not on BN property and the source of these metals is unknown. Elevated lead was reported in a HA-2 sample and in a sample from B-11, also located off BN property . The lead source is also unknown. Ecology has been notified and is expected to work with the property owners of these areas.

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FIGURES

TABLES

QUALIFIERS

B — Indicates compound was found in daily calibration blank.

J — Indicates compound was detected less than the MDL (Method Detection Limit) or result was estimated.

U — Indicates compound was not detected.

NA — Not Analyzed

QUALIFIERS

B – Indicates compound was found in daily calibration blank.

J – Indicates compound was detected < than the MDL (Method Detection Limit) or result was estimated.

U – Indicates compound was not detected.

NA – Not Analyzed

TABLE 2–1
MONTHLY AND ANNUAL MEAN DISCHARGES OF SOUTH FORK SKYKOMISH RIVER BNRR MAINTENANCE AND FUELING FACILITY SKYKOMISH, WASHINGTON

Year	DISCHARGE (CFS)												Total
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
1930	263.2	229.3	671	354	1941	1154	2219	1811	1575	727	329.1	261.5	952
1931	566	633	534	1078	1139	1388	1515	2581	1788	660	321.9	347	1045
1947	868	802	2193	1462	1521	1526	2296	3385	2450	1150	474	421.4	1546
1948	1857	1938	1535	870	721	657	1308	3616	5020	1609	711	4158	1700
1949	1034	1119	868	451	754	1106	1959	4500	3322	1907	749	583	1534
Mean	918	944	1160	843	1215	1166	1859	3179	2831	1211	517	1154	1355

NOTE:

Discharge data is the sum of the South Fork Skykomish River above the confluence with the Beckler River (USGS, 1984).

TABLE 3-1
COMPOSITION OF DIESEL FUEL #2

COMPONENT	% VOLUME	COMPONENT	VOLUME (v/v)
C_{10} paraffins	0.9	C_{15} paraffins	7.4
C_{10} cycloparaffins	0.6	C_{15} cycloparaffins	5.5
C_{10} aromatics	0.4	C_{15} aromatics	3.2
C_{11} paraffins	2.3	C_{16} paraffins	5.8
C_{11} cycloparaffins	0.6	C_{16} cycloparaffins	4.4
C_{11} aromatics	0.4	C_{16} aromatics	2.5
C_{12} paraffins	3.8	C_{17} paraffins	5.5
C_{12} cycloparaffins	2.8	C_{17} cycloparaffins	4.1
C_{12} aromatics	1.6	C_{17} aromatics	2.4
C_{13} paraffins	6.4	C_{18} paraffins	4.3
C_{13} cycloparaffins	4.8	C_{18} cycloparaffins	3.2
C_{13} aromatics	2.8	C_{18} aromatics	1.8
C_{14} paraffins	8.8	C_{19} paraffins	0.7
C_{14} cycloparaffins	6.6	C_{19} cycloparaffins	0.6
C_{14} aromatics	3.8	C_{19} aromatics	0.3
		Total	**98.3%**

Source: **McKetta,** J., 1965.

TABLE 3-2
Physical / Chemical Properties of Selected PAH Compounds

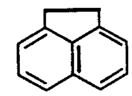
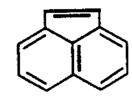
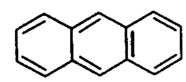
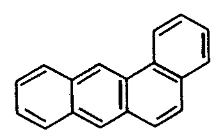
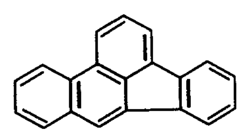
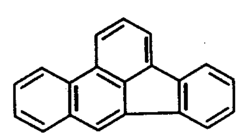
Name (and Synonyms) (a)	CAS Reg. No.	# of Rings	Formula	Mol. Wt.	Physical Property (b)	Structure
* Acenaphthene 1, 2-Dihydroacenaphthylene Peri-Ethylenenaphthylene 1:8 Dimethylane-naphthalene	83-32-9	3	$C_{12}H_{10}$	154	Sol = 3.42 M.P. = 95°C B.P. = 278°C H = 9.2×10^{-5} V.P. = 1.55×10^{-3} Koc = 4,600 log Kow = 4.0	
* Acenaphthylene	208-96-8	3	$C_{12}H_8$	152	Sol = 3.93 M.P. = 92°C B.P. = 265°C H = 1.48×10^{-3} V.P. = 2.90×10^{-2} Koc = 2,500 log Kow = 3.70	
* Anthracene	120-12-7	3	$C_{14}H_{10}$	178	Sol = 0.045 M.P. = 217°C B.P. = 340°C H = 1.02×10^{-3} V.P. = 1.95×10^{-4} Koc = 14,000 log Kow = 4.45	
* ≠ Benz (a) Anthracene tetraphene 1, 2-Benzanthracene 2, 3-Benzophenanthrene	56-55-3	4	$C_{18}H_{12}$	228	Sol = 0.0057 M.P. = 157-162°C B.P. = 438°C H = 1.16×10^{-6} V.P. = 2.2×10^{-8} Koc = 1,380,000 log Kow = 5.6	
* ≠ Benzo (b) fluoranthene Benzo (e) acephenanthrylene 2, 3-Benzofluoranthene	205-99-2	5	$C_{20}H_{12}$	252	Sol = 0.0014 M.P. = 167°C B.P. = 481°C V.P. = 5.0×10^{-7} H = 1.19×10^{-5} Koc = 550,000 log Kow = 6.06	
* Benzo (k) fluoranthene 8.9-Benzofluoranthene 11, 12-Benzofluoranthene	207-08-9	5	$C_{20}H_{12}$	252	Sol = 0.0043 M.P. = 215°C B.P. = 480°C V.P. = 5.6×10^{-7} H = 3.94×10^{-5} Koc = 550,000 log Kow = 6.06	

TABLE 3-2 (Continued)

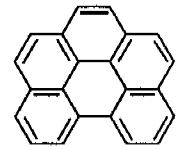
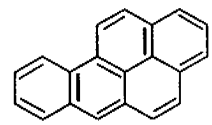
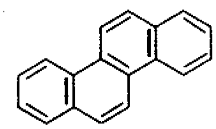
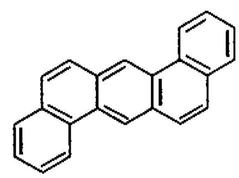
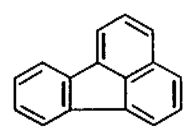
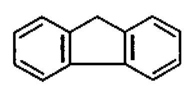
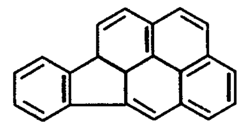
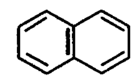
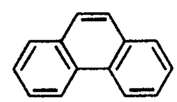
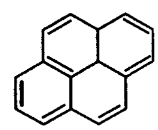
Name (and Synonyms) (a)	CAS Reg. No.	# of Rings	Formula	Mol. Wt.	Physical Property (b)	Structure
* Benzo (ghi) Perylene 1, 12-Benzoperylene	191-24-2	6	$C_{22}H_{12}$	276	Sol = 0.0007 M.P. = 273°C B.P. = +500°C V.P. = 1.03 x 10^{-10} H = 5.34 x 10^{-8} Koc = 1,600,000 log Kow = 6.51	
* ≠ Benzo (a) Pyrene 1, 2-Benzopyrene 3, 4-Benzopyrene	50-32-8	5	$C_{20}H_{12}$	252	Sol = 0.0012 M.P. = 178°C B.P. = 495°C H = 1.5 x 10^{-6} V.P. = 5.6 x10^{-9} Koc = 5,500,000 log Kow = 6.06	
* ≠ Chrysene	218-01-9	4	$C_{18}H_{12}$	228	Sol = 0.0018 M.P. = 245-256°C B.P. = 436-448°C V.P. = 6.3 x 10^{-9} H = 1.05 x 10^{-6} Koc = 200,000 log Kow = 5.61	
* ≠ Dibenz (a,h) Anthracene 1,2:5, 6-Dibenzanthracene	53-70-3	5	$C_{22}H_{14}$	278	Sol = 0.0005 M.P. = 266°C B.P. = 524°C V.P = 1.0 x 10^{-10} H = 7.33 x 10^{-8} Koc = 3,300,000 log Kow = 6.80	
* ≠ Fluoranthene	206-44-0	4	$C_{16}H_{10}$	202	Sol = 0.206 M.P. = 110°C B.P. = 393°C V.P. = 5.0 x 10^{-6} H = 6.46 x 10^{-6} Koc = 38,000 log Kow = 4.90	
* Fluorene	86-73-7	3	$C_{13}H_{10}$	166	Sol = 1.69 M.P. = 115°C B.P. = 294°C V.P. = 7.1 x 10^{-4} H = 6.42 x 10^{-5} Koc = 7,300 log Kow = 4.20	

TABLE 3-2 (Continued)

Name (and Synonyms) (a)	CAS Reg. No.	# of Rings	Formula	Mol. Wt.	Physical Property (b)	Structure
* ≠ Indeno (1,2,3-CD) pyrene O-phenylenepyrene	193-39-5	6	$C_{22}H_{12}$	276	Sol = 0.00054 M.P. = 163°C B.P. = V.P. = 1.0×10^{-10} H = 6.86×10^{-8} Koc = 1,600,000 log Kow = 6.50	
* ≠ Napthalene	91-20-3	2	$C_{10}H_8$	128	Sol = 31.7 M.P. = 80°C B.P. = 218°C H = 2.6×10^{-4} V.P. = 4.92×10^{-2} Koc = 2300 log Kow = 3.01/3.45	
* Phenanthrene	85-01-3	3	$C_{14}H_{10}$	178	Sol = 1.0 M.P. = 101°C B.P. = 340°C H = 4.54×10^{-7} V.P. = 6.8×10^{-4} Koc = 14.2 log Kow = 1.46	
* Pyrene	129-00-0	4	$C_{16}H_{10}$	202	Sol = 0.132 M.P. = 149°C B.P. = 393°C H = 5.04×10^{-6} V.P. = 2.5×10^{-6} Koc = 38,000 log Kow = 4.88	

Notes:

(a) ≠ Indicates a RCRA Appendix VIII compound (40 CFR Part 26: Appendix VIII). Other PAH listed in Appendix VIII that are not given in this table are dibenz (a,h)-acridene, dibenz (a,j)-acridene, 7H-dibenzo (c,g) carbazole, dibenzo (a,e)pyrene, dibenzo (a,h) pyrene, and dibenzo (a, i) pyrene. Very little property data are available for these compounds and they are not commonly found.

* Indicates a priority pollutant compound (40 CFR part 122 Appendix D). All priority pollutant PAH are listed in this table.

(b) Sol = Solubility in mg/1 in distilled water at 25°C from EPA 1986.

M.P. = Melting point in °C as reported by Anderson and Wu (1963) unless otherwise noted.

B.P. = Boiling point in °C as reported by Anderson and Wu (1963) unless otherwise noted.

V.P. = Vapor pressure in torr mm Hg at 20°C from U.S. EPA, 1986.

H = Henry's law constant in atm-m³/mole at 25°C from EPA, 1986.

Koc = Organic carbon partition coefficient (ml/g) from EPA, 1986.

log Kow = Logarithm of octanol-water partition coefficient from EPA, 1986

TABLE 3-3
PHYSICAL AND CHEMICAL PROPERTIES OF SELECTED VOLATILE ORGANIC COMPOUNDS BNRR MAINTENANCE AND FUELING FACILITY SKYKOMISH, WASHINGTON

Compound	Molecular Weight	Water Solubility (mg/L)	K_{ow}
2-Butanone (Methylethylketone)	72	353,000	NA
1,2-Dichloroethane	99	8,690	28
1,1,2,2-Tetrachloroethane	168	2,900	363
Styrene	104	2,900	841
1,1-Dichloroethene	97	210	30
Benzene	78	1,780	122.7
Toluene	92	515	468
Ethylbenzene	106	152	841

NOTE:

K_{ow} = Octonal/Water Partition Coefficient
NA = Not applicable

References:

Cohen, 1993
Dragun, 1988
Jeng, 1992
U.S. EPA, 1986
U.S. EPA 1993
Verschueren, 1983

TABLE 3-4
PHYSICAL AND CHEMICAL PROPERTIES OF POLYCHLORINATED BIPHENYLS
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Aroclor	Molecular Weight (g)	Water Solubility (mg/L)	K_{ow}
PCB-1016	258	0.23	758,578
PCB-1221	192	0.59	630
PCB-1232	221	1.45	1,585
PCB-1242	261	0.20	12,883
PCB-1248	288	0.05	1,288,250
PCB-1254	327	0.05	2,951,209

NOTE: K_{ow} – Octonal/Water Partition Coefficient

Reference: Cohen, 1993

TABLE 4-1
SAMPLE LOCATION SURVEY DATA
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

RETEC

Sample No.	Steel Elev.* (feet msl)	PVC (Reference) Elev. (feet msl)	Ground Surface (feet msl)	Northing	Easting
B-4			938.47	259,176.38	1,511,425.55
B-4A			938.38	259,099.91	1,511,396.83
B-4B			938.26	259,087.09	1,511,436.31
B-5			936.62	259,134.91	1,511,291.92
B-6			930.56	258,873.13	1,510,958.71
B-7			934.53	259,148.88	1,510,694.15
B-8			935.13	259,045.85	1,510,758.84
B-9			934.51	258,922.57	1,511,211.43
B-10			934.39	258,984.73	1,510,915.73
B-11			923.81	259,222.99	1,510,073.50
B-12			936.22	258,715.61	1,511,035.88
HA-1			936.93	259,387.97	1,510,730.26
HA-2			935.99	259,307.03	1,510,759.03
HA-3			925.10	259,390.04	1,510,377.14
HA-4			925.33	259,313.49	1,510,390.06
MW-1	941.08	939.20	938.30	259,065.71	1,511,499.22
MW-2	939.73	939.20	936.80	258,938.54	1,511,585.22
MW-3	939.17	938.03	936.60	258,892.62	1,511,429.51
MW-4	938.12	936.95	935.60	258,895.02	1,511,286.04
MW-5	934.84	933.36	932.10	258,924.48	1,511,109.71
MW-6	938.97	937.94	936.50	259,014.21	1,510,908.10
MW-7	937.01	936.89	934.40	258,966.86	1,510,753.72
MW-8	937.75	936.78	935.30	259,025.30	1,510,754.66
MW-9	938.86	937.53	936.20	259,061.59	1,510,972.90
MW-10	939.61	938.34	936.70	259,093.03	1,511,179.22
MW-11	939.95	939.20	937.50	259,124.93	1,511,365.55
MW-12	933.08	931.45	930.50	258,866.42	1,510,935.48
MW-13	936.56	934.93	933.90	258,828.59	1,510,763.01
MW-14	936.91	936.49	934.30	258,844.76	1,510,714.42
MW-15	937.26	936.80	934.60	258,911.25	1,510,621.65
MW-16	935.35	934.57	932.60	258,944.48	1,510,268.04
MW-17	939.26	939.11	936.60	258,969.84	1,511,312.35
MW-18	940.98	940.68	938.10	259,074.98	1,511,267.52
MW-19	932.91	932.55	930.00	259,100.30	1,510,378.13
MW-20	934.54	933.74	934.54	259,139.79	1,510,696.31
MW-21	938.91	938.56	936.10	259,215.39	1,511,177.09
MW-22	925.80	925.22	925.80	259,295.41	1,510,264.82
MW-23	926.36	925.58	926.36	259,474.03	1,510,348.72
MW-24	926.60	925.84	926.60	259,491.75	1,510,415.63
MW-25	927.01	926.90	927.01	259,496.99	1,510,475.60
MW-26	930.99	930.65	930.99	259,257.73	1,510,560.05
MW-27	936.47	936.23	936.47	259,294.25	1,510,848.49
MW-28	941.50	940.63	939.20	259,186.47	1,511,727.80
MW-29	948.81	948.13	945.90	259,289.13	1,512,682.60
MW-30	932.20	931.95	929.60	258,902.28	1,509,695.72
MW-31	934.44	934.11	931.40	258,915.23	1,510,075.38
MW-32	926.46	926.06	923.00	258,976.36	1,509,688.05
MW-33	934.34	934.00	934.34	259,349.51	1,511,836.58
MW-34	935.99	935.52	935.99	259,289.44	1,511,404.11
MW-35	936.48	936.15	936.48	259,325.13	1,511,118.02

TABLE 4-1 (Continued)
SAMPLE LOCATION SURVEY DATA
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

RETEC

Sample No.	Steel Elev.* (feet msl)	PVC (Reference) Elev. feet msl)	Ground Surface (feet msl)	Northing	Easting
MW-36	928.90	928.39	928.90	259,415.20	1,510,596.08
MW-37	932.71	932.32	932.71	259,154.37	1,510,522.05
MW-38	923.08	922.56	923.08	259,075.45	1,510,071.82
MW-39	936.40	936.21	933.20	258,771.33	1,511,022.48
MW-40	936.87	936.52	933.50	258,849.54	1,510,601.87
DW-1	943.52	942.92	940.10	259,079.31	1,511,780.17
DW-2	935.88	934.54	933.20	258,834.98	1,510,600.09
DW-3	930.88	930.09	928.30	258,873.44	1,509,596.57
DW-4	925.18	924.79	925.18	259,396.94	1,510,186.85
DW-5	932.91	932.54	932.91	259,573.24	1,510,813.71
SW-1			922.78	258,295.54	1,510,415.97
SW-2			919.20	258,568.68	1,510,027.94
SW-3			912.65	258,884.26	1,509,300.50
SW-4			924.18	259,463.58	1,511,680.77
SW-5			916.54	259,483.16	1,510,130.19
SW-6			911.57	259,017.06	1,509,310.96
SW-7			924.36	258,774.15	1,510,560.15
SS-13			933.77	258,878.35	1,510,616.36
SS-14			935.00	259,006.46	1,510,617.83
SS-15			934.35	258,987.23	1,510,495.09
SS-16			932.37	258,969.76	1,510,213.80
SS-17			931.92	258,880.35	1,510,259.39
SS-18			932.93	258,889.89	1,510,323.93
SS-19			932.17	258,944.33	1,510,193.08
SS-19.1			931.96	258,944.62	1,510,200.53
SS-20			930.93	258,873.81	1,510,046.20
SS-21			931.77	258,945.23	1,510,093.13
SS-22			931.16	258,920.49	1,509,986.95
SS-23			928.05	258,838.07	1,509,500.42
SS-24			929.39	258,838.37	1,509,750.38
SS-25			929.94	258,992.70	1,509,954.14
SS-26			930.71	259,014.17	1,510,095.49
SS-27			934.36	258,913.92	1,510,724.31
SS-28			935.24	258,979.08	1,511,143.53
SS-29			934.45	258,949.86	1,511,172.54
SS-30			941.84	259,168.22	1,512,070.42
SS-31			945.07	259,209.66	1,512,703.58
SS-32			947.18	259,163.20	1,512,965.93
SED-1			917.50	259,620.88	1,510,455.93
SED-2			917.39	259,573.05	1,510,356.02
SED-3			916.48	259,544.37	1,510,234.76
SED-4			916.74	259,467.54	1,510,156.88
SED-5			916.78	259,435.84	1,510,089.86
SED-6			929.65	258,873.51	1,511,251.90
SED-7			926.21	258,736.41	1,510,711.28
Maloney Creek		918.27		258,847.86	1,509,336.66
Culvert		924.27		258,770.00	1,510,555.00
Skykomsh River		920.73		259,776.47	1,510,462.80

NOTES:

* Top of steel on aboveground completions = top of well cap. Subtract 0.03 feet to top of steel casing.

msl = mean sea level

TABLE 4-2
SOIL AND SEDIMENT ANALYTICAL SAMPLING SUMMARY
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Sample ID	Depth Zone	METHOD WTPH 418.1	WTPH-G	WTPH-D	VOC 8240	SVOC 8270	PCB 8080	Metals 6010/7000	TOC 415.1	Phys. Char.
SURFACE										
SS (13-32)	0 - 0.5	X					X	X		
SS19.1	0 - 0.5	X					X	X		
SS41 (SS14 dup)	0 - 0.5	X					X	X		
SS92 (SS29 dup)	0 - 0.5	X					X	X		
BG (1-2)	0 - 0.5	X					X	X		
HAND AUGER										
HA1	2	X			X	X		X		
HA10 (HA1 dup)	2	X			X	X		X		
HA2	1	X			X	X		X		
HA3	1	X			X	X		X		
HA4	0	X			X	X		X		
SEDIMENT										
SED (1-7)	0-0.5	X			X	X	X	X	X	
SED10 (SED3 dup)	0-0.5	X			X	X	X	X	X	
BOREHOLE										
B4	0						X	X		
	2						X			
	10	X		X	X	X	X		X	
	17	X								
B40 (B4 dup)	10				X					
B5	0						X	X		
	7	X		X	X	X			X	
	17	X								
B50 (B5 dup)	17	X								
B6	0						X	X		
	8	X		X	X	X			X	
	10.5	X		X		X	X	X		
	23	X								
B7	0						X	X		
	11	X		X						
	17	X		X						
	22	X								

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TABLE 4-2 (Continued)
SOIL AND SEDIMENT ANALYTICAL SAMPLING SUMMARY
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Sample ID	Depth Zone	METHOD WTPH 418.1	WTPH-G	WTPH-D	VOC 8240	SVOC 8270	PCB 8080	Metals 6010/7000	TOC 415.1	Phys. Char.
B8	0						X	X		
	12	X		X						
	17	X		X						
	22	X								
B80 (B8 dup)	17	X		X						
B9	0						X	X		
	7.5	X		X	X	X			X	
	12.5	X								
B10	0							X	X	X
	2								X	X
	5									X
	10	X		X					X	
	12.5									X
	15	X		X					X	
	27	X								
B11	0							X		
	5	X		X						
	10	X								
B110	0							X		
B12	0							X		
	7.5	X	X	X	X	X				
	12.5	X								
MW33	0							X		
	2.5	X	X	X		X				
	5				X					
	12.5	X								
MW34	0							X		
	7.5				X					
	10	X		X		X				
	17	X								
BOREHOLE										
MW35	0							X		
	7.5				X					
	10	X		X						
	17.5	X								
MW53	7.5				X					
(MW35 dup)	10	X		X						
MW36	0							X	X	X
	2								X	X
	6	X		X	X				X	X
	7.5	X		X					X	X
	17	X								

TABLE 4-2 (Continued)
SOIL AND SEDIMENT ANALYTICAL SAMPLING SUMMARY
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Sample ID	Depth Zone	METHOD								
		WTPH 418.1	WTPH-G	WTPH-D	VOC 8240	SVOC 8270	PCB 8080	Metals 6010/7000	TOC 415.1	Phys. Char.
MW37	0							X		
	7.5	X	X	X	X					
	12.5	X		X						
	23	X								
MW73 (MW37 dup)	23	X								
MW38	0							X		
	7.5	X		X	X					
	12	X								
MW39	0							X		
	6	X	X	X	X	X				
	10	X		X						
	15.5	X								
MW93 (MW39 dup)	10	X		X						
MW40	0							X		
	5	X	X	X	X	X	X			
	12.5	X								
DW1	0							X	X	X
	2								X	X
	5	X		X					X	X
	22.5	X								
DW10 (DW1 dup)	22.5	X								
DW2	0						X	X		
	2						X			
	5	X		X		X				
	10				X					
	12.5	X								
DW3	0						X	X		
	2						X			
	7.5	X		X						
	17.5	X								
DW4	0							X		
	2.5	X		X						
	7.5	X		X						
	17.5	X								
DW5	0							X		
	12	X		X						
	17	X								
DW50 (DW5 dup)	17	X								

NOTES:

WTPH = Washington Method, Total Petroleum Hydrocarbons
WTPH-D = Washington Method, Diesel Range
WTPH-G = Washington Method, Gasoline Range
VOC = Volatile Organic Compounds
SVOC = Semi-volatile Organic Compounds
PCB = Polychlorinated Biphenyls
Metals = Priority Pollutant Metals
TOC = Total Organic Carbon

RETEC

TABLE 4-3
WELL CONSTRUCTION DETAILS
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Well No.	Steel Elev.* (ft msl)	PVC Elev. (ft msl)	Ground Surface (ft msl)	Date Completed	Screen Length	Top of Screen		Bottom of Screen		Bottom of Well	
						Depth	Elev. (ft msl)	Depth	Elev. (ft msl)	Depth	Elev. (ft msl)
MW-1	941.08	939.20	938.30	9/17/90	10.0	10.5	927.80	20.5	917.80	20.5	917.80
MW-2	939.73	939.20	936.80	9/18/90	10.0	10.0	926.80	20.0	916.80	20.0	916.80
MW-3	939.17	938.03	936.60	9/18/90	13.5	6.0	930.60	19.5	917.10	19.5	917.10
MW-4	938.12	936.95	935.60	9/18/90	13.0	6.0	929.60	19.0	916.60	19.0	916.60
MW-5	934.84	933.36	932.10	9/19/90	10.0	4.0	928.10	14.0	918.10	14.0	918.10
MW-6	938.97	937.94	936.50	9/19/90	10.0	9.0	927.50	19.0	917.50	20.5	916.00
MW-7	937.01	936.89	934.40	9/19/90	14.0	5.0	929.40	19.0	915.40	19.0	915.40
MW-8	937.75	936.78	935.30	9/19/90	10.0	9.0	926.30	19.0	916.30	19.0	916.30
MW-9	938.86	937.53	936.20	9/20/90	12.0	7.0	929.20	19.0	917.20	19.0	917.20
MW-10	939.61	938.34	936.70	9/20/90	12.0	7.0	929.70	19.0	917.70	19.0	917.70
MW-11	939.95	939.20	937.50	9/20/90	10.0	9.0	928.50	19.0	918.50	19.0	918.50
MW-12	933.08	931.45	930.50	9/20/90	10.0	4.0	926.50	14.0	916.50	14.0	916.50
MW-13	936.56	934.93	933.90	9/20/90	10.0	4.0	929.90	14.0	919.90	14.0	919.90
MW-14	936.91	936.49	934.30	9/21/90	10.0	4.0	930.30	14.0	920.30	14.0	920.30
MW-15	937.26	936.80	934.60	9/21/90	12.0	7.0	927.60	19.0	915.60	19.0	915.60
MW-16	935.35	934.57	932.60	9/21/90	12.5	7.0	925.60	19.5	913.10	19.5	913.10
MW-17	939.26	939.11	936.60	9/24/90	12.0	7.0	929.60	19.0	917.60	19.0	917.60
MW-18	940.98	940.68	938.10	9/24/90	15.0	4.0	934.10	19.0	919.10	19.0	919.10
MW-19	932.91	932.55	930.00	9/26/90	10.0	4.0	926.00	14.0	916.00	14.0	916.00
MW-20	934.54	933.74	934.54	9/26/90	10.0	9.0	925.54	19.0	915.54	19.0	915.54
MW-21	938.91	938.56	936.10	9/25/90	10.0	9.0	927.10	19.0	917.10	19.0	917.10
MW-22	925.80	925.22	925.80	9/24/90	10.0	4.0	921.80	14.0	911.80	14.0	911.80
MW-23	926.36	925.58	926.36	9/25/90	12.0	2.0	924.36	14.0	912.36	14.0	912.36
MW-24	926.60	925.84	926.60	9/25/90	12.0	2.0	924.60	14.0	912.60	14.0	912.60
MW-25	927.01	926.90	927.01	9/25/90	12.0	2.0	925.01	14.0	913.01	14.0	913.01
MW-26	930.99	930.65	930.99	9/26/90	15.0	4.0	926.99	19.0	911.99	19.0	911.99
MW-27	936.47	936.23	936.47	9/26/90	12.0	7.0	929.47	19.0	917.47	19.0	917.47
MW-28	941.50	940.63	939.20	11/4/91	15.0	3.5	935.70	18.5	920.70	18.5	920.70
MW-29	948.81	948.13	945.90	11/5/91	19.5	3.5	942.40	23.0	922.90	23.0	922.90
MW-30	932.20	931.95	929.60	11/6/91	15.0	3.5	926.10	18.5	911.10	18.5	911.10
MW-31	934.44	934.11	931.40	11/6/91	15.0	3.5	927.90	18.5	912.90	18.5	912.90
MW-32	926.46	926.06	923.00	11/8/91	7.9	1.5	921.50	9.4	913.60	9.4	913.60
MW-33	934.34	934.00	934.34	9/28/93	14.46	5.54	928.80	20.00	914.34	20.54	913.80
MW-34	935.99	935.52	935.99	10/23/93	14.40	5.65	930.34	20.05	915.94	20.78	915.21
MW-35	936.48	936.15	936.48	10/19/93	14.42	5.48	931.00	19.90	916.58	20.73	915.75
MW-36	928.90	928.39	928.90	10/21/93	14.44	5.69	923.21	20.13	908.77	20.94	907.96
MW-37	932.71	932.32	932.71	10/22/93	14.42	5.63	927.08	20.05	912.66	20.88	911.83
MW-38	923.08	922.56	923.08	10/24/93	14.40	5.67	917.41	20.07	903.01	20.90	902.18
MW-39	936.40	936.21	933.20	10/19/93	14.54	6.43	926.77	20.97	912.23	21.64	911.56
MW-40	936.87	936.52	933.50	9/27/93	12.62	5.02	928.48	17.64	915.86	17.68	915.82
DW-1	943.52	942.92	940.10	9/28/93	4.48	31.29	908.81	35.77	904.33	36.58	903.52
DW-2	935.88	934.54	933.20	9/27/93	4.42	38.77	894.43	43.19	890.01	44.02	889.18
DW-3	930.88	930.09	928.30	9/29/93	4.41	38.57	889.73	42.98	885.32	43.73	884.57
DW-4	925.18	924.79	925.18	10/21/93	4.46	38.31	886.87	42.77	882.41	43.18	882.00
DW-5	932.91	932.54	932.91	10/23/93	4.46	40.46	892.45	44.92	887.99	45.71	887.20

NOTE:
* Top of steel on aboveground completions = top of well cap. Subtract 0.03 feet to top of steel casing.

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TABLE 4-4
GROUND AND SURFACE WATER ANALYTICAL SAMPLING SUMMARY
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Well No.	Total Petroleum Hydrocarbons			Volatile Organic Compounds		Semi-volatile Organic Compounds		PCBs	Metals EPA 6010 PPM			Total Suspended Solids
	WTPH-418.1	WTPH-D Extended*	WTPH-D Modified Extended**	EPA 8240	EPA 8020	EPA 8270	EPA 8310	EPA 8080	Total (1)	Total (As, Cr, Pb)	Dissolved (As, Cr, Pb)	
MW-1	--	1	2,3,4	--	--	--	--	--	--	--	--	--
MW-2	--	1	--	--	--	--	--	--	2	1	2,3,4	2,3,4
MW-3	--	1	3,4	1	--	1	--	--	--	1	--	--
MW-4	--	1	2,3,4	1	--	1	--	1	--	1	--	--
MW-5	--	1	2,3,4	--	--	2	3	--	2	--	2,3,4	2,3,4
MW-7	--	1	--	--	2	1	--	1	--	1	--	--
MW-9	--	1	4	1	--	1	2,3	2,3	2	--	2,3,4	2,3,4
MW-10	--	1	--	--	2	1	--	--	--	1	--	--
MW-11	--	1	4	1	2	2	3	--	--	1	--	--
MW-12	--	1	--	1	--	1	2,3	1	--	1	--	--
MW-13	--	1	2,3,4	--	2	--	--	--	--	--	--	--
MW-14	--	1	2,4	1	--	1	--	1	--	1	--	--
MW-15	--	1	--	--	--	--	--	--	--	1	--	--
MW-16	--	1	--	--	--	--	--	1	2	--	2,3,4	2,3,4
MW-18	--	1	--	--	--	--	--	--	--	--	--	--
MW-19	--	1	2,3,4	1	--	1	--	1,2,3	--	1	--	--
MW-23	--	1	2,3,4	1	2	1	2,3	--	2	1	2,3,4	2,3,4
MW-24	--	1	--	--	--	1	--	--	--	--	--	--
MW-26	--	--	4	--	--	--	--	--	--	--	--	--
MW-28	--	1	2,3	--	--	1,2	3	--	--	1	--	--
MW-29	--	1	--	--	--	--	--	--	--	--	--	--
MW-30	--	1	--	--	--	--	--	--	--	--	--	--
MW-31	--	1	--	1	--	1	--	1	2	1	2,3,4	2,3,4
MW-32	--	1	--	--	--	--	--	1,2	--	--	--	--
MW-33	--	1	--	--	--	--	--	--	--	--	--	--
MW-34	--	1	2,3,4	1	--	--	--	--	--	--	--	--
MW-35	--	1	2,3,4	1	--	1	--	--	2	1	2,3,4	2,3,4
MW-36	--	1	2,3	1	2	--	2,3	--	2	--	2,3	2,3,4
MW-37	--	1	2,3,4	1	2	--	2,3	--	2	--	2,3,4	2,3,4
MW-38	--	1	2,3,4	--	--	1	--	--	2	--	2,3,4	2,3,4

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TABLE 4-4 (Continued)
GROUND AND SURFACE WATER ANALYTICAL SAMPLING SUMMARY
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Well No.	Total Petroleum Hydrocarbons			Volatile Organic Compounds		Semi-volatile Organic Compounds		PCBs	Metals EPA 6010 PPM			Total Suspended Solids
	WTPH-418.1	WTPH-D Extended*	WTPH-D Modified Extended**	EPA 8240	EPA 8020	EPA 8270	EPA 8310	EPA 8080	Total (1)	Total (As, Cr, Pb)	Dissolved (As, Cr, Pb)	
MW-40	--	1	2,3,4	--	--	1	--	1	2	--	2,3,4	2,3,4
DW-1	--	1	2,3	--	--	1	--	--	--	--	--	--
DW-2	--	1	2,3	--	--	1	--	1	2	1	2,3,4	2,3,4
DW-3	--	1	--	--	--	1	--	1	2	--	2,3,4	2,3,4
DW-4	--	1	2,3	--	--	1	--	--	--	1	--	--
DW-5	--	1	2,3	--	--	1	--	--	--	--	--	--
FB	--	1	2,3,4	--	2	1,2	2,3	1,2,3	2	1	2,3,4	2,3,4
SW-1	1	--	--	--	--	1	--	--	1	--		
SW-2	1	--	--	--	--	1	--	--	1	--		
SW-3	1	--	2,3	--	--	1	--	--	1	2,3	2	
SW-4	1	--	--	--	--	1	--	--	1	--		
SW-5	1	--	2,3,4	--	--	1,2,3	--	--	1	2,3	2	
SW-6	1	--	2,3,4	--	--	1	--	--	1	2,3	2	
SW-7	1	--	2	--	--	--	--	--	--	2	2	
FB	--	1	2,3,4	--	--	1,2,3	--	--	1	2	2	

NOTES:

* WTPH-D Extended includes carbon range C10 to C32
** Modified WTPH-D Extended includes carbon range C9 to C36
The numbers specify which quarter the samples were collected in: 1) November 1993, 2) April 1994, 3) August 1994, and 4) November 1994.
MW and DW are monitoring wells; FB are field blanks.
PPS = Priority Pollutant Scan; TSS = Total Suspended Solids.
FB = includes FB-101 through FB-104 and FB-200.
(1) Metals include: Ag, As, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, Tl

TABLE 5-1
TPH ANALYTICAL RESULTS - SOIL
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

RETEC

ANALYSIS				WTPH by 418.1 IR (C8 - C30+)			WTPH as Diesel GC/FID (>C10-C28)			WTPH as Gasoline GC/FID, (C6-C10)		
Sample ID:	Lab Sample ID:	Sample Date:	Sample Depth: (feet bgs)	Conc.: (mg/kg)	MDL	Q	Conc.: (mg/kg)	MDL	Q	Conc.: (mg/kg)	MDL	Q
Surface Soil												
DW3-0	573-2857	09/29/93	0		112	U						
HA1-2	590-2937	10/07/93	2		105	U						
HA10-2	590-2941	10/07/93	2		104	U						
(HA1-2 Dup)												
HA2-1	590-2938	10/07/93	1		117	U						
HA3-1	590-2939	10/07/93	1		119	U						
HA4-0	590-2940	10/07/93	0	100	106	J						
SS13-0	573-2863	09/30/93	0		104	U						
SS14-0	573-2864	09/30/93	0	190	102							
SS41-0	573-2865	09/30/93	0	200	102							
(SS14-0 Dup)												
SS15-0	573-2866	09/30/93	0	250	103							
SS16-0	573-2867	09/30/93	0	270	106							
SS17-0	573-2869	09/30/93	0		125	U						
SS18-0	573-2868	09/30/93	0	130	105							
SS19-0	573-2870	09/30/93	0	2800	832							
SS19. 1-0	573-2871	09/30/93	0	3600	860							
SS20-0	578-2896	10/01/93	0		104	U						
SS21-0	573-2872	09/30/93	0	180	110							
SS22-0	573-2873	09/30/93	0	110	103							
SS23-0	573-2874	09/30/93	0	270	119							
SS24-0	573-2875	09/30/93	0		102	U						
SS25-0	578-2898	10/01/93	0		119	U						
SS26-0	578-2897	10/01/93	0	170	114							
SS27-0	573-2861	09/30/93	0	660	105							
SS28-0	573-2855	09/28/93	0	4900	1,697							
SS29-0	573-2860	09/30/93	0	880	105							
SS92-0	573-2862	09/30/93	0	950	105							
(SS29-0 Dup)												
SS30-0	573-2856	09/30/93	0		117	U						
SS31-0	573-2859	09/30/93	0		108	U						
SS32-0	573-2858	09/30/93	0		105	U						
BG1-0	578-2895	10/01/93	0		121	U						
BG2-0	573-2854	09/30/93	0		149	U						

TABLE 5-1 (Continued)
TPH ANALYTICAL RESULTS - SOIL
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

ANALYSIS				WTPH by 418.1 IR (C8 - C30+)			WTPH as Diesel GC/FID (>C10-C28)			WTPH as Gasoline GC/FID, (C6-C10)		
Sample ID:	Lab Sample ID:	Sample Date:	Sample Depth: (feet bgs)	Conc.: (mg/kg)	MDL	Q	Conc.: (mg/kg)	MDL	Q	Conc.: (mg/kg)	MDL	Q
Vadose Zone												
B4-10	559-2785	09/28/93	10	340	100							
B5-7	626-3160	10/24/93	7		102	U	26	26				
B6-8	618-3096	10/18/93	8	1600	100		770	25				
B7-11	626-3163	10/22/93	11	2500	200		844	26				
B8-12	621-3141	10/20/93	12	2500	209		880	26				
B9-7 ½	618-3095	10/18/93	7.5	120	100		49	36				
B10-10	573-2851	09/29/93	10	14000	1,754		9500	274				
B11-5	559-2776	09/27/93	5		105	U		26	U			
B12-7 ½	640-3235	10/29/93	7.5		105	U	13	26	J		5	U
MW33-2 ½	559-2775	09/28/93	2.5		123	U	63	31			6	U
MW34-10	559-2773	09/28/93	10		105	U		26	U			
MW35-10	573-2848	09/28/93	10		103	U	17	26	J			
MW53-10	573-2849	09/28/93	10		103	U		26	U			
(MW35-10 Dup)												
MW36-6	621-3145	10/21/93	6	4400	526		3600	132				
MW37-7 ½	626-3159	10/22/93	7.5	3300	504		740	25			5	U
MW38-7 ½	626-3161	10/24/93	7.5		113	U		28	U			
MW39-6	618-3097	10/19/93	6	480	100		29	25		6	5	
MW40-5	559-2772	09/27/93	5					26	U		5	U
DW1-5	559-2777	09/28/93	5		120	U		30	U			
DW2-5	559-2774	09/27/93	5		110	U	18	28	J			
DW3-0	573-2857	09/29/93	0		112	U						
DW3-7 ½	573-2850	09/29/93	7.5		119	U	43	30				
DW4-2 ½	568-2822	09/27/93	2.5	420	108		89	11				
DW5-12	626-3165	10/23/93	12		101	U		25	U			
Saturated-Contaminated Zone												
B6-10 ½	618-3098	10/19/93	10.5	760	100		380	25				
B7-17	626-3164	10/21/93	17	5500	597		2750	299				
B8-17	621-3142	10/20/93	17	200	105		59	26				
B80-17	621-3143	10/20/93	17	280	136		120	34				
(B8-17 Dup)												
B10-15	573-2852	09/29/93	15	3900	1,122		2800	281				
MW36-7 ½	621-3144	10/21/93	7.5	90	134	J	150	34				
MW37-12 ½	626-3162	10/24/93	12.5	Insufficient Sample			130	25				
MW39-10	618-3094	10/18/93	10	3200	200		1560	30				
MW93-10	621-3140	10/19/93	10	3500	236		1800	30				
(MW39-10 Dup)												
DW4-7 ½	559-2778	09/27/93	7.5	27000	1,909		12172	298				

TABLE 5-1 (Continued)
TPH ANALYTICAL RESULTS - SOIL
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

RETEC

ANALYSIS				WTPH by 418.1 IR (C8 - C30+)			WTPH as Diesel GC/FID (>C10-C28)			WTPH as Gasoline GC/FID, (C6-C10)		
Sample ID:	Lab Sample ID:	Sample Date:	Sample Depth: (feet bgs)	Conc.: (mg/kg)	MDL	Q	Conc.: (mg/kg)	MDL	Q	Conc.: (mg/kg)	MDL	Q
Saturated-Clean Zone												
B4B-17	626-3173	10/24/93	17		112	U						
B5-17	626-3174	10/24/93	17		136	U						
B50-17 (B5-17 Dup)	626-3175	10/24/93	17		137	U						
B6-23	618-3093	10/18/93	23		100	U						
B7-22	626-3168	10/22/93	22		137	U						
B8-22	621-3137	10/20/93	22		137	U						
B9-12 ½	618-3092	10/18/93	12.5		100	U						
B10B-27	618-3091	10/18/93	27		100	U						
B11-10	559-2781	09/27/93	10		115	U						
B12-12 ½	640-3236	10/29/93	12.5		110	U						
MW33-12 ½	559-2784	09/28/93	12.5		133	U						
MW34B-17	626-3169	10/23/93	17		130	U						
MW35B-17 ½	621-3136	10/19/93	17.5		122	U						
MW36-17	621-3139	10/21/93	17		121	U						
MW37-23	626-3166	10/22/93	23		123	U						
MW73-23 (MW37-23 Dup)	626-3167	10/22/93	23		136	U						
MW38-12	626-3172	10/24/93	12		126	U						
MW39-15 ½	621-3135	10/19/93	15.5		119	U						
MW40-12 ½	559-2780	09/27/93	12.5		117	U						
DW1-22 ½	559-2782	09/28/93	22.5		132	U						
DW10-22 ½ (DW1-22 ½ Dup)	559-2783	09/28/93	22.5		132	U						
DW2- 12 ½	559-2779	09/27/93	12.5		121	U						
DW3-17 ½	573-2847	09/29/93	17.5		118	U						
DW4B-17 ½	621-3138	10/20/93	17.5		121	U						
DW5-17	626-3170	10/23/93	17		136	U						
DW50-17 (DW5-17 Dup)	626-3171	10/23/93	17		130	U						

Table 5-2A
SVOC Analytical Results - Surface Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

	Sample location:	PQL	HA-1	HA-1	HA-2	HA-3
	Sample no:	PQL-SV	HA1-2	HA10-2	HA2-1	HA3-1
	Depth(ft):	0.0-0.0	1.0-2.0	1.0-2.0	1.0-1.5	0.0-1.0
	Matrix:	Soil	Soil	Soil	Soil	Soil
	Sample Date:	/ /	10/07/93	10/07/93	10/07/93	10/07/93
	Type:	Primary	Primary	Duplicate	Primary	Primary
	Method:	EPA8270	EPA8270	EPA8270	EPA8270	EPA8270
Analyte	CAS NO.					
Semi-Volatile Organic Compounds(ug/Kg)						
Phenol	108-95-2	660	<346U	<344U	<386U	<1575U
bis(2-Chloroethyl) ether	111-44-4	660	<346U	<344U	<386U	<1575U
2-Chlorophenol	95-57-8	660	<346U	<344U	<386U	<1575U
1,3-Dichlorobenzene	541-73-1	660	<346U	<344U	<386U	<1575U
1,4-Dichlorobenzene	106-46-7	660	<346U	<344U	<386U	<1575U
Benzyl alcohol	100-51-6	660	<346U	<344U	<386U	<1575U
1,2-Dichlorobenzene	95-50-1	660	<346U	<344U	<386U	<1575U
2-Methylphenol	95-48-7	660	<346U	<344U	<386U	<1575U
Bis(2-chloroisopropyl)ether	39638-32-9	660	<346U	<344U	<386U	<1575U
4-Methylphenol	106-44-5	660	<346U	<344U	<386U	<1575U
N-Nitroso-di-n-propylamine	621-64-7	660	<346U	<344U	<386U	<1575U
Hexachloroethane	67-72-1	660	<346U	<344U	<386U	<1575U
Nitrobenzene	98-95-3	660	<346U	<344U	<386U	<1575U
Isophorone	78-59-1	660	<346U	<344U	<386U	<1575U
2-Nitrophenol	88-75-5	660	<346U	<344U	<386U	<1575U
2,4-Dimethylphenol	105-67-9	660	<1730U	<1721U	<1928U	<7876U
Benzoic acid	65-85-0	660	<346U	<344U	<386U	<1575U
Bis(2-chloroethoxy)methane	111-91-1	660	<346U	<344U	<386U	<1575U
2,4-Dichlorophenol	120-83-2	660	<346U	<344U	<386U	<1575U
1,2,4-Trichlorobenzene	120-82-1	660	<346U	<344U	<386U	<1575U
4-Chloroaniline	106-47-8	660	<346U	<344U	<386U	<1575U
Hexachlorobutadiene	87-68-3	660	<346U	<344U	<386U	<1575U
4-Chloro-3-methylphenol	59-50-7	1300	<346U	<344U	<386U	<1575U
2-Methylnaphthalene	91-57-6	660	<346U	<344U	<386U	<1575U
Hexachlorocyclopentadiene	77-47-4	660	<346U	<344U	<386U	<1575U
2,4,6-Trichlorophenol	88-06-2	660	<346U	<344U	<386U	<1575U
2,4,5-Trichlorophenol	95-95-4	3300	<1730U	<1721U	<1928U	<7876U
2-Chloronaphthalene	91-58-7	660	<346U	<344U	<386U	<1575U
2-Nitroaniline	88-74-4	3300	<1730U	<1721U	<1928U	<7876U
Dimethyl phthalate	131-11-3	660	<346U	<344U	<386U	<1575U
2,6-Dinitrotoluene	606-20-2	3300	<1730U	<1721U	<1928U	<7876U
3-Nitroaniline	99-09-2	3300	<1730U	<1721U	<1928U	<7876U
N-Nitrosodimethylamine	62-75-9	660	<346U	<344U	<386U	<1575U
2,4-Dinitrophenol	51-28-5	3300	<1730U	<1721U	<1928U	<7876U
4-Nitrophenol	100-02-7	3300	<1730U	<1721U	<1928U	<7876U
Dibenzofuran	132-64-9	660	<346U	<344U	<386U	<1575U
2,4-Dinitrotoluene	121-14-2	660	<346U	<344U	<386U	<1575U
Diethylphthalate	84-66-2	660	<346U	<344U	<386U	<1575U
4-Chlorophenyl-phenylether	7005-72-3	660	<346U	<344U	<386U	<1575U
4-Nitroaniline	100-01-6	3300	<1730U	<1721U	<1928U	<7876U
4,6-Dinitro,2-methylphenol	534-52-1	3300	<1730U	<1721U	<1928U	<7876U
N-Nitrosodiphenylamine	86-30-6	660	<346U	<344U	<386U	<1575U
4-Bromophenyl-phenylether	101-55-3	660	<346U	<344U	<386U	<1575U
Hexachlorobenzene	118-74-1	660	<346U	<344U	<386U	<1575U
Pentachlorophenol	87-86-5	3300	<1730U	<1721U	<1928U	<7876U
Di-n-butyl phthalate	84-74-2	660	<346U	55J	<386U	<1575U
Butylbenzylphthalate	85-68-7	660	<346U	<344U	<386U	<1575U
3,3'-Dichlorobenzidine	91-94-1	1300	<692U	<688U	<771U	<3150U
Bis(2-ethylhexyl)phthalate	117-81-7	660	<346U	<344U	<386U	<1575U
Di-n-octyl phthalate	117-84-0	660	<346U	<344U	<386U	<1575U
Azobenzene	103-33-3	3300	<1730U	<1721U	<1928U	<7876U
Naphthalene	91-20-3	660	<346U	<344U	<386U	<1575U
Acenaphthylene	208-96-8	660	<346U	<344U	<386U	<1575U
Acenaphthene	83-32-9	660	<346U	<344U	<386U	<1575U
Fluorene	86-73-7	660	<346U	<344U	<386U	<1575U
Phenanthrene	85-01-8	660	<346U	<344U	<386U	<1575U
Anthracene	120-12-7	660	<346U	<344U	<386U	<1575U
Fluoranthene	206-44-0	660	<346U	<344U	<386U	<1575U
Pyrene	129-00-0	660	<346U	<344U	<386U	<1575U
Benzo(a)anthracene	56-55-3	660	<346U	<344U	<386U	<1575U
Chrysene	218-01-9	660	<346U	<344U	<386U	<1575U
Benzo(b)fluoranthene	205-99-2	660	<346U	<344U	<386U	<1575U
Benzo(k)fluoranthene	207-08-9	660	<346U	<344U	<386U	<1575U
Benzo(a)pyrene	50-32-8	660	<346U	<344U	<386U	<1575U
Indeno(1,2,3-cd)pyrene	193-39-5	660	<346U	<344U	<386U	<1575U
Dibenzo(a,h)anthracene	53-70-3	660	<346U	<344U	<386U	<1575U
Benzo(g,h,i)perylene	191-24-2	660	<346U	<344U	<386U	<1575U
Sum of PAHs		10560	0	0	0	0
Sum of Carcinogenic PAHs		4620	0	0	0	0

Table 5-2A
SVOC Analytical Results - Surface Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	CAS NO.	HA-4				
	Sample location:	HA-4				
	Sample no:	HA4-0				
	Depth(ft):	0.0-1.0				
	Matrix:	Soil				
	Sample Date:	10/07/93				
	Type:	Primary				
	Method:	EPA8270				
Semi-Volatile Organic Compounds(ug/Kg)						
Phenol	108-95-2	<2791U				
bis(2-Chloroethyl) ether	111-44-4	<2791U				
2-Chlorophenol	95-57-8	<2791U				
1,3-Dichlorobenzene	541-73-1	<2791U				
1,4-Dichlorobenzene	106-46-7	<2791U				
Benzyl alcohol	100-51-6	<2791U				
1,2-Dichlorobenzene	95-50-1	<2791U				
2-Methylphenol	95-48-7	<2791U				
Bis(2-chloroisopropyl)ether	39638-32-9	<2791U				
4-Methylphenol	106-44-5	<2791U				
N-Nitroso-di-n-propylamine	621-64-7	<2791U				
Hexachloroethane	67-72-1	<2791U				
Nitrobenzene	98-95-3	<2791U				
Isophorone	78-59-1	<2791U				
2-Nitrophenol	88-75-5	<2791U				
2,4-Dimethylphenol	105-67-9	<13953U				
Benzoic acid	65-85-0	<2791U				
Bis(2-chloroethoxy)methane	111-91-1	<2791U				
2,4-Dichlorophenol	120-83-2	<2791U				
1,2,4-Trichlorobenzene	120-82-1	<2791U				
4-Chloroaniline	106-47-8	<2791U				
Hexachlorobutadiene	87-68-3	<2791U				
4-Chloro-3-methylphenol	59-50-7	<2791U				
2-Methylnaphthalene	91-57-6	<2791U				
Hexachlorocyclopentadiene	77-47-4	<2791U				
2,4,6-Trichlorophenol	88-06-2	<2791U				
2,4,5-Trichlorophenol	95-95-4	<13953U				
2-Chloronaphthalene	91-58-7	<2791U				
2-Nitroaniline	88-74-4	<13953U				
Dimethyl phthalate	131-11-3	<2791U				
2,6-Dinitrotoluene	606-20-2	<13953U				
3-Nitroaniline	99-09-2	<13953U				
N-Nitrosodimethylamine	62-75-9	<2791U				
2,4-Dinitrophenol	51-28-5	<13953U				
4-Nitrophenol	100-02-7	<13953U				
Dibenzofuran	132-64-9	<2791U				
2,4-Dinitrotoluene	121-14-2	<2791U				
Diethylphthalate	84-66-2	<2791U				
4-Chlorophenyl-phenylether	7005-72-3	<2791U				
4-Nitroaniline	100-01-6	<13953U				
4,6-Dinitro,2-methylphenol	534-52-1	<13953U				
N-Nitrosodiphenylamine	86-30-6	<2791U				
4-Bromophenyl-phenylether	101-55-3	<2791U				
Hexachlorobenzene	118-74-1	<2791U				
Pentachlorophenol	87-86-5	<13953U				
Di-n-butyl phthalate	84-74-2	<2791U				
Butylbenzylphthalate	85-68-7	<2791U				
3,3'-Dichlorobenzidine	91-94-1	<5581U				
Bis(2-ethylhexyl)phthalate	117-81-7	<2791U				
Di-n-octyl phthalate	117-84-0	<2791U				
Azobenzene	103-33-3	<13953U				
Naphthalene	91-20-3	<2791U				
Acenaphthylene	208-96-8	<2791U				
Acenaphthene	83-32-9	<2791U				
Fluorene	86-73-7	<2791U				
Phenanthrene	85-01-8	<2791U				
Anthracene	120-12-7	<2791U				
Fluoranthene	206-44-0	<2791U				
Pyrene	129-00-0	<2791U				
Benzo(a)anthracene	56-55-3	<2791U				
Chrysene	218-01-9	<2791U				
Benzo(b)fluoranthene	205-99-2	<2791U				
Benzo(k)fluoranthene	207-08-9	<2791U				
Benzo(a)pyrene	50-32-8	<2791U				
Indeno(1,2,3-cd)pyrene	193-39-5	<2791U				
Dibenzo(a,h)anthracene	53-70-3	<2791U				
Benzo(g,h,i)perylene	191-24-2	<2791U				
Sum of PAHs		0				
Sum of Carcinogenic PAHs		0				

Table 5-2B
SVOC Analytical Results - Vadose Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	PQL / PQL-SV / 0.0-0.0 / Soil / / / / Primary / EPA8270	B-4 / B4-10 / 10.0-11.5 / Soil / 09/28/93 / Primary / EPA8270	B-5 / B5-7 / 7.0-8.5 / Soil / 10/24/93 / Primary / EPA8270	B-6 / B6-8 / 8.0-9.5 / Soil / 10/18/93 / Primary / EPA8270	B-9 / B9-7.5 / 7.5-9.0 / Soil / 10/18/93 / Primary / EPA8270
Semi-Volatile Organic Compounds(ug/Kg)						
Phenol	108-95-2	660	<6600U	<337U	<330U	<473U
bis(2-Chloroethyl) ether	111-44-4	660	<6600U	<337U	<330U	<473U
2-Chlorophenol	95-57-8	660	<6600U	<337U	<330U	<473U
1,3-Dichlorobenzene	541-73-1	660	<6600U	<337U	<330U	<473U
1,4-Dichlorobenzene	106-46-7	660	<6600U	<337U	<330U	<473U
Benzyl alcohol	100-51-6	660	<6600U	<337U	<330U	<473U
1,2-Dichlorobenzene	95-50-1	660	<6600U	<337U	<330U	<473U
2-Methylphenol	95-48-7	660	<6600U	<337U	<330U	<473U
Bis(2-chloroisopropyl)ether	39638-32-9	660	<6600U	<337U	<330U	<473U
4-Methylphenol	106-44-5	660	<6600U	<337U	<330U	<473U
N-Nitroso-di-n-propylamine	621-64-7	660	<6600U	<337U	<330U	<473U
Hexachloroethane	67-72-1	660	<6600U	<337U	<330U	<473U
Nitrobenzene	98-95-3	660	<6600U	<337U	<330U	<473U
Isophorone	78-59-1	660	<6600U	<337U	<330U	<473U
2-Nitrophenol	88-75-5	660	<6600U	<337U	<330U	<473U
2,4-Dimethylphenol	105-67-9	660	<33000U	<1687U	<1650U	<2367U
Benzoic acid	65-85-0	660	<6600U	<337U	<330U	<473U
Bis(2-chloroethoxy)methane	111-91-1	660	<6600U	<337U	<330U	<473U
2,4-Dichlorophenol	120-83-2	660	<6600U	<337U	<330U	<473U
1,2,4-Trichlorobenzene	120-82-1	660	<6600U	<337U	<330U	<473U
4-Chloroaniline	106-47-8	660	<6600U	<337U	<330U	<473U
Hexachlorobutadiene	87-68-3	660	<6600U	<337U	<330U	<473U
4-Chloro-3-methylphenol	59-50-7	1300	<6600U	<337U	<330U	<473U
2-Methylnaphthalene	91-57-6	660	8300	<337U	260J	100J
Hexachlorocyclopentadiene	77-47-4	660	<6600U	<337U	<330U	<473U
2,4,6-Trichlorophenol	88-06-2	660	<6600U	<337U	<330U	<473U
2,4,5-Trichlorophenol	95-95-4	3300	<33000U	<1687U	<1650U	<2367U
2-Chloronaphthalene	91-58-7	660	<6600U	<337U	<330U	<473U
2-Nitroaniline	88-74-4	3300	<33000U	<1687U	<1650U	<2367U
Dimethyl phthalate	131-11-3	660	<6600U	<337U	<330U	<473U
2,6-Dinitrotoluene	606-20-2	3300	<33000U	<1687U	<1650U	<2367U
3-Nitroaniline	99-09-2	3300	<33000U	<1687U	<1650U	<2367U
N-Nitrosodimethylamine	62-75-9	660	<6600U	<337U	<330U	<473U
2,4-Dinitrophenol	51-28-5	3300	<33000U	<1687U	<1650U	<2367U
4-Nitrophenol	100-02-7	3300	<33000U	<1687U	<1650U	<2367U
Dibenzofuran	132-64-9	660	<6600U	<337U	<330U	<473U
2,4-Dinitrotoluene	121-14-2	660	<6600U	<337U	<330U	<473U
Diethylphthalate	84-66-2	660	<6600U	<337U	<330U	<473U
4-Chlorophenyl-phenylether	7005-72-3	660	<6600U	<337U	<330U	<473U
4-Nitroaniline	100-01-6	3300	<33000U	<1687U	<1650U	<2367U
4,6-Dinitro,2-methylphenol	534-52-1	3300	<33000U	<1687U	<1650U	<2367U
N-Nitrosodiphenylamine	86-30-6	660	<6600U	<337U	<330U	<473U
4-Bromophenyl-phenylether	101-55-3	660	<6600U	<337U	<330U	<473U
Hexachlorobenzene	118-74-1	660	<6600U	<337U	<330U	<473U
Pentachlorophenol	87-86-5	3300	<33000U	<1687U	<1650U	<2367U
Di-n-butyl phthalate	84-74-2	660	<6600U	72J	110J	115J
Butylbenzylphthalate	85-68-7	660	<6600U	<337U	<330U	<473U
3,3'-Dichlorobenzidine	91-94-1	1300	<13200U	<675U	<660U	<947U
Bis(2-ethylhexyl)phthalate	117-81-7	660	<6600U	102J	<330U	<473U
Di-n-octyl phthalate	117-84-0	660	<6600U	112J	<330U	<473U
Azobenzene	103-33-3	3300	<33000U	<1687U	<1650U	<2367U
Naphthalene	91-20-3	660	<6600U	<337U	<330U	<473U
Acenaphthylene	208-96-8	660	<6600U	<337U	<330U	<473U
Acenaphthene	83-32-9	660	<6600U	<337U	<330U	<473U
Fluorene	86-73-7	660	<6600U	<337U	110J	<473U
Phenanthrene	85-01-8	660	7500	<337U	<330U	<473U
Anthracene	120-12-7	660	<6600U	<337U	<330U	<473U
Fluoranthene	206-44-0	660	<6600U	<337U	<330U	<473U
Pyrene	129-00-0	660	<6600U	<337U	190J	<473U
Benzo(a)anthracene	56-55-3	660	<6600U	<337U	<330U	<473U
Chrysene	218-01-9	660	<6600U	<337U	180J	<473U
Benzo(b)fluoranthene	205-99-2	660	<6600U	<337U	<330U	<473U
Benzo(k)fluoranthene	207-08-9	660	<6600U	<337U	<330U	<473U
Benzo(a)pyrene	50-32-8	660	<6600U	<337U	<330U	<473U
Indeno(1,2,3-cd)pyrene	193-39-5	660	<6600U	<337U	<330U	<473U
Dibenzo(a,h)anthracene	53-70-3	660	<6600U	<337U	<330U	<473U
Benzo(g,h,i)perylene	191-24-2	660	<6600U	<337U	<330U	<473U
Sum of PAHs		10560	7500	0	480	0
Sum of Carcinogenic PAHs		4620	0	0	180	0

Table 5-2B
SVOC Analytical Results - Vadose Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	B-12 B12-7.5 7.5-9.0 Soil 10/29/93 Primary EPA8270	MW-33 MW33-2.5 2.5-4.0 Soil 09/28/93 Primary EPA8270	MW-34 MW34-10 10.0-11.5 Soil 09/28/93 Primary EPA8270	MW-39 MW39-6 6.0-7.5 Soil 10/19/93 Primary EPA8270	MW-40 MW40-5 5.0-6.5 Soil 09/27/93 Primary EPA8270
Semi-Volatile Organic Compounds(ug/Kg)						
Phenol	108-95-2	<345U	<402U	<347U	<330U	<347U
bis(2-Chloroethyl) ether	111-44-4	<345U	<402U	<347U	<330U	<347U
2-Chlorophenol	95-57-8	<345U	<402U	<347U	<330U	<347U
1,3-Dichlorobenzene	541-73-1	<345U	<402U	<347U	<330U	<347U
1,4-Dichlorobenzene	106-46-7	<345U	<402U	<347U	<330U	<347U
Benzyl alcohol	100-51-6	<345U	<402U	<347U	<330U	<347U
1,2-Dichlorobenzene	95-50-1	<345U	<402U	<347U	<330U	<347U
2-Methylphenol	95-48-7	<345U	<402U	<347U	<330U	<347U
Bis(2-chloroisopropyl)ether	39638-32-9	<345U	<402U	<347U	<330U	<347U
4-Methylphenol	106-44-5	<345U	<402U	<347U	<330U	<347U
N-Nitroso-di-n-propylamine	621-64-7	<345U	<402U	<347U	<330U	<347U
Hexachloroethane	67-72-1	<345U	<402U	<347U	<330U	<347U
Nitrobenzene	98-95-3	<345U	<402U	<347U	<330U	<347U
Isophorone	78-59-1	<345U	<402U	<347U	<330U	<347U
2-Nitrophenol	88-75-5	<345U	<402U	<347U	<330U	<347U
2,4-Dimethylphenol	105-67-9	<1726U	<2012U	<1737U	<1650U	<1737U
Benzoic acid	65-85-0	<345U	<402U	<347U	<330U	<347U
Bis(2-chloroethoxy)methane	111-91-1	<345U	<402U	<347U	<330U	<347U
2,4-Dichlorophenol	120-83-2	<345U	<402U	<347U	<330U	<347U
1,2,4-Trichlorobenzene	120-82-1	<345U	<402U	<347U	<330U	<347U
4-Chloroaniline	106-47-8	<345U	<402U	<347U	<330U	<347U
Hexachlorobutadiene	87-68-3	<345U	<402U	<347U	<330U	<347U
4-Chloro-3-methylphenol	59-50-7	<345U	<402U	<347U	<330U	<347U
2-Methylnaphthalene	91-57-6	<345U	<402U	<347U	**320J**	<347U
Hexachlorocyclopentadiene	77-47-4	<345U	<402U	<347U	<330U	<347U
2,4,6-Trichlorophenol	88-06-2	<345U	<402U	<347U	<330U	<347U
2,4,5-Trichlorophenol	95-95-4	<1726U	<2012U	<1737U	<1650U	<1737U
2-Chloronaphthalene	91-58-7	<345U	<402U	<347U	<330U	<347U
2-Nitroaniline	88-74-4	<1726U	<1650U	<1737U	<1650U	<1737U
Dimethyl phthalate	131-11-3	<345U	<402U	<347U	<330U	<347U
2,6-Dinitrotoluene	606-20-2	<1726U	<1650U	<1737U	<1650U	<1737U
3-Nitroaniline	99-09-2	<1726U	<2012U	<1737U	<1650U	<1737U
N-Nitrosodimethylamine	62-75-9	<345U	<402U	<347U	<330U	<347U
2,4-Dinitrophenol	51-28-5	<1726U	<2012U	<1737U	<1650U	<1737U
4-Nitrophenol	100-02-7	<1726U	<2012U	<1737U	<1650U	<1737U
Dibenzofuran	132-64-9	<345U	<402U	<347U	<330U	<347U
2,4-Dinitrotoluene	121-14-2	<345U	<402U	<347U	<330U	<347U
Diethylphthalate	84-66-2	<345U	<402U	<347U	<330U	<347U
4-Chlorophenyl-phenylether	7005-72-3	<345U	<402U	<347U	<330U	<347U
4-Nitroaniline	100-01-6	<1726U	<2012U	<1737U	<1650U	<1737U
4,6-Dinitro,2-methylphenol	534-52-1	<1726U	<2012U	<1737U	<1650U	<1737U
N-Nitrosodiphenylamine	86-30-6	<345U	<402U	<347U	<330U	<347U
4-Bromophenyl-phenylether	101-55-3	<345U	<402U	<347U	<330U	<347U
Hexachlorobenzene	118-74-1	<345U	<402U	<347U	<330U	<347U
Pentachlorophenol	87-86-5	<1726U	<2012U	<1737U	<1650U	<1737U
Di-n-butyl phthalate	84-74-2	<345U	<402U	<347U	**80J**	<347U
Butylbenzylphthalate	85-68-7	**136J**	<402U	<347U	<330U	<347U
3,3'-Dichlorobenzidine	91-94-1	<660U	<805U	<695U	<660U	<695U
Bis(2-ethylhexyl)phthalate	117-81-7	**136J**	<402U	<347U	<330U	<347U
Di-n-octyl phthalate	117-84-0	<345U	<402U	<347U	<330U	<347U
Azobenzene	103-33-3	<1726U	<2012U	<1737U	<1650U	<1737U
Naphthalene	91-20-3	<345U	<402U	<347U	<330U	<347U
Acenaphthylene	208-96-8	<345U	<402U	<347U	<330U	<347U
Acenaphthene	83-32-9	<345U	<402U	<347U	<330U	<347U
Fluorene	86-73-7	<345U	<402U	<347U	<330U	<347U
Phenanthrene	85-01-8	<345U	<402U	<347U	**180J**	<347U
Anthracene	120-12-7	<345U	<402U	<347U	<330U	<347U
Fluoranthene	206-44-0	<345U	<402U	<347U	**200J**	<347U
Pyrene	129-00-0	<345U	<402U	<347U	**300J**	<347U
Benzo(a)anthracene	56-55-3	<345U	<402U	<347U	**110J**	<347U
Chrysene	218-01-9	<345U	<402U	<347U	<330U	<347U
Benzo(b)fluoranthene	205-99-2	<345U	<402U	<347U	**260J**	<347U
Benzo(k)fluoranthene	207-08-9	<345U	<402U	<347U	**80J**	<347U
Benzo(a)pyrene	50-32-8	<345U	<402U	<347U	**130J**	<347U
Indeno(1,2,3-cd)pyrene	193-39-5	<345U	<402U	<347U	**130J**	<347U
Dibenzo(a,h)anthracene	53-70-3	<345U	<402U	<347U	<330U	<347U
Benzo(g,h,i)perylene	191-24-2	<345U	<402U	<347U	**170J**	<347U
Sum of PAHs		**0**	**0**	**0**	**1560**	**0**
Sum of Carcinogenic PAHs		**0**	**0**	**0**	**710**	**0**

Table 5-2B
SVOC Analytical Results - Vadose Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	DW-2 / DW2-5 / 5.0-6.5 / Soil / 09/27/93 / Primary / EPA8270				
Semi-Volatile Organic Compounds(ug/Kg)						
Phenol	108-95-2	<367U				
bis(2-Chloroethyl) ether	111-44-4	<367U				
2-Chlorophenol	95-57-8	<367U				
1,3-Dichlorobenzene	541-73-1	<367U				
1,4-Dichlorobenzene	106-46-7	<367U				
Benzyl alcohol	100-51-6	<367U				
1,2-Dichlorobenzene	95-50-1	<367U				
2-Methylphenol	95-48-7	<367U				
Bis(2-chloroisopropyl)ether	39638-32-9	<367U				
4-Methylphenol	106-44-5	<367U				
N-Nitroso-di-n-propylamine	621-64-7	<367U				
Hexachloroethane	67-72-1	<367U				
Nitrobenzene	98-95-3	<367U				
Isophorone	78-59-1	<367U				
2-Nitrophenol	88-75-5	<367U				
2,4-Dimethylphenol	105-67-9	<1833U				
Benzoic acid	65-85-0	<367U				
Bis(2-chloroethoxy)methane	111-91-1	<367U				
2,4-Dichlorophenol	120-83-2	<367U				
1,2,4-Trichlorobenzene	120-82-1	<367U				
4-Chloroaniline	106-47-8	<367U				
Hexachlorobutadiene	87-68-3	<367U				
4-Chloro-3-methylphenol	59-50-7	<367U				
2-Methylnaphthalene	91-57-6	<367U				
Hexachlorocyclopentadiene	77-47-4	<367U				
2,4,6-Trichlorophenol	88-06-2	<367U				
2,4,5-Trichlorophenol	95-95-4	<1833U				
2-Chloronaphthalene	91-58-7	<367U				
2-Nitroaniline	88-74-4	<1833U				
Dimethyl phthalate	131-11-3	<367U				
2,6-Dinitrotoluene	606-20-2	<1833U				
3-Nitroaniline	99-09-2	<1833U				
N-Nitrosodimethylamine	62-75-9	<367U				
2,4-Dinitrophenol	51-28-5	<1833U				
4-Nitrophenol	100-02-7	<1833U				
Dibenzofuran	132-64-9	<367U				
2,4-Dinitrotoluene	121-14-2	<367U				
Diethylphthalate	84-66-2	<367U				
4-Chlorophenyl-phenylether	7005-72-3	<367U				
4-Nitroaniline	100-01-6	<1833U				
4,6-Dinitro,2-methylphenol	534-52-1	<1833U				
N-Nitrosodiphenylamine	86-30-6	<367U				
4-Bromophenyl-phenylether	101-55-3	<367U				
Hexachlorobenzene	118-74-1	<367U				
Pentachlorophenol	87-86-5	<1833U				
Di-n-butyl phthalate	84-74-2	<367U				
Butylbenzylphthalate	85-68-7	**300J**				
3,3'-Dichlorobenzidine	91-94-1	<733U				
Bis(2-ethylhexyl)phthalate	117-81-7	<367U				
Di-n-octyl phthalate	117-84-0	<367U				
Azobenzene	103-33-3	<1833U				
Naphthalene	91-20-3	<367U				
Acenaphthylene	208-96-8	<367U				
Acenaphthene	83-32-9	<367U				
Fluorene	86-73-7	<367U				
Phenanthrene	85-01-8	**144J**				
Anthracene	120-12-7	<367U				
Fluoranthene	206-44-0	**144J**				
Pyrene	129-00-0	<367U				
Benzo(a)anthracene	56-55-3	<367U				
Chrysene	218-01-9	**189J**				
Benzo(b)fluoranthene	205-99-2	<367U				
Benzo(k)fluoranthene	207-08-9	<367U				
Benzo(a)pyrene	50-32-8	<367U				
Indeno(1,2,3-cd)pyrene	193-39-5	<367U				
Dibenzo(a,h)anthracene	53-70-3	<367U				
Benzo(g,h,i)perylene	191-24-2	<367U				
Sum of PAHs		**477**				
Sum of Carcinogenic PAHs		**189**				

Table 5-2C
SVOC Analytical Results - Saturated Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REIEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	PQL / PQL-SV / 0.0-0.0 / Soil / / / / Primary / EPA8270	B-6 / B6-10.5 / 10.5-12.0 / Soil / 10/19/93 / Primary / EPA8270			
Semi-Volatile Organic Compounds(ug/Kg)						
Phenol	108-95-2	660	<330U			
bis(2-Chloroethyl) ether	111-44-4	660	<330U			
2-Chlorophenol	95-57-8	660	<330U			
1,3-Dichlorobenzene	541-73-1	660	<330U			
1,4-Dichlorobenzene	106-46-7	660	<330U			
Benzyl alcohol	100-51-6	660	<330U			
1,2-Dichlorobenzene	95-50-1	660	<330U			
2-Methylphenol	95-48-7	660	<330U			
Bis(2-chloroisopropyl)ether	39638-32-9	660	<330U			
4-Methylphenol	106-44-5	660	<330U			
N-Nitroso-di-n-propylamine	621-64-7	660	<330U			
Hexachloroethane	67-72-1	660	<330U			
Nitrobenzene	98-95-3	660	<330U			
Isophorone	78-59-1	660	<330U			
2-Nitrophenol	88-75-5	660	<330U			
2,4-Dimethylphenol	105-67-9	660	<1650U			
Benzoic acid	65-85-0	660	<330U			
Bis(2-chloroethoxy)methane	111-91-1	660	<330U			
2,4-Dichlorophenol	120-83-2	660	<330U			
1,2,4-Trichlorobenzene	120-82-1	660	<330U			
4-Chloroaniline	106-47-8	660	<330U			
Hexachlorobutadiene	87-68-3	660	<330U			
4-Chloro-3-methylphenol	59-50-7	1300	<330U			
2-Methylnaphthalene	91-57-6	660	520			
Hexachlorocyclopentadiene	77-47-4	660	<330U			
2,4,6-Trichlorophenol	88-06-2	660	<330U			
2,4,5-Trichlorophenol	95-95-4	3300	<1650U			
2-Chloronaphthalene	91-58-7	660	<330U			
2-Nitroaniline	88-74-4	3300	<1650U			
Dimethyl phthalate	131-11-3	660	<330U			
2,6-Dinitrotoluene	606-20-2	3300	<1650U			
3-Nitroaniline	99-09-2	3300	<1650U			
N-Nitrosodimethylamine	62-75-9	660	<330U			
2,4-Dinitrophenol	51-28-5	3300	<1650U			
4-Nitrophenol	100-02-7	3300	<1650U			
Dibenzofuran	132-64-9	660	<330U			
2,4-Dinitrotoluene	121-14-2	660	<330U			
Diethylphthalate	84-66-2	660	<330U			
4-Chlorophenyl-phenylether	7005-72-3	660	<330U			
4-Nitroaniline	100-01-6	3300	<1650U			
4,6-Dinitro,2-methylphenol	534-52-1	3300	<1650U			
N-Nitrosodiphenylamine	86-30-6	660	<330U			
4-Bromophenyl-phenylether	101-55-3	660	<330U			
Hexachlorobenzene	118-74-1	660	<330U			
Pentachlorophenol	87-86-5	3300	<1650U			
Di-n-butyl phthalate	84-74-2	660	70J			
Butylbenzylphthalate	85-68-7	660	<330U			
3,3'-Dichlorobenzidine	91-94-1	1300	<660U			
Bis(2-ethylhexyl)phthalate	117-81-7	660	<330U			
Di-n-octyl phthalate	117-84-0	660	<330U			
Azobenzene	103-33-3	3300	<1650U			
Naphthalene	91-20-3	660	<330U			
Acenaphthylene	208-96-8	660	<330U			
Acenaphthene	83-32-9	660	<330U			
Fluorene	86-73-7	660	<330U			
Phenanthrene	85-01-8	660	<330U			
Anthracene	120-12-7	660	<330U			
Fluoranthene	206-44-0	660	<330U			
Pyrene	129-00-0	660	<330U			
Benzo(a)anthracene	56-55-3	660	<330U			
Chrysene	218-01-9	660	<330U			
Benzo(b)fluoranthene	205-99-2	660	<330U			
Benzo(k)fluoranthene	207-08-9	660	<330U			
Benzo(a)pyrene	50-32-8	660	<330U			
Indeno(1,2,3-cd)pyrene	193-39-5	660	<330U			
Dibenzo(a,h)anthracene	53-70-3	660	<330U			
Benzo(g,h,i)perylene	191-24-2	660	<330U			
Sum of PAHs		10560	0			
Sum of Carcinogenic PAHs		4620	0			

Table 5-3A
VOC Analytical Results - Surface Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RE|EC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	PQL / PQL-TVP / 0.0-0.0 / Soil / / / / Primary / EPA8240	HA-1 / HA1-2 / 1.0-2.0 / Soil / 10/07/93 / Primary / EPA8240	HA-1 / HA10-2 / 1.0-2.0 / Soil / 10/07/93 / Duplicate / EPA8240	HA-2 / HA2-1 / 1.0-1.5 / Soil / 10/07/93 / Primary / EPA8240	HA-3 / HA3-1 / 0.0-1.0 / Soil / 10/07/93 / Primary / EPA8240
Volatile Organic Compounds(ug/Kg)						
Chloromethane	74-87-3	10	<10U	<10U	<12U	<12U
Bromomethane	74-83-9	10	<10U	<10U	<12U	<12U
Vinyl chloride	75-01-4	10	<10U	<10U	<12U	<12U
Chloroethane	75-00-3	10	<10U	<10U	<12U	<12U
Methylene chloride	75-09-2	5	**3JB**	**3JB**	**12B**	**11B**
Acrolein	107-02-8	10	<10U	<10U	<12U	<12U
Acrylonitrile	107-13-1	10	<10U	<10U	<12U	<12U
Acetone	67-64-1	5	<5U	<5U	<6U	<6U
Carbon disulfide	75-15-0	5	<5U	<5U	<6U	<6U
1,1-Dichloroethene	75-35-4	5	<5U	<5U	<6U	<6U
1,1-Dichloroethane	75-34-3	5	<5U	<5U	<6U	<6U
1,2-Dichloroethene	540-59-0	5	<5U	<5U	<6U	<6U
Chloroform	67-66-3	5	<5U	<5U	<6U	<6U
1,2-Dichloroethane	107-06-2	5	<5U	<5U	<6U	<6U
2-Butanone	78-93-3	5	<10U	<10U	<12U	<12U
1,1,1-Trichloroethane	71-55-6	5	<5U	<5U	<6U	<6U
Carbon tetrachloride	56-23-5	5	<5U	<5U	<6U	<6U
Vinyl acetate	108-05-4	5	<10U	<10U	<12U	<12U
Bromodichloromethane	75-27-4	5	<5U	<5U	<6U	<6U
1,2-Dichloropropane	78-87-5	5	<5U	<5U	<6U	<6U
cis-1,3-Dichloropropene	10061-01-5	5	<5U	<5U	<6U	<6U
Trichloroethene	79-01-6	5	<5U	<5U	<6U	<6U
Dibromochloromethane	124-48-1	5	<5U	<5U	<6U	<6U
1,1,2-Trichloroethane	79-00-5	5	<5U	<5U	<6U	<6U
trans-1,3-Dichloropropene	10061-02-6	5	<5U	<5U	<6U	<6U
2-Chloroethylvinyl ether	110-75-8	5	<5U	<5U	<6U	<6U
Bromoform	75-25-2	5	<5U	<5U	<6U	<6U
4-Methyl-2-pentanone	108-10-1	10	<10U	<10U	<12U	<12U
2-Hexanone	591-78-6	10	<10U	<10U	<12U	<12U
Tetrachloroethene	127-18-4	5	<5U	<5U	<6U	<6U
1,1,2,2-Tetrachloroethane	79-34-5	5	<5U	<5U	<6U	<6U
Chlorobenzene	108-90-7	5	<5U	<5U	<6U	<6U
Styrene	100-42-5	5	<5U	<5U	<6U	<6U
Benzene	71-43-2	5	<5U	<5U	<6U	<6U
Toluene	108-88-3	5	<5U	<5U	<6U	<6U
Ethylbenzene	100-41-4	5	<5U	<5U	<6U	<6U
Total xylenes	1330-20-7	5	<5U	<5U	<6U	<6U

Table 5-3A
VOC Analytical Results - Surface Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	HA-4 / HA4-0 / 0.0-1.0 / Soil / 10/07/93 / Primary / EPA8240				
Volatile Organic Compounds(ug/Kg)						
Chloromethane	74-87-3	<11U				
Bromomethane	74-83-9	<11U				
Vinyl chloride	75-01-4	<11U				
Chloroethane	75-00-3	<11U				
Methylene chloride	75-09-2	3JB				
Acrolein	107-02-8	<11U				
Acrylonitrile	107-13-1	<11U				
Acetone	67-64-1	14B				
Carbon disulfide	75-15-0	<5U				
1,1-Dichloroethene	75-35-4	<5U				
1,1-Dichloroethane	75-34-3	<5U				
1,2-Dichloroethene	540-59-0	<5U				
Chloroform	67-66-3	<5U				
1,2-Dichloroethane	107-06-2	<5U				
2-Butanone	78-93-3	<11U				
1,1,1-Trichloroethane	71-55-6	<5U				
Carbon tetrachloride	56-23-5	<5U				
Vinyl acetate	108-05-4	<11U				
Bromodichloromethane	75-27-4	<5U				
1,2-Dichloropropane	78-87-5	<5U				
cis-1,3-Dichloropropene	10061-01-5	<5U				
Trichloroethene	79-01-6	<5U				
Dibromochloromethane	124-48-1	<5U				
1,1,2-Trichloroethane	79-00-5	<5U				
trans-1,3-Dichloropropene	10061-02-6	<5U				
2-Chloroethylvinyl ether	110-75-8	<5U				
Bromoform	75-25-2	<5U				
4-Methyl-2-pentanone	108-10-1	<11U				
2-Hexanone	591-78-6	<11U				
Tetrachloroethene	127-18-4	<5U				
1,1,2,2-Tetrachloroethane	79-34-5	<5U				
Chlorobenzene	108-90-7	<5U				
Styrene	100-42-5	<5U				
Benzene	71-43-2	<5U				
Toluene	108-88-3	<5U				
Ethylbenzene	100-41-4	<5U				
Total xylenes	1330-20-7	<5U				

Table 5-3B
VOC Analytical Results - Vadose Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REITEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	PQL / PQL-TVP / 0.0-0.0 / Soil / / / / Primary / EPA8240	B-4 / B4-10 / 10.0-11.5 / Soil / 09/28/93 / Primary / EPA8240	B-4 / B40-10 / 10.0-11.5 / Soil / 09/28/93 / Duplicate / EPA8240	B-5 / B5-7 / 7.0-8.5 / Soil / 10/24/93 / Primary / EPA8240	B-6 / B6-8 / 8.0-9.5 / Soil / 10/18/93 / Primary / EPA8240
Volatile Organic Compounds(ug/Kg)						
Chloromethane	74-87-3	10	<53U	<53U	<10U	<20U
Bromomethane	74-83-9	10	<53U	<53U	<10U	<20U
Vinyl chloride	75-01-4	10	<53U	<53U	<10U	<20U
Chloroethane	75-00-3	10	<53U	<53U	<10U	<20U
Methylene chloride	75-09-2	5	38B	37B	10	10B
Acrolein	107-02-8	10	<53U	<53U	<10U	<20U
Acrylonitrile	107-13-1	10	<53U	<53U	<10U	<20U
Acetone	67-64-1	5	109B	100B	<5U	48B
Carbon disulfide	75-15-0	5	<27U	<27U	<5U	<10U
1,1-Dichloroethene	75-35-4	5	<27U	<27U	<5U	<10U
1,1-Dichloroethane	75-34-3	5	<27U	<27U	<5U	<10U
1,2-Dichloroethene	540-59-0	5	<27U	<27U	<5U	<10U
Chloroform	67-66-3	5	<27U	<27U	<5U	<10U
1,2-Dichloroethane	107-06-2	5	<27U	<27U	<5U	<10U
2-Butanone	78-93-3	5	<53U	<53U	<10U	<20U
1,1,1-Trichloroethane	71-55-6	5	<27U	<27U	<5U	<10U
Carbon tetrachloride	56-23-5	5	<27U	<27U	<5U	<10U
Vinyl acetate	108-05-4	5	<53U	<53U	<10U	<20U
Bromodichloromethane	75-27-4	5	<27U	<27U	<5U	<10U
1,2-Dichloropropane	78-87-5	5	<27U	<27U	<5U	<10U
cis-1,3-Dichloropropene	10061-01-5	5	<27U	<27U	<5U	<10U
Trichloroethene	79-01-6	5	<27U	<27U	<5U	<10U
Dibromochloromethane	124-48-1	5	<27U	<27U	<5U	<10U
1,1,2-Trichloroethane	79-00-5	5	<27U	<27U	<5U	<10U
trans-1,3-Dichloropropene	10061-02-6	5	<27U	<27U	<5U	<10U
2-Chloroethylvinyl ether	110-75-8	5	<27U	<27U	<5U	<10U
Bromoform	75-25-2	5	<27U	<27U	<5U	<10U
4-Methyl-2-pentanone	108-10-1	10	<53U	<53U	<10U	<20U
2-Hexanone	591-78-6	10	<53U	<53U	<10U	<20U
Tetrachloroethene	127-18-4	5	<27U	<27U	<5U	<10U
1,1,2,2-Tetrachloroethane	79-34-5	5	<27U	<27U	<5U	<10U
Chlorobenzene	108-90-7	5	<27U	<27U	<5U	<10U
Styrene	100-42-5	5	<27U	<27U	176	16
Benzene	71-43-2	5	<27U	<27U	<5U	<10U
Toluene	108-88-3	5	<27U	<27U	<5U	<10U
Ethylbenzene	100-41-4	5	<27U	<27U	<5U	<10U
Total xylenes	1330-20-7	5	<27U	<27U	<5U	<10U

Table 5-3B
VOC Analytical Results - Vadose Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	B-9 / B9-7.5 / 7.5-9.0 / Soil / 10/18/93 / Primary / EPA8240	B-12 / B12-7.5 / 7.5-9.0 / Soil / 10/29/93 / Primary / EPA8240	MW-33 / MW33-5 / 5.0-6.5 / Soil / 09/28/93 / Primary / EPA8240	MW-34 / MW34-7.5 / 7.5-9.0 / Soil / 09/28/93 / Primary / EPA8240	MW-35 / MW35-7.5 / 7.5-9.0 / Soil / 09/28/93 / Primary / EPA8240
Volatile Organic Compounds(ug/Kg)						
Chloromethane	74-87-3	<14U	<10U	<11U	<10U	<10U
Bromomethane	74-83-9	<14U	<10U	<11U	<10U	<10U
Vinyl chloride	75-01-4	<14U	<10U	<11U	<10U	<10U
Chloroethane	75-00-3	<14U	<10U	<11U	<10U	<10U
Methylene chloride	75-09-2	**10B**	**6B**	**13B**	**4JB**	**5B**
Acrolein	107-02-8	<14U	<10U	<11U	<10U	<10U
Acrylonitrile	107-13-1	<14U	<10U	<11U	<10U	<10U
Acetone	67-64-1	**86B**	<5U	**14B**	**15B**	**10B**
Carbon disulfide	75-15-0	<7U	<5U	<5U	<5U	<5U
1,1-Dichloroethene	75-35-4	<7U	<5U	<5U	<5U	<5U
1,1-Dichloroethane	75-34-3	<7U	<5U	<5U	<5U	<5U
1,2-Dichloroethene	540-59-0	<7U	<5U	<5U	<5U	<5U
Chloroform	67-66-3	<7U	<5U	<5U	<5U	<5U
1,2-Dichloroethane	107-06-2	<7U	<5U	**9**	<5U	<5U
2-Butanone	78-93-3	**24**	<10U	<11U	<10U	<10U
1,1,1-Trichloroethane	71-55-6	<7U	<5U	<5U	<5U	<5U
Carbon tetrachloride	56-23-5	<7U	<5U	<5U	<5U	<5U
Vinyl acetate	108-05-4	<14U	<10U	<11U	<10U	<10U
Bromodichloromethane	75-27-4	<7U	<5U	<5U	<5U	<5U
1,2-Dichloropropane	78-87-5	<7U	<5U	<5U	<5U	<5U
cis-1,3-Dichloropropene	10061-01-5	<7U	<5U	<5U	<5U	<5U
Trichloroethene	79-01-6	<7U	<5U	<5U	<5U	<5U
Dibromochloromethane	124-48-1	<7U	<5U	<5U	<5U	<5U
1,1,2-Trichloroethane	79-00-5	<7U	<5U	<5U	<5U	<5U
trans-1,3-Dichloropropene	10061-02-6	<7U	<5U	<5U	<5U	<5U
2-Chloroethylvinyl ether	110-75-8	<7U	<5U	<5U	<5U	<5U
Bromoform	75-25-2	<7U	<5U	<5U	<5U	<5U
4-Methyl-2-pentanone	108-10-1	<14U	<10U	<11U	<10U	<10U
2-Hexanone	591-78-6	<14U	<10U	<11U	<10U	<10U
Tetrachloroethene	127-18-4	<7U	<5U	<5U	<5U	<5U
1,1,2,2-Tetrachloroethane	79-34-5	<7U	<5U	<5U	<5U	<5U
Chlorobenzene	108-90-7	<7U	<5U	<5U	<5U	<5U
Styrene	100-42-5	**19**	<5U	<5U	<5U	<5U
Benzene	71-43-2	<7U	<5U	<5U	<5U	<5U
Toluene	108-88-3	<7U	<5U	<5U	<5U	<5U
Ethylbenzene	100-41-4	<7U	<5U	<5U	<5U	<5U
Total xylenes	1330-20-7	<7U	<5U	<5U	<5U	<5U

Table 5-3B
VOC Analytical Results - Vadose Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RE||EC

Analyte	Sample location: / CAS NO.	MW-35	MW-36	MW-37	MW-38	MW-39
	Sample no:	MW53-7.5	MW36-6	MW37-7.5	MW38-7.5	MW39-6
	Depth(ft):	7.5-9.0	6.0-7.5	7.5-9.0	7.5-9.0	6.0-7.5
	Matrix:	Soil	Soil	Soil	Soil	Soil
	Sample Date:	09/28/93	10/21/93	10/22/93	10/24/93	10/19/93
	Type:	Duplicate	Primary	Primary	Primary	Primary
	Method:	EPA8240	EPA8240	EPA8240	EPA8240	EPA8240
Volatile Organic Compounds(ug/Kg)						
Chloromethane	74-87-3	<10U	<53U	<10U	<11U	<10U
Bromomethane	74-83-9	<10U	<53U	<10U	<11U	<10U
Vinyl chloride	75-01-4	<10U	<53U	<10U	<11U	<10U
Chloroethane	75-00-3	<10U	<53U	<10U	<11U	<10U
Methylene chloride	75-09-2	**12B**	**56B**	**17B**	**14B**	**14B**
Acrolein	107-02-8	<10U	<53U	<10U	<11U	<10U
Acrylonitrile	107-13-1	<10U	<53U	<10U	<11U	<10U
Acetone	67-64-1	**12B**	**88B**	**37B**	**19B**	**17B**
Carbon disulfide	75-15-0	<5U	<26U	<5U	<6U	<5U
1,1-Dichloroethene	75-35-4	<5U	<26U	<5U	<6U	<5U
1,1-Dichloroethane	75-34-3	<5U	<26U	<5U	<6U	<5U
1,2-Dichloroethene	540-59-0	<5U	<26U	<5U	<6U	<5U
Chloroform	67-66-3	<5U	<26U	<5U	<6U	<5U
1,2-Dichloroethane	107-06-2	<5U	<26U	<5U	<6U	<5U
2-Butanone	78-93-3	<10U	<53U	<10U	<11U	<10U
1,1,1-Trichloroethane	71-55-6	<5U	<26U	<5U	<6U	<5U
Carbon tetrachloride	56-23-5	<5U	<26U	<5U	<6U	<5U
Vinyl acetate	108-05-4	<10U	<53U	<10U	<11U	<10U
Bromodichloromethane	75-27-4	<5U	<26U	<5U	<6U	<5U
1,2-Dichloropropane	78-87-5	<5U	<26U	<5U	<6U	<5U
cis-1,3-Dichloropropene	10061-01-5	<5U	<26U	<5U	<6U	<5U
Trichloroethene	79-01-6	<5U	<26U	<5U	<6U	<5U
Dibromochloromethane	124-48-1	<5U	<26U	<5U	<6U	<5U
1,1,2-Trichloroethane	79-00-5	<5U	<26U	<5U	<6U	<5U
trans-1,3-Dichloropropene	10061-02-6	<5U	<26U	<5U	<6U	<5U
2-Chloroethylvinyl ether	110-75-8	<5U	<26U	<5U	<6U	<5U
Bromoform	75-25-2	<5U	<26U	<5U	<6U	<5U
4-Methyl-2-pentanone	108-10-1	<10U	<53U	<10U	<11U	<10U
2-Hexanone	591-78-6	<10U	<53U	<10U	<11U	<10U
Tetrachloroethene	127-18-4	<5U	<26U	<5U	<6U	<5U
1,1,2,2-Tetrachloroethane	79-34-5	<5U	<26U	**23**	<6U	<5U
Chlorobenzene	108-90-7	<5U	<26U	<5U	<6U	<5U
Styrene	100-42-5	<5U	<26U	<5U	**58**	**28**
Benzene	71-43-2	<5U	<26U	<5U	<6U	<5U
Toluene	108-88-3	<5U	<26U	<5U	<6U	<5U
Ethylbenzene	100-41-4	<5U	<26U	<5U	<6U	<5U
Total xylenes	1330-20-7	<5U	<26U	<5U	<6U	<5U

Table 5-3B
VOC Analytical Results - Vadose Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REI EC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	MW-40 / MW40-5 / 5.0-6.5 / Soil / 09/27/93 / Primary / EPA8240	DW-2 / DW2-10 / 10.0-11.5 / Soil / 09/27/93 / Primary / EPA8240			
Volatile Organic Compounds(ug/Kg)						
Chloromethane	74-87-3	<10U	<11U			
Bromomethane	74-83-9	<10U	<11U			
Vinyl chloride	75-01-4	<10U	<11U			
Chloroethane	75-00-3	<10U	<11U			
Methylene chloride	75-09-2	**4JB**	**4JB**			
Acrolein	107-02-8	<10U	<11U			
Acrylonitrile	107-13-1	<10U	<11U			
Acetone	67-64-1	**7B**	**23B**			
Carbon disulfide	75-15-0	<5U	<5U			
1,1-Dichloroethene	75-35-4	<5U	<5U			
1,1-Dichloroethane	75-34-3	<5U	<5U			
1,2-Dichloroethene	540-59-0	<5U	<5U			
Chloroform	67-66-3	<5U	<5U			
1,2-Dichloroethane	107-06-2	<5U	<5U			
2-Butanone	78-93-3	<10U	<11U			
1,1,1-Trichloroethane	71-55-6	<5U	<5U			
Carbon tetrachloride	56-23-5	<5U	<5U			
Vinyl acetate	108-05-4	<10U	<11U			
Bromodichloromethane	75-27-4	<5U	<5U			
1,2-Dichloropropane	78-87-5	<5U	<5U			
cis-1,3-Dichloropropene	10061-01-5	<5U	<5U			
Trichloroethene	79-01-6	<5U	<5U			
Dibromochloromethane	124-48-1	<5U	<5U			
1,1,2-Trichloroethane	79-00-5	<5U	<5U			
trans-1,3-Dichloropropene	10061-02-6	<5U	<5U			
2-Chloroethylvinyl ether	110-75-8	<5U	<5U			
Bromoform	75-25-2	<5U	<5U			
4-Methyl-2-pentanone	108-10-1	<10U	<11U			
2-Hexanone	591-78-6	<10U	<11U			
Tetrachloroethene	127-18-4	<5U	<5U			
1,1,2,2-Tetrachloroethane	79-34-5	<5U	<5U			
Chlorobenzene	108-90-7	<5U	<5U			
Styrene	100-42-5	<5U	<5U			
Benzene	71-43-2	<5U	<5U			
Toluene	108-88-3	<5U	<5U			
Ethylbenzene	100-41-4	<5U	<5U			
Total xylenes	1330-20-7	<5U	<5U			

Table 5-4A
Metals Analytical Results - Surface Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	PQL / PQL-METAL / 0.0-0.0 / Soil / / / / Primary	B-4 / B4-0 / 0.0-0.5 / Soil / 09/28/93 / Primary	B-5 / B5-0 / 0.0-0.5 / Soil / 10/24/93 / Primary	B-6 / B6-0 / 0.0-0.5 / Soil / 10/18/93 / Primary	B-7 / B7-0 / 0.0-0.5 / Soil / 10/22/93 / Primary
Total Metals - EPA 6010(mg/Kg)						
Silver	7440-22-4	1.0	<1U	<1U	<1.1U	<1U
Beryllium	7440-41-7	0.05	<0.5U	<0.4U	<0.6U	<0.5U
Cadmium	7440-43-9	0.5	<0.5U	<0.5U	1	<0.5U
Copper	7440-50-8	1.0	252	66	68.5	38
Mercury	7439-97-6	0.01	0.04	0.02	0.05	0.19
Nickel	7440-02-0	2.0	24	21	33.4	28
Antimony	7440-36-0	0.01	0.2	0.14	0.2	<0.11U
Selenium	7782-49-2	0.10	<0.2U	0.1	<0.6U	0.2
Thallium	7440-28-0	0.20	<0.2U	<0.2U	<0.2U	<0.2U
Zinc	7440-66-6	1.0	58	112	460	82
Arsenic	7440-38-2	0.10	4.8	11.7	9	9.7
Chromium	7440-47-3	1.0	20	20	25.3	27
Lead	7439-92-1	2.0	125	99	480	102

Table 5-4A
Metals Analytical Results - Surface Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	B-8 / B8-0 / 0.0-0.5 / Soil / 10/20/93 / Primary	B-9 / B9-0 / 0.0-0.5 / Soil / 10/18/93 / Primary	B-10 / B10-0 / 0.0-0.5 / Soil / 09/29/93 / Primary	B-11 / B11-0 / 0.0-0.5 / Soil / 09/27/93 / Primary	B-11 / B110-0 / 0.0-0.5 / Soil / 09/27/93 / Duplicate
Total Metals - EPA 6010(mg/Kg)						
Silver	7440-22-4	<1U	<1.1U	<1U	<1U	<1U
Beryllium	7440-41-7	<0.5U	<0.6U	<0.5U	<0.5U	<0.5U
Cadmium	7440-43-9	<0.6U	**0.8**	<0.6U	<0.5U	<0.5U
Copper	7440-50-8	**70.9**	**317**	**28.4**	**36**	**33**
Mercury	7439-97-6	**0.03**	**0.07**	<0.02U	**0.16**	**0.13**
Nickel	7440-02-0	**23**	**41.6**	**33**	**37**	**36**
Antimony	7440-36-0	<0.2U	**2.2**	<0.3U	**0.1**	<0.1U
Selenium	7782-49-2	<0.2U	<0.6U	<0.1U	**0.3**	<0.2U
Thallium	7440-28-0	<0.2U	<0.2U	<0.2U	<0.2U	<0.2U
Zinc	7440-66-6	**93.3**	**450**	**47.8**	**187**	**147**
Arsenic	7440-38-2	**7**	**6**	**10**	**11.2**	**10.9**
Chromium	7440-47-3	**18.1**	**21.8**	**35.4**	**43**	**41**
Lead	7439-92-1	**133**	**3600**	**11.3**	**1897**	**967**

Table 5-4A
Metals Analytical Results - Surface Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REIEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	B-12 / B12-0 / 0.0-0.5 / Soil / 10/29/93 / Primary	HA-1 / HA1-2 / 1.0-2.0 / Soil / 10/07/93 / Primary	HA-1 / HA10-2 / 1.0-2.0 / Soil / 10/07/93 / Duplicate	HA-2 / HA2-1 / 1.0-1.5 / Soil / 10/07/93 / Primary	HA-3 / HA3-1 / 0.0-1.0 / Soil / 10/07/93 / Primary
Total Metals - EPA 6010(mg/Kg)						
Silver	7440-22-4	<1U	<1U	<1U	<1.1U	<2.4U
Beryllium	7440-41-7	<0.5U	<0.5U	<0.5U	1	<1.2U
Cadmium	7440-43-9	<0.5U	<0.6U	<0.6U	16.6	<1.2U
Copper	7440-50-8	26	18.7	14.6	85.7	38.7
Mercury	7439-97-6	0.03	0.02	<0.02U	59	0.08
Nickel	7440-02-0	35	26.1	21.7	22.5	37.8
Antimony	7440-36-0	<0.11U	<0.2U	<0.2U	1.5	<0.3U
Selenium	7782-49-2	<0.11U	<0.1U	<0.1U	0.6	<0.2U
Thallium	7440-28-0	<0.2U	<0.2U	<0.2U	0.2	<0.2U
Zinc	7440-66-6	67	46.9	37.5	2400	207
Arsenic	7440-38-2	5.5	9	4	8	12
Chromium	7440-47-3	33	29.7	27.9	26.4	58.3
Lead	7439-92-1	9	20.9	11.4	550	116

Table 5-4A
Metals Analytical Results - Surface Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	HA-4 / HA4-0 / 0.0-1.0 / Soil / 10/07/93 / Primary	MW-33 / MW33-0 / 0.0-0.5 / Soil / 09/28/93 / Primary	MW-34 / MW34-0 / 0.0-0.5 / Soil / 09/28/93 / Primary	MW-35 / MW35-0 / 0.0-0.5 / Soil / 09/28/93 / Primary	MW-36 / MW36-0 / 0.0-0.5 / Soil / 10/21/93 / Primary
Total Metals - EPA 6010(mg/Kg)						
Silver	7440-22-4	<1.1U	<1U	<1U	<1U	<1U
Beryllium	7440-41-7	<0.5U	<0.5U	<0.5U	<0.6U	<0.5U
Cadmium	7440-43-9	<0.6U	<0.5U	<0.5U	<0.6U	<0.6U
Copper	7440-50-8	41.6	110	23	16.6	25.3
Mercury	7439-97-6	0.10	0.17	<0.02U	<0.02U	0.03
Nickel	7440-02-0	30.8	41	34	22	22.7
Antimony	7440-36-0	<0.3U	1.0	<0.5U	<0.2U	<0.2U
Selenium	7782-49-2	<0.2U	<0.2U	<0.2U	0.1	<0.1U
Thallium	7440-28-0	<0.2U	<0.2U	<0.2U	<0.2U	<0.2U
Zinc	7440-66-6	222	76	49	34.7	79.8
Arsenic	7440-38-2	7	3	8.4	10	0.1
Chromium	7440-47-3	40.9	21	40	24.3	25.8
Lead	7439-92-1	196	211	9	3.6	78.5

Table 5-4A
Metals Analytical Results - Surface Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REIEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	MW-37 / MW37-0 / 0.0-0.5 / Soil / 10/21/93 / Primary	MW-38 / MW38-0 / 0.0-0.5 / Soil / 10/23/93 / Primary	MW-39 / MW39-0 / 0.0-0.5 / Soil / 10/19/93 / Primary	MW-40 / MW40-0 / 0.0-0.5 / Soil / 09/27/93 / Primary	DW-1 / DW1-0 / 0.0-0.5 / Soil / 09/28/93 / Primary
Total Metals - EPA 6010(mg/Kg)						
Silver	7440-22-4	<1.1U	<1U	<1.2U	<1U	<1U
Beryllium	7440-41-7	<0.5U	<0.5U	<0.6U	<0.5U	<0.5U
Cadmium	7440-43-9	<0.6U	<0.5U	<0.6U	0.5	<0.5U
Copper	7440-50-8	36.4	25	21.7	57	39
Mercury	7439-97-6	0.02	0.02	0.04	0.07	<0.02U
Nickel	7440-02-0	18.2	27	25.5	34	27
Antimony	7440-36-0	<0.2U	<0.11U	<0.2U	0.2	<0.1U
Selenium	7782-49-2	<0.2U	0.1	<0.1U	<0.2U	<0.2U
Thallium	7440-28-0	<0.2U	<0.2U	<0.2U	<0.2U	<0.2U
Zinc	7440-66-6	84.5	63	48	197	76
Arsenic	7440-38-2	8	8.7	4	5.8	6.1
Chromium	7440-47-3	19.3	28	28.4	46	42
Lead	7439-92-1	104	48	37.8	283	79

Table 5-4A
Metals Analytical Results - Surface Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	DW-2 / DW2-0 / 0.0-0.5 / Soil / 09/27/93 / Primary	DW-3 / DW3-0 / 0.0-0.5 / Soil / 09/29/93 / Primary	DW-4 / DW4-0 / 0.0-0.5 / Soil / 09/27/93 / Primary	DW-5 / DW5-0 / 0.0-0.5 / Soil / 10/23/93 / Primary	SS-13 / SS13-0 / 0.0-0.5 / Soil / 09/30/93 / Primary
Total Metals - EPA 6010(mg/Kg)						
Silver	7440-22-4	<1U	<2.3U	<1U	<1U	<1U
Beryllium	7440-41-7	<0.5U	<1.1U	<0.5U	<0.5U	<0.5U
Cadmium	7440-43-9	<0.5U	1.4	<0.5U	<0.5U	<0.6U
Copper	7440-50-8	51	124	37	23	36.5
Mercury	7439-97-6	0.12	0.06	<0.02U	<0.02U	0.11
Nickel	7440-02-0	42	27.1	27	32	22.2
Antimony	7440-36-0	<0.1U	0.6	0.2	<0.1U	<0.3U
Selenium	7782-49-2	<0.2U	0.2	0.2	<0.1U	<0.1U
Thallium	7440-28-0	<0.2U	<0.2U	<0.2U	<0.2U	<0.2U
Zinc	7440-66-6	240	306	60	37	162
Arsenic	7440-38-2	11	17	<0.2U	7.3	14
Chromium	7440-47-3	52	20.7	29	27	23.2
Lead	7439-92-1	337	179	29	6	106

Table 5-4A
Metals Analytical Results - Surface Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REIEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	SS-14 / SS14-0 / 0.0-0.5 / Soil / 09/30/93 / Primary	SS-14 / SS41-0 / 0.0-0.5 / Soil / 09/30/93 / Duplicate	SS-15 / SS15-0 / 0.0-0.5 / Soil / 09/30/93 / Primary	SS-16 / SS16-0 / 0.0-0.5 / Soil / 09/30/93 / Primary	SS-17 / SS17-0 / 0.0-0.5 / Soil / 09/30/93 / Primary
Total Metals - EPA 6010(mg/Kg)						
Silver	7440-22-4	<1U	<1U	<1U	<5.2U	<1.2U
Beryllium	7440-41-7	<0.5U	<0.5U	<0.5U	<2.7U	<0.6U
Cadmium	7440-43-9	<0.6U	<0.6U	<0.6U	<3U	<0.7U
Copper	7440-50-8	39.5	40	63.4	160	32.4
Mercury	7439-97-6	0.02	<0.02U	0.03	0.06	0.05
Nickel	7440-02-0	17.5	18.7	22	27.3	35.4
Antimony	7440-36-0	<0.3U	<0.3U	<0.3U	8.8	0.2
Selenium	7782-49-2	<0.1U	<0.1U	<0.1U	0.1	<0.1U
Thallium	7440-28-0	<0.2U	<0.2U	<0.2U	<0.2U	0.2
Zinc	7440-66-6	60	62.5	95.2	149	178
Arsenic	7440-38-2	12	11	19	22	18
Chromium	7440-47-3	17.5	18.9	20.8	22	39.4
Lead	7439-92-1	67.4	73.3	196	1300	79.1

Table 5-4A
Metals Analytical Results - Surface Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REIC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	SS-18 / SS18-0 / 0.0-0.5 / Soil / 09/30/93 / Primary	SS-19 / SS19-0 / 0.0-0.5 / Soil / 09/30/93 / Primary	SS-19.1 / SS19.1-0 / 0.0-0.5 / Soil / 09/30/93 / Primary	SS-20 / SS20-0 / 0.0-0.5 / Soil / 10/01/93 / Primary	SS-21 / SS21-0 / 0.0-0.5 / Soil / 09/30/93 / Primary
Total Metals - EPA 6010(mg/Kg)						
Silver	7440-22-4	<5.2U	<10U	<5.3U	<1U	<5.4U
Beryllium	7440-41-7	<2.7U	<5.2U	<2.6U	<0.5U	<2.7U
Cadmium	7440-43-9	<2.6U	<5.2U	<2.6U	<0.6U	<2.7U
Copper	7440-50-8	37.8	125	126	61.3	118
Mercury	7439-97-6	0.05	0.08	0.08	0.02	0.08
Nickel	7440-02-0	28.9	52.5	27.6	21.6	32.4
Antimony	7440-36-0	<0.3U	0.9	<0.3U	<0.3U	<0.3U
Selenium	7782-49-2	<0.1U	<0.2U	<0.2U	<0.5U	<0.2U
Thallium	7440-28-0	<0.2U	0.3	0.2	<0.2U	0.3
Zinc	7440-66-6	99.2	337	308	86.9	170
Arsenic	7440-38-2	12	64	48	6	20
Chromium	7440-47-3	30.4	42.2	27	20.2	26.5
Lead	7439-92-1	133	660	357	119	425

Table 5-4A
Metals Analytical Results - Surface Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	SS-22 / SS22-0 / 0.0-0.5 / Soil / 09/30/93 / Primary	SS-23 / SS23-0 / 0.0-0.5 / Soil / 09/30/93 / Primary	SS-24 / SS24-0 / 0.0-0.5 / Soil / 09/30/93 / Primary	SS-25 / SS25-0 / 0.0-0.5 / Soil / 10/01/93 / Primary	SS-26 / SS26-0 / 0.0-0.5 / Soil / 10/01/93 / Primary
Total Metals - EPA 6010(mg/Kg)						
Silver	7440-22-4	<5.2U	<1.2U	<1U	<6U	<6U
Beryllium	7440-41-7	<2.6U	<0.6U	<0.5U	<3U	<3U
Cadmium	7440-43-9	<2.6U	1.3	<0.6U	<2.8U	<2.9U
Copper	7440-50-8	73.6	130	45.9	146	107
Mercury	7439-97-6	0.02	0.06	<0.02U	0.08	0.04
Nickel	7440-02-0	29.9	23.2	18.6	29.7	22.6
Antimony	7440-36-0	<0.3U	<0.3U	<0.3U	0.6	<0.3U
Selenium	7782-49-2	<0.2U	<0.2U	<0.1U	<0.6U	<0.6U
Thallium	7440-28-0	<0.2U	<0.2U	0.3	<0.2U	<0.2U
Zinc	7440-66-6	151	208	52.8	80.6	175
Arsenic	7440-38-2	24	21	10	9	20
Chromium	7440-47-3	23.2	23.6	18.4	17.4	27.1
Lead	7439-92-1	222	156	28.4	268	110

Table 5-4A
Metals Analytical Results - Surface Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REIEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	SS-27 / SS27-0 / 0.0-0.5 / Soil / 09/30/93 / Primary	SS-28 / SS28-0 / 0.0-0.5 / Soil / 09/29/93 / Primary	SS-29 / SS29-0 / 0.0-0.5 / Soil / 09/30/93 / Primary	SS-29 / SS92-0 / 0.0-0.5 / Soil / 09/30/93 / Duplicate	SS-30 / SS30-0 / 0.0-0.5 / Soil / 09/30/93 / Primary
Total Metals - EPA 6010(mg/Kg)						
Silver	7440-22-4	<1U	<1U	<2.1U	<1U	<1.2U
Beryllium	7440-41-7	<0.5U	0.5	<1.1U	<0.5U	<0.6U
Cadmium	7440-43-9	0.6	<0.6U	<1.1U	<0.6U	<0.6U
Copper	7440-50-8	36	195	323	350	26.7
Mercury	7439-97-6	0.13	<0.02U	0.05	0.06	0.18
Nickel	7440-02-0	21.5	35	71.9	72.2	29.1
Antimony	7440-36-0	0.2	2.7	2.6	1.6	<0.3U
Selenium	7782-49-2	<0.2U	0.3	0.2	0.5	0.2
Thallium	7440-28-0	<0.2U	<0.2U	<0.2U	<0.2U	<0.2U
Zinc	7440-66-6	223	101	264	262	62.5
Arsenic	7440-38-2	11	8	21	17	20
Chromium	7440-47-3	22	10.3	18.1	22.3	35
Lead	7439-92-1	151	920	402	440	18.3

Table 5-4A
Metals Analytical Results - Surface Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REIEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	SS-31 / SS31-0 / 0.0-0.5 / Soil / 09/30/93 / Primary	SS-32 / SS32-0 / 0.0-0.5 / Soil / 09/30/93 / Primary	BG-1 / BG1-0 / 0.0-0.5 / Soil / 10/01/93 / Primary	BG-2 / BG2-0 / 0.0-0.5 / Soil / 09/30/93 / Primary	
Total Metals - EPA 6010(mg/Kg)						
Silver	7440-22-4	<5.4U	<1U	<1.2U	<1.5U	
Beryllium	7440-41-7	<2.7U	<0.5U	<0.6U	<0.7U	
Cadmium	7440-43-9	<2.7U	<0.6U	<0.6U	<0.7U	
Copper	7440-50-8	37.3	22.5	18.5	26.2	
Mercury	7439-97-6	0.06	<0.02U	0.03	0.06	
Nickel	7440-02-0	51.3	37.5	22.8	33.7	
Antimony	7440-36-0	<0.3U	<0.3U	<0.3U	<0.3U	
Selenium	7782-49-2	0.1	0.1	<0.6U	0.1	
Thallium	7440-28-0	<0.2U	<0.2U	<0.2U	0.3	
Zinc	7440-66-6	74	35.7	62.4	75.3	
Arsenic	7440-38-2	24	6	7	31	
Chromium	7440-47-3	47	36.2	30.9	41.7	
Lead	7439-92-1	11.9	9.7	15.7	28.2	

Table 5-4B
Metals Analytical Results - Saturated Zone Soil
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	PQL / PQL-METAL / 0.0-0.0 / Soil / / / / Primary	B-6 / B6-10.5 / 10.5-12.0 / Soil / 10/19/93 / Primary			
Total Metals - EPA 6010(mg/Kg)						
Silver	7440-22-4	1.0	<1.1U			
Beryllium	7440-41-7	0.05	<0.5U			
Cadmium	7440-43-9	0.5	<0.6U			
Copper	7440-50-8	1.0	15.5			
Mercury	7439-97-6	0.01	<0.02U			
Nickel	7440-02-0	2.0	13.7			
Antimony	7440-36-0	0.01	<0.2U			
Selenium	7782-49-2	0.10	<0.1U			
Thallium	7440-28-0	0.20	<0.2U			
Zinc	7440-66-6	1.0	28.6			
Arsenic	7440-38-2	0.10	3			
Chromium	7440-47-3	1.0	14.3			
Lead	7439-92-1	2.0	4.2			

TABLE 5-5
PCB ANALYTICAL RESULTS - SOIL
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

COMPOUND:				PCBs (EPA Method 8080)																				
				Aroclor 1016			Aroclor 1221			Aroclor 1232			Aroclor 1242			Aroclor 1248			Aroclor 1254			Aroclor 1260		
Sample ID:	Laboratory Sample ID:	Sample Date:	PQL (µg/kg)	Conc. (µg/kg)	MDL	Q	Conc. (µg/kg)	MDL	Q	Conc. (µg/kg)	MDL	Q	Conc. (µg/kg)	MDL	Q	Conc. (µg/kg)	MDL	Q	Conc. (µg/kg)	MDL	Q	Conc. (µg/kg)	MDL	Q
Surface Soil																								
B4-0	559-2789	9/28/93	33		85	U		85	U		85	U		85	U		85	U	86	170	J		170	U
B4-2	559-2787	9/28/93	33		92	U		92	U		92	U		92	U		92	U		183	U		183	U
B5-0	626-3177	10/24/93	33		80	U		80	U		80	U		80	U		80	U	24	160	J		160	U
B6-0	618-3100	10/18/93	33		93	U		93	U		93	U		93	U		93	U	45	186	J		186	U
B7-0	626-3176	10/22/93	33		85	U		85	U		85	U		85	U		85	U	25	171	J		171	U
B8-0	621-3146	10/20/93	33		84	U		84	U		84	U		84	U		84	U	14	169	J		169	U
B9-0	618-3099	10/18/93	33		89	U		89	U		89	U		89	U		89	U	54	178	J		178	U
DW2-0	559-2788	9/27/93	33		93	U		93	U		93	U		93	U		93	U		186	U		186	U
DW2-2	559-2786	9/27/93	33		92	U		92	U		92	U		92	U		92	U		184	U		184	U
DW3-0	573-2857	9/29/93	33		90	U		90	U		90	U		90	U		90	U		180	U		180	U
DW3-2	573-2853	9/29/93	33		97	U		97	U		97	U		97	U		97	U		194	U		194	U
SS13-0	573-2863	9/30/93	33		83	U		83	U		83	U		83	U		83	U		166	U		166	U
SS14-0	573-2864	9/30/93	33		82	U		82	U		82	U		82	U		82	U		163	U		163	U
SS41-0 (SS14-0 Dup)	573-2865	9/30/93	33		82	U		82	U		82	U		82	U		82	U		163	U		163	U
SS15-0	573-2866	9/30/93	33		83	U		83	U		83	U		83	U		83	U		165	U		165	U
SS16-0	573-2867	9/30/93	33		85	U		85	U		85	U		85	U		85	U		169	U	137	169	J
SS17-0	573-2869	9/30/93	33		100	U		100	U		100	U		100	U		100	U		200	U		200	U
SS18-0	573-2868	9/30/93	33		84	U		84	U		84	U		84	U		84	U		168	U		168	U
SS19-0	573-2870	9/30/93	33		83	U		83	U		83	U		83	U		83	U	83	166	J	92	166	J
SS19.1-(	573-2871	9/30/93	33		86	U		86	U		86	U		86	U		86	U		172	U		172	U
SS20-0	578-2896	10/1/93	33		83	U		83	U		83	U		83	U		83	U		166	U		166	U
SS21-0	573-2872	9/30/93	33		88	U		88	U		88	U		88	U		88	U		176	U		176	U
SS22-0	573-2873	9/30/93	33		82	U		82	U		82	U		82	U		82	U		165	U		165	U
SS23-0	573-2874	9/30/93	33		95	U		95	U		95	U		95	U		95	U		190	U		190	U
SS24-0	573-2875	9/30/93	33		82	U		82	U		82	U		82	U		82	U		164	U		164	U
SS25-0	578-2898	10/1/93	33		95	U		95	U		95	U		95	U		95	U		190	U		190	U
SS26-0	578-2897	10/1/93	33		91	U		91	U		91	U		91	U		91	U		183	U		183	U
SS27-0	573-2861	9/30/93	33		84	U		84	U		84	U		84	U		84	U	1200	169	J		169	U
SS28-0	573-2855	9/28/93	33		85	U		85	U		85	U		85	U		85	U		170	U		170	U
SS29-0	573-2860	9/30/93	33		84	U		84	U		84	U		84	U		84	U		168	U		168	U
SS92-0 (SS29-0 Dup)	573-2862	9/30/93	33		84	U		84	U		84	U		84	U		84	U		168	U		168	U
SS30-0	573-2856	9/30/93	33		94	U		94	U		94	U		94	U		94	U		188	U		188	U
SS31-0	573-2859	9/30/93	33		86	U		86	U		86	U		86	U		86	U		173	U		173	U
SS32-0	573-2858	9/30/93	33		84	U		84	U		84	U		84	U		84	U		168	U		168	U
BG1-0	578-2895	10/1/93	33		97	U		97	U		97	U		97	U		97	U		193	U		193	U
BG2-0	573-2854	9/30/93	33		119	U		119	U		119	U		119	U		119	U		238	U		238	U
Vadose Zone																								
MW40-5	559-2772	9/27/93	33		83	U		83	U		83	U		83	U		83	U		165	U		165	U
B4-10	559-2785	9/28/93	33		80	U		80	U		80	U		80	U		80	U		160	U		160	U
Saturated Contaminated Zone																								
B6-10 1/2	618-3098	10/19/93	33		80	U		80	U		80	U		80	U		80	U		160	U		160	U

TABLE 5–6
SOIL PHYSICAL RESULTS
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Sample ID	B10–0	B10–2	B10–5	B10–12.5	DW1–0	DW1–2	DW1–5	MW36–0	MW36–2	MW36–6	MW36–7.5
Gradation											
Gravel (%)	11.5	12.2	41.7	56.3	17.0	18.9	0.0	43.5	48.6	85.6	0.0
Sand (%)	85.7	83.4	57.4	41.4	77.5	77.6	83.0	53.2	48.2	11.9	13.2
Silt (%)	2.8	1.3	0.9	0.6	3.9	0.3	12.7	2.5	2.7	1.7	69.6
Clay (%)		3.1		1.7	1.6	3.2	4.3	0.8	0.5	0.8	17.2
Ave. K (cm/sec)	0.000918	0.00071	0.0052	0.0279	0.00376	0.00335	0.000726	0.00338	0.000558	0.000919	0.000142
Moisture (%)	10.5	16.8	10.7	6.0	8.0	8.0	20.1	4.1	3.7	3.2	13.9
Specific Gravity								2.64	2.69	2.60	2.64

NOTES:

Sample ID indicates boring or well number and depth. For example, sample B10–5 was collected from boring B–10 at 5 feet below ground surface.

REITEC

TABLE 5–7
SOIL TOC CONCENTRATIONS
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

SAMPLE ID	DEPTH (Feet)	TOTAL ORGANIC CARBON (%)
B4–10	10	1.4
B5–7	7	0.3
B6–8	8	0.4
B9–7.5	7.5	2.0
B10–0	0	0.2
B10–2	2	0.4
B10–10	10	2.5
B10–15	15	0.8
DW1–0	0	2.0
DW1–2	2	2.7
DW1–5	5	0.8
MW36–0	0	1.2
MW36–2	2	0.5
MW36–6	6	0.7
MW36–7 1/2	7.5	0.3
SED–1	0	0.4
SED–2	0	0.4
SED–3	0	0.3
SED–4	0	0.8
SED–5	0	0.5
SED–6	0	2.1
SED–7	0	3.1

TABLE 6-1
WELL GAUGING DATA
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Well	PVC	TOS	October 1, 1990					October 18, 1990					November 29, 1990					March 19, 1991				
No.	Elev.	Elev.	DTW	DTO	OT	CDTW	Elev.	DTW	DTO	OT	CDTW	Elev	DTW	DTO	OT	CDTW	Elev.	DTW	DTO	OT	CDTW	Elev.
MW-1	939.20	927.80	14.29				924.91	10.86				928.34 **	9.63				929.57 **	11.82				-11.82
MW-2	939.20	926.80	14.11				925.09	10.26				928.94 **	8.63				930.57 **	11.15				-11.15
MW-3	938.03	930.60	12.91				925.12	8.06				929.97	6.22				931.81 **	8.95				-8.95
MW-4	936.95	929.60	12.00				924.95	7.15				929.80 **	6.63				930.32 **	7.97				-7.97
MW-5	933.36	928.10	9.38				923.98	4.76				928.60 **	4.30				929.06 **	6.18				-6.18
MW-6	937.94	927.50	15.23	Trace	Trace		922.71	10.90				927.04	10.11	Trace	Trace		927.83 **	12.56	12.55	0.01	12.55	-12.55
MW-7	936.89	929.40	14.81	Trace	Trace		922.08	10.40				926.49	10.11				926.78	12.21				-12.21
MW-8	936.78	926.30	14.83	Product	Product		921.95	10.52	Trace	Trace		926.26	10.01	9.98	0.03	9.98	926.80 **	12.74	12.15	0.59	12.17	-12.17
MW-9	937.53	929.20	14.72	Trace	Trace		922.81	10.46				927.07	9.58				927.95	12.04	Trace	Trace		-12.04
MW-10	938.34	929.70	14.36				923.98	10.56				927.78	9.52				928.82	11.92				-11.92
MW-11	939.20	928.50	15.39				923.81	11.79				927.41	10.73				928.47	13.14				-13.14
MW-12	931.45	926.50	7.90	Trace	Trace		923.55	3.18				928.27 **	2.99				928.46 **	5.25				-5.25
MW-13	934.93	929.90	11.98				922.95	7.70				927.23	7.55				927.38	9.38				-9.38
MW-14	936.49	930.30	13.73				922.76	9.57				926.92	9.39				927.10	11.21				-11.21
MW-15	936.80	927.60	15.16				921.64	11.80				925.00	10.45				926.35	12.38	Trace	Trace		-12.38
MW-16	934.57	925.60	16.09				918.48	12.99				921.58	12.52				922.05	14.09				-14.09
MW-17	939.11	929.60	14.07	Trace	Trace		925.04	10.19				928.92	9.02	8.98	0.04	8.98	930.13 **	11.45	11.15	0.30	11.16	-11.16
MW-18	940.68	934.10	16.37				924.31	12.58				928.10	11.45				929.23	13.82				-13.82
MW-19	932.55	926.00	13.07	Trace	Trace		919.48	7.85	Trace	Trace		924.70	8.81				923.74	10.63				-10.63
MW-20	933.74	925.54	12.06	Trace	Trace		921.68	7.63				926.11 **	7.20				926.54 **	9.31	Trace	Trace		-9.31
MW-21	938.56	927.10	15.55	Trace	Trace		923.01	12.32				926.24	11.24	11.21	0.03	11.21	927.35 **	14.44	13.54	0.90	13.56	-13.56
MW-22	925.22	921.80	7.98	Trace	Trace		917.24	4.61	Trace	Trace		920.61	NG				--	6.88	6.28	0.60	6.30	-6.30
MW-23	925.58	924.36	8.26				917.32	5.23	Trace	Trace		920.35	4.69				920.89	7.10				-7.10
MW-24	925.84	924.60	8.32	Trace	Trace		917.52	5.44	Trace	Trace		920.40	4.97				920.87	7.60				-7.60
MW-25	926.90	925.01	9.33	Trace	Trace		917.57	6.68	Trace	Trace		920.22	NG				--	9.10	8.70	0.40	8.71	-8.71
MW-26	930.65	926.99	10.31	10.30	0.01	10.30	920.35	5.99				924.66	5.63				925.02	7.64				-7.64
MW-27	936.23	929.47	13.85	Trace	Trace		922.38	10.05				926.18	9.31				926.92	12.24	11.54	0.70	11.56	-11.56
MW-28	940.63	935.70	NG				--	NG				--	NG				--	NG				--
MW-29	948.13	942.40	NG				--	NG				--	NG				--	NG				--
MW-30	931.95	926.10	NG				--	NG				--	NG				--	NG				--
MW-31	934.11	927.90	NG				--	NG				--	NG				--	NG				--
MW-32	926.06	921.50	NG				--	NG				--	NG				--	NG				--
MW-33	934.00	928.80	NG				--	NG				--	NG				--	NG				--
MW-34	935.52	930.34	NG				--	NG				--	NG				--	NG				--
MW-35	936.15	931.00	NG				--	NG				--	NG				--	NG				--
MW-36	928.39	923.21	NG				--	NG				--	NG				--	NG				--
MW-37	932.32	927.08	NG				--	NG				--	NG				--	NG				--
MW-38	922.56	917.41	NG				--	NG				--	NG				--	NG				--
MW-39	936.21	926.77	NG				--	NG				--	NG				--	NG				--
MW-40	936.52	928.48	NG				--	NG				--	NG				--	NG				--
DW-1	942.92	908.81	NG				--	NG				--	NG				--	NG				--
DW-2	934.54	894.43	NG				--	NG				--	NG				--	NG				--
DW-3	930.09	889.73	NG				--	NG				--	NG				--	NG				--
DW-4	924.79	886.87	NG				--	NG				--	NG				--	NG				--
DW-5	932.54	892.45	NG				--	NG				--	NG				--	NG				--
Maloney Ck.																						
SWG-3	918.27		NG				--	NG				--	NG				--	NG				--
SWG-2	924.27		NG				--	NG				--	NG				--	NG				--
SkykomshR.																						
SWG-1	920.73		NG				--	NG				--	NG				--	NG				--

NOTES:
DTW = Depth to Groundwater
DTO = Depth to Oil
OT = Oil Thickness
TOS = Top of Screen
CDTW = DTW-(OT*SG); where SG is the average specific gravity of product samples from the site (0.974).
NG = Not Gauged

Product = Product present but thickness not gauged
* = DTW in drop tube
** = Groundwater elevations > TOS; product ay be present in the formation, but not detected in the wells.
Elevations are relative to mean sea level (msl).
*** = Wells evaluated DNAPL. No DNAPL present.

TABLE 6-1 (Continued)
WELL GAUGING DATA
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

REIEC

Well	PVC	TOS	October 2, 1991					November 7, 1991					December 17, 1991					March 4, 1992				
No.	Elev.	Elev.	DTW	DTO	OT	CDTW	Elev.	DTW	DTO	OT	CDTW	Elev.	DTW	DTO	OT	CDTW	Elev.	DTW	DTO	OT	CDTW	Elev.
MW-1	939.20	927.80	14.42				924.78	NG				--	11.10				928.10 **	11.30				927.90 **
MW-2	939.20	926.80	14.22				924.98	NG				--	10.40				928.80 **	10.65				928.55 **
MW-3	938.03	930.60	13.05				924.98	NG				--	8.30				929.73	8.60				929.43
MW-4	936.95	929.60	12.20				924.75	NG				--	7.38				929.57	7.60				929.35
MW-5	933.36	928.10	9.60				923.76	NG				--	5.20				928.16 **	5.73				927.63
MW-6	937.94	927.50	15.75	15.35	0.40	15.36	922.58	NG				--	11.00	10.70	0.30	10.71	927.23	12.25	12.15	0.10	12.15	925.79
MW-7	936.89	929.40	14.98				921.91	NG				--	11.00				925.89	11.78				925.11
MW-8	936.78	926.30	15.70	14.90	0.80	14.92	921.86	NG				--	11.20	11.10	0.10	11.10	925.68	11.95	11.94	0.01	11.94	924.84
MW-9	937.53	929.20	14.90				922.63	NG				--	11.00				926.53	11.85				925.68
MW-10	938.34	929.70	14.54				923.80	NG				--	11.10				927.24	11.53				926.81
MW-11	939.20	928.50	15.65				923.55	NG				--	12.60				926.60	12.67				926.53
MW-12	931.45	926.50	8.12	Trace	Trace		923.33	NG				--	5.98				925.47	4.80				926.65 **
MW-13	934.93	929.90	12.15				922.78	NG				--	14.82				920.11	9.00				925.93
MW-14	936.49	930.30	13.85				922.64	NG				--	10.22				926.27	10.81				925.68
MW-15	936.80	927.60	15.35	15.15	0.20	15.16	921.64	NG				--	11.65	11.62	0.03	11.62	925.18	12.30				924.50
MW-16	934.57	925.60	16.25				918.32	NG				--	13.75				920.82	13.95				920.62
MW-17	939.11	929.60	14.60	13.80	0.80	13.82	925.29	NG				--	8.10	7.70	0.40	7.71	931.40 **	10.78	10.48	0.30	10.49	928.62
MW-18	940.68	934.10	16.50				924.18	NG				--	12.95				927.73	13.38				927.30
MW-19	932.55	926.00	13.25				919.30	NG				--	10.17				922.38	10.33				922.22
MW-20	933.74	925.54	12.25				921.49	NG				--	8.20				925.54	8.90				924.84
MW-21	938.56	927.10	16.50	15.60	0.90	15.62	922.94	NG				--	12.97	12.87	0.10	12.87	925.69	13.40	13.30	0.10	13.30	925.26
MW-22	925.22	921.80	9.90	9.30	0.60	9.32	915.90	NG				--	7.80	7.50	0.30	7.51	917.71	5.70	5.65	0.05	5.65	919.57
MW-23	925.58	924.36	8.50				917.08	NG				--	6.60				918.98	6.50				919.08
MW-24	925.84	924.60	8.80				917.04	NG				--	7.15				918.69	6.85				918.99
MW-25	926.90	925.01	10.40	9.70	0.70	9.72	917.18	NG				--	NG				--	7.88	7.83	0.05	7.83	919.07
MW-26	930.65	926.99	10.50				920.15	NG				--	NG				--	7.65				923.00
MW-27	936.23	929.47	15.20	14.40	0.80	14.42	921.81	NG				--	11.00	10.20	0.80	10.22	926.01	11.28	10.98	0.30	10.99	925.24
MW-28	940.63	935.70	NG				--	14.90				925.73	13.20				927.43	13.25				927.38
MW-29	948.13	942.40	NG				--	18.70				929.43	18.60				929.53	17.50				930.63
MW-30	931.95	926.10	NG				--	14.80				917.15	14.75				917.20	14.75				917.20
MW-31	934.11	927.90	NG				--	14.65				919.46	14.30				919.81	14.45				919.66
MW-32	926.06	921.50	NG				--	8.60				917.46	8.90				917.16	8.93				917.13
MW-33	934.00	928.80	NG				--	NG				--	NG				--	NG				--
MW-34	935.52	930.34	NG				--	NG				--	NG				--	NG				--
MW-35	936.15	931.00	NG				--	NG				--	NG				--	NG				--
MW-36	928.39	923.21	NG				--	NG				--	NG				--	NG				--
MW-37	932.32	927.08	NG				--	NG				--	NG				--	NG				--
MW-38	922.56	917.41	NG				--	NG				--	NG				--	NG				--
MW-39	936.21	926.77	NG				--	NG				--	NG				--	NG				--
MW-40	936.52	928.48	NG				--	NG				--	NG				--	NG				--
DW-1	942.92	908.81	NG				--	NG				--	NG				--	NG				--
DW-2	934.54	894.43	NG				--	NG				--	NG				--	NG				--
DW-3	930.09	889.73	NG				--	NG				--	NG				--	NG				--
DW-4	924.79	886.87	NG				--	NG				--	NG				--	NG				--
DW-5	932.54	892.45	NG				--	NG				--	NG				--	NG				--
Maloney Ck.																						
SWG-3	918.27		NG				--	NG				--	NG				--	NG				--
SWG-2	924.27		NG				--	NG				--	NG				--	NG				--
SkykomshR.																						
SWG-1	920.73		NG				--	NG				--	NG				--	NG				--

NOTES:
DTW = Depth to Groundwater
DTO = Depth to Oil
OT = Oil Thickness
TOS = Top of Screen
CDTW = DTW-(OT*SG); where SG is the average specific gravity of product samples from the site (0.974).
NG = Not Gauged

Product = Product present but thickness not gauged
* = DTW in drop tube
** = Groundwater elevations > TOS; product ay be present in the formation, but not detected in the wells.
Elevations are relative to mean sea level (msl).
*** = Wells evaluated DNAPL. No DNAPL present.

TABLE 6-1 (Continued)
WELL GAUGING DATA
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

REIEC

Well	PVC	TOS	April 17, 1992					May 10, 1993					June 16, 1993					June 30, 1993				
No.	Elev.	Elev.	DTW	DTO	OT	CDTW	Elev.	DTW	DTO	OT	CDTW	Elev.	DTW	DTO	OT	CDTW	Elev.	DTW	DTO	OT	CDTW	Elev.
MW-1	939.20	927.80	11.16				928.04 **	10.87				928.33 **	11.64				927.56	12.12				927.08
MW-2	939.20	926.80	10.44				928.76 **	10.12				929.08 **	11.05				928.15 **	11.62				927.58 **
MW-3	938.03	930.60	8.37				929.66	9.51				928.52	10.32				927.71	9.60				928.43
MW-4	936.95	929.60	7.32				929.63 **	7.21				929.74 **	7.89				929.06	8.35				928.60
MW-5	933.36	928.10	5.66				927.70	5.26				928.10	6.16				927.20	6.61				926.75
MW-6	937.94	927.50	12.45	12.20	0.25	12.21	925.73	NG	13.00	Product		-	NG				-	NG				-
MW-7	936.89	929.40	12.00				924.89	11.21				925.68	12.35				924.54	12.90				923.99
MW-8	936.78	926.30	12.00	Trace	Trace		924.78	NG	11.66	Product		-	NG				-	NG				-
MW-9	937.53	929.20	11.90				925.63	11.00				926.53	12.07				925.46	12.59				924.94
MW-10	938.34	929.70	11.69				926.65	10.97				927.37	11.85				926.49	12.37				925.97
MW-11	939.20	928.50	12.71				926.49	12.10	12.04	0.06	12.04	927.16	12.92				926.28	13.38				925.82
MW-12	931.45	926.50	4.55				926.90 **	6.65				924.80	5.41				926.04	5.91				925.54
MW-13	934.93	929.90	8.95				925.98	9.92				925.01	9.63				925.30	10.13				924.80
MW-14	936.49	930.30	10.84				925.65	11.72				924.77	11.42				925.07	11.92				924.57
MW-15	936.80	927.60	12.18				924.62	12.86				923.94	12.59				924.21	13.13	Trace	Trace		923.68
MW-16	934.57	925.60	13.90				920.67	NG				-	NG				-	NG				-
MW-17	939.11	929.60	10.58				928.53	NG	10.17	Product		-	NG				-	NG				-
MW-18	940.68	934.10	13.45				927.23	12.85				927.83	13.71				926.97	14.23				926.45
MW-19	932.55	926.00	10.48				922.07	9.69				922.86	10.64				921.91	11.17				921.38
MW-20	933.74	925.54	9.22				924.52	NG				-	NG				-	NG				-
MW-21	938.56	927.10	13.20	13.03	0.17	13.03	925.53	NG	12.66	Product		-	NG				-	NG				-
MW-22	925.22	921.80	4.95	Trace	Trace		920.27	NG	4.92	Product		-	5.87	Trace	Trace		919.35	6.20 *	NG	0.05		919.02
MW-23	925.58	924.36	5.37				920.21	5.46				920.12	6.43				919.15	7.07				918.51
MW-24	925.84	924.60	5.46				920.38	5.87				919.97	6.78				919.06	7.44				918.40
MW-25	926.90	925.01	6.80	6.72	0.08	6.72	920.18	NG	6.92	Product		-	12.45	Trace	Trace		914.45	8.49				918.41
MW-26	930.65	926.99	7.28				923.37	NG				-	NG				-	NG				-
MW-27	936.23	929.47	13.00	12.67	0.33	12.68	923.55	NG	10.42	Product		-	11.37	Trace	Trace		924.86	11.63 *	NG	0.05		924.60
MW-28	940.63	935.70	13.37				927.26	12.52				928.11	13.32				927.31	13.98				926.65
MW-29	948.13	942.40	17.00				931.13	18.06				930.07	17.73				930.40	18.38				929.75
MW-30	931.95	926.10	14.44				917.51	14.42				917.53	14.91				917.04	15.19				916.76
MW-31	934.11	927.90	14.26				919.85	14.00				920.11	14.67				919.44	14.99				919.12
MW-32	926.06	921.50	8.57				917.49	8.57				917.49	9.03				917.03	9.30				916.76
MW-33	934.00	928.80	NG				--	NG				-	NG				-	NG				-
MW-34	935.52	930.34	NG				--	NG				-	NG				-	NG				-
MW-35	936.15	931.00	NG				--	NG				-	NG				-	NG				-
MW-36	928.39	923.21	NG				--	NG				-	NG				-	NG				-
MW-37	932.32	927.08	NG				--	NG				-	NG				-	NG				-
MW-38	922.56	917.41	NG				--	NG				-	NG				-	NG				-
MW-39	936.21	926.77	NG				--	NG				-	NG				-	NG				-
MW-40	936.52	928.48	NG				--	NG				-	NG				-	NG				-
DW-1	942.92	908.81	NG				--	NG				-	NG				-	NG				-
DW-2	934.54	894.43	NG				--	NG				-	NG				-	NG				-
DW-3	930.09	889.73	NG				--	NG				-	NG				-	NG				-
DW-4	924.79	886.87	NG				--	NG				-	NG				-	NG				-
DW-5	932.54	892.45	NG				--	NG				-	NG				-	NG				-
Maloney Ck.																						
SWG-3	918.27		NG				--	NG				-	NG				-	NG				-
SWG-2	924.27		NG				--	NG				-	NG				-	NG				-
SkykomshR.																						
SWG-1	920.73		NG				--	NG				-	NG				-	NG				-

NOTES:
DTW = Depth to Groundwater
DTO = Depth to Oil
OT = Oil Thickness
TOS = Top of Screen
CDTW = DTW-(OT*SG); where SG is the average specific gravity of product samples from the site (0.974).
NG = Not Gauged

Product = Product present but thickness not gauged
* = DTW in drop tube
** = Groundwater elevations > TOS; product ay be present in the formation, but not detected in the wells.
Elevations are relative to mean sea level (msl).
*** = Wells evaluated DNAPL. No DNAPL present.

TABLE 6-1 (Continued)
WELL GAUGING DATA
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Well	PVC	TOS	July 15, 1993					November 1-3, 1993***					December 29, 1993					April 4, 1994***				
No.	Elev.	Elev.	DTW	DTO	OT	CDTW	Elev.	DTW	DTO	OT	CDTW	Elev.	DTW	DTO	OT	CDTW	Elev.	DTW	DTO	OT	CDTW	Elev.
MW-1	939.20	927.80	12.63				926.57	13.24				925.96	12.78				926.42	11.72				927.48
MW-2	939.20	926.80	12.18				927.02 **	13.04				926.16	12.39				926.81 **	11.19				928.01 **
MW-3	938.03	930.60	10.39				927.64	11.52				926.51	10.55				927.48	9.49				928.54
MW-4	936.95	929.60	9.32				927.63	10.42				926.53	8.53				928.42	8.07				928.88
MW-5	933.36	928.10	7.31				926.05	8.01				925.35	6.86				926.50	6.19				927.17
MW-6	937.94	927.50	13.58 *	13.54	0.04		924.36	14.79 *	NG	Product		923.15	11.70 *	NG	Product		926.24	10.65 *	Trace	Trace		927.29
MW-7	936.89	929.40	13.48				923.41	13.91				922.98	13.26				923.63	12.27				924.62
MW-8	936.78	926.30	13.58 *	13.50	0.08		923.20	13.70 *	NG	Product		923.08	11.95 *	NG	Product		924.83	12.29 *	12.25	0.04		924.49
MW-9	937.53	929.20	13.16				924.37	13.69				923.84	13.01				924.52	12.13				925.40
MW-10	938.34	929.70	12.91				925.43	13.46				924.88	12.93				925.41	12.02				926.32
MW-11	939.20	928.50	13.85				925.35	14.46				924.74	13.95	13.90	0.05	13.90	925.30	13.05	13.03	0.02	13.03	926.17
MW-12	931.45	926.50	6.49				924.96	6.95				924.50	6.35				925.10	5.26				926.19
MW-13	934.93	929.90	10.63				924.30	10.98				923.95	10.45				924.48	9.43				925.50
MW-14	936.49	930.30	12.43				924.06	12.78				923.71	12.24				924.25	11.27				925.22
MW-15	936.80	927.60	13.70				923.10	14.09	Trace	Trace		922.71	13.46				923.34	12.45				924.35
MW-16	934.57	925.60	NG				-	15.20				919.37	14.99				919.58	14.17				920.40
MW-17	939.11	929.60	14.68 *	12.21	2.47		924.43	13.18 *	NG	Product		925.93	11.21 *	NG	Product		927.90	11.00 *	11.29	Product		928.11
MW-18	940.68	934.10	14.87				925.81	15.39				925.29	14.84				925.84	13.93				926.75
MW-19	932.55	926.00	11.67				920.88	12.02				920.53	11.61				920.94	10.62				921.93
MW-20	933.74	925.54	NG				-	NG	11.02	Product		-	12.82	10.34	2.48	10.40	923.34	NG	9.42	0.25		924.31
MW-21	938.56	927.10	14.67 *	14.42	0.25		923.89	14.82 *	NG	Product		923.74	12.30 *	NG	Product		926.26	13.88 *	13.83	0.05		924.68
MW-22	925.22	921.80	6.85 *	5.92	0.93		918.37	7.43 *	NG	Product		917.79	NG				-	5.83 *	5.83	Product		919.39
MW-23	925.58	924.36	7.56				918.02	8.10				917.48	NG				-	6.36				919.22
MW-24	925.84	924.60	7.92				917.92	NG				-	NG				-	6.62				919.22
MW-25	926.90	925.01	8.96 *	8.92	0.04		917.94	9.65 *	NG	Product		917.25	NG				-	7.79 *	7.75	0.04		919.11
MW-26	930.65	926.99	NG				-	NG				-	NG				-	7.62				923.03
MW-27	936.23	929.47	12.33 *	12.29	0.04		923.90	12.90 *	NG	Product		923.33	NG				-	10.17 *	11.17	Product		926.06
MW-28	940.63	935.70	14.45				926.18	15.06				925.57	14.51				926.12	13.46				927.17
MW-29	948.13	942.40	18.91				929.22	19.75				928.38	19.05				929.08	17.63				930.50
MW-30	931.95	926.10	15.47				916.48	15.71				916.24	15.47				916.48	14.80				917.15
MW-31	934.11	927.90	15.28				918.83	15.48				918.63	15.29				918.82	14.56				919.55
MW-32	926.06	921.50	9.58				916.48	9.87				916.19	9.61				916.45	8.97				917.09
MW-33	934.00	928.80	NG				-	8.61				925.39	7.98				926.02	6.90				927.10
MW-34	935.52	930.34	NG				-	11.56				923.96	11.43				924.09	10.74				924.78
MW-35	936.15	931.00	NG				-	12.57				923.58	12.11				924.04	11.51				924.64
MW-36	928.39	923.21	NG				-	8.64				919.75	7.46				920.93	6.53				921.86
MW-37	932.32	927.08	NG				-	10.50				921.82	NG				-	8.50				923.82
MW-38	922.56	917.41	NG				-	5.58				916.98	NG				-	4.68				917.88 **
MW-39	936.21	926.77	NG				-	NG	10.32	Product		-	NG	NG	Product		-	8.63 *	11.10	Product		927.58 **
MW-40	936.52	928.48	NG				-	12.88				923.64	12.90				923.62	11.91				924.61
DW-1	942.92	908.81	NG				-	16.74				926.18 **	16.16				926.76 **	14.95				927.97 **
DW-2	934.54	894.43	NG				-	13.13				921.41 **	12.27				922.27 **	11.41				923.13 **
DW-3	930.09	889.73	NG				-	13.29				916.80 **	12.88				917.21 **	12.10				917.99 **
DW-4	924.79	886.87	NG				-	6.40				918.39 **	6.05				918.74 **	5.10				919.69 **
DW-5	932.54	892.45	NG				-	11.41				921.13 **	11.10				921.44 **	10.13				922.41 **
Maloney Ck.																						
SWG-3	918.27		NG				-	NG				-	3.92				914.35 **	3.73				914.54 **
SWG-2	924.27		NG				-	NG				-	-0.17				924.44 **	-0.38				924.65 **
SkykomshR.																						
SWG-1	920.73		NG				-	NG				-	3.33				917.40 **	1.74				918.99 **

NOTES:
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TOS = Top of Screen
CDTW = DTW-(OT*SG); where SG is the average specific gravity of product samples from the site (0.974).
NG = Not Gauged

Product = Product present but thickness not gauged
* = DTW in drop tube
** = Groundwater elevations > TOS; product ay be present in the formation, but not detected in the wells.
Elevations are relative to mean sea level (msl).
*** = Wells evaluated DNAPL. No DNAPL present.

TABLE 6-1 (Continued)
WELL GAUGING DATA
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

REIEC

Well	PVC	TOS	June 3, 1994					August 1, 1994					November 7, 1994				
No.	Elev.	Elev.	DTW	DTO	OT	CDTW	Elev.	DTW	DTO	OT	CDTW	Elev.	DTW	DTO	OT	CDTW	Elev.
MW-1	939.20	927.80	12.12				927.08	13.44				925.76	11.37				927.83 **
MW-2	939.20	926.80	11.66				927.54 **	13.13				926.07	13.72				925.48
MW-3	938.03	930.60	9.85				928.18	11.62				926.41	9.65				928.38
MW-4	936.95	929.60	8.60				928.35	10.70				926.25	8.07				928.88
MW-5	933.36	928.10	6.81				926.55	8.24				925.12	4.87				928.49 **
MW-6	937.94	927.50	12.68 *	12.33	0.35		925.26	13.43 *	14.08	Product		924.51	10.87 *	11.17	Product		927.07
MW-7	936.89	929.40	12.97				923.92	14.09				922.80	10.89				926.00
MW-8	936.78	926.30	12.75 *	12.60	0.15		924.03	13.96 *	14.17	Product		922.82	10.62 *	10.79	Product		926.16
MW-9	937.53	929.20	12.61				924.92	13.84				923.69	10.84				926.69
MW-10	938.34	929.70	12.39				925.95	13.65				924.69	10.98				927.36
MW-11	939.20	928.50	13.37				925.83	14.60				924.60	12.24				926.96
MW-12	931.45	926.50	6.11				925.34	7.13				924.32	3.37				928.08 **
MW-13	934.93	929.90	10.23				924.70	11.23				923.70	7.85				927.08
MW-14	936.49	930.30	12.03				924.46	13.03				923.46	9.78				926.71
MW-15	936.80	927.60	13.19				923.61	14.37	14.35	0.02	14.35	922.45	11.10				925.70
MW-16	934.57	925.60	14.56				920.01	15.37				919.20	13.64				920.93
MW-17	939.11	929.60	11.46 *	11.40	0.06		927.65	12.53 *	13.25	Product		926.58	8.97 *	10.33	Product		930.14 **
MW-18	940.68	934.10	14.26				926.42	15.57				925.11	12.97				927.71
MW-19	932.55	926.00	11.12				921.43	12.25				920.30	9.87				922.68
MW-20	933.74	925.54	NG				-	17.83	18.00	Product		915.91	NG	12.58	Product		-
MW-21	938.56	927.10	13.28 *	11.70	1.58		925.28	13.56 *	14.83	Product		925.00	11.22 *	11.75	Product		927.34 **
MW-22	925.22	921.80	6.19 *	6.25	Product		919.03	NG				-	5.38 *	5.00	0.38		919.84
MW-23	925.58	924.36	6.72				918.86	7.97				917.61	6.54				919.04
MW-24	925.84	924.60	6.98				918.86	8.32				917.52	7.51				918.33
MW-25	926.90	925.01	7.98 *	7.98	Product		918.92	9.37 *	NG	Product		917.53	8.40 *	8.42	Product		918.50
MW-26	930.65	926.99	NG				-	NG				-	6.41				924.24
MW-27	936.23	929.47	NG				-	NG				-	9.92 *	10.25	Product		926.31
MW-28	940.63	935.70	13.79				926.84	14.98				925.65	13.16	13.08	0.08	13.08	927.55
MW-29	948.13	942.40	18.03				930.10	19.46				928.67	19.41				928.72
MW-30	931.95	926.10	15.08				916.87	15.83				916.12	14.75				917.20
MW-31	934.11	927.90	14.94				919.17	15.62				918.49	14.23				919.88
MW-32	926.06	921.50	9.20				916.86	9.97				916.09	9.87				916.19
MW-33	934.00	928.80	7.25				926.75	8.37				925.63	6.97				927.03
MW-34	935.52	930.34	10.98				924.54	11.68				923.84	10.52				925.00
MW-35	936.15	931.00	11.80				924.35	12.68				923.47	10.81				925.34
MW-36	928.39	923.21	6.95				921.44	7.95				920.44	NG	6.50	Product		-
MW-37	932.32	927.08	9.12				923.20	10.17				922.15	7.26				925.06
MW-38	922.56	917.41	4.94				917.62 **	5.64				916.92	4.48				918.08 **
MW-39	936.21	926.77	NG	10.96	Product		-	NG	11.83	Product		-	7.68 *	12.67	Product		928.53 **
MW-40	936.52	928.48	12.64				923.88	14.82				921.70	10.56				925.96
DW-1	942.92	908.81	15.39				927.53 **	16.74				926.18 **	14.85				928.07 **
DW-2	934.54	894.43	11.80				922.74 **	12.84				921.70 **	11.10				923.44 **
DW-3	930.09	889.73	12.54				917.55 **	14.48				915.61 **	11.96				918.13 **
DW-4	924.79	886.87	5.44				919.35 **	6.51				918.28 **	5.12				919.67 **
DW-5	932.54	892.45	10.35				922.19 **	11.44				921.10 **	10.09				922.45 **
Maloney Ck.																	
SWG-3	918.27		3.72				914.55 **	>3.8				<914.47	3.45				914.82 **
SWG-2	924.27		DRY				<924.27	DRY				<924.27	-0.58				924.85 **
SkykomshR.																	
SWG-1	920.73		1.75				918.98 **	>2.00				<918.73	2.55				918.18 **

NOTES:

DTW = Depth to Groundwater
DTO = Depth to Oil
OT = Oil Thickness
TOS = Top of Screen
CDTW = DTW-(OT*SG); where SG is the average specific gravity of product samples from the site (0.974).
NG = Not Gauged

Product = Product present but thickness not gauged
* = DTW in drop tube
** = Groundwater elevations > TOS; product ay be present in the formation, but not detected in the wells.
Elevations are relative to mean sea level (msl).
*** = Wells evaluated DNAPL. No DNAPL present.

TABLE 6-2
SLUG TEST RESULTS
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Well	Lithology	Hydraulic Conductivity	
		feet/minute	feet/day
DW-1	Gravelly sand	0.049	71
DW-2	Interbedded silty sand and gravelly sand	0.028	41
DW-4	Gravelly sand	0.0066	9.4
MW-5	Interbedded sand and sandy gravel	0.058	84
MW-36	Interbedded sand and gravelly sand	0.0027	3.9

TABLE 6-3
VERTICAL GRADIENT ANALYSIS
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

WELL NUMBER	PVC Elevation	Top of Screen Elevation	Nov-93 Elevation	Dec-93 Elevation	Apr-94 Elevation	June 94 Elevation	Aug-94 Elevation	Nov-94 Elevation
Groundwater Elevation								
DW-2	934.54	894.43	921.41	922.27	923.13	922.74	921.70	923.44
MW-40	936.52	928.48	923.64	923.62	924.61	923.88	921.70	925.96
Elevation Difference		34.05	-2.23	-1.35	-1.48	-1.14	0	-2.52
Vertical Gradient			-0.065	-0.040	-0.043	-0.033	0.000	-0.074
Groundwater Elevation								
DW-3	930.09	889.73	916.80	917.21	917.99	917.55	915.61	918.13
MW-30	931.95	926.10	916.24	916.48	917.15	916.87	916.12	917.20
Elevation Difference		36.37	0.56	0.73	0.84	0.68	-0.51	0.93
Vertical Gradient			0.015	0.020	0.023	0.019	-0.014	0.026

TABLE 6-4
TPH ANALYTICAL RESULTS - GROUNDWATER
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

PRE-REMEDIAL INVESTIGATION DATA				
Sample ID:	**TPH-418.1 10/90 (mg/L)**	**TPH-418.1 3/91 (mg/L)**	**TPH-418.1 10/91 (mg/L)**	**TPH-418.1 3/92 (mg/L)**
MW-1	< 1 U	< 1 U	< 1 U	< 1 U
MW-60 (MW-1 Dup)	NA	NA	NA	NA
MW-2	< 1 U	< 1 U	< 1 U	< 1 U
MW-3	< 1 U	< 1 U	< 1 U	< 1 U
MW-4	14	< 1 U	< 1 U	< 1 U
MW-53/4B (MW-4 Dup)	NA	NA	NA	NA
MW-5	< 1 U	< 1 U	< 1 U	< 1 U
MW-50 (MW-5 Dup)	NA	NA	NA	NA
MW-6	45	LNAPL	LNAPL	LNAPL
MW-6A (MW-6 Dup)	13	NA	NA	NA
MW-7	240	< 1 U	< 1 U	1.9
MW-8	36	LNAPL	LNAPL	LNAPL
MW-9	200	6	1.6	< 1 U
MW-10	3	< 1 U	< 1 U	< 1 U
MW-11	6	2	2.2	62
MW-12	210	4	1.9	5.8
MW-13	1	< 1 U	< 1 U	NA
MW-14	3	< 1 U	< 1 U	10
MW-140 (MW-12 Dup)	NA	NA	NA	NA
MW-15	100	< 1 U	LNAPL	8.2
MW-16	< 1 U	< 1 U	< 1 U	< 1 U
MW-17	< 1 U	LNAPL	LNAPL	LNAPL
MW-18	< 1 U	< 1 U	< 1 U	< 1 U
MW-19	< 1 U	< 1 U	< 1 U	< 1 U
MW-52 / 190 (MW-19 Dup)	NA	NA	NA	NA
MW-20	53	12	4.7	27
MW-20DUP	NA	NA	NA	21
MW-21	100	LNAPL	LNAPL	LNAPL
MW-22	47	LNAPL	LNAPL	LNAPL
MW-23	8	< 1 U	1.2	< 1.0 U
MW-23A (MW-23 Dup)	NA	NA	1.1	NA
MW-23B (MW-23 Dup)	NA	NA	NA	NA
MW-24	42	< 1 U	1.2	3.3
MW-25	24	LNAPL	LNAPL	LNAPL
MW-26	65	38	7.6	3.0
MW-27	200	LNAPL	LNAPL	LNAPL
MW-28	NI	NI	NI	NI
MW-29	NI	NI	NI	NI
MW-30	NI	NI	NI	NI
MW-31	NI	NI	NI	NI
MW-101(MW-31 Dup)	NA	NA	NA	NA
MW-102 (MW-31 Dup)	NA	NA	NA	NA
MW-32	NI	NI	NI	NI
MW-33	NI	NI	NI	NI
MW-34	NI	NI	NI	NI
MW-35	NI	NI	NI	NI
MW-36	NI	NI	NI	NI
MW-37	NI	NI	NI	NI
MW-370 (MW-37 Dup)	NA	NA	NA	NA
MW-38	NI	NI	NI	NI
MW-39	NI	NI	NI	NI
MW-40	NI	NI	NI	NI
MW-400 / 40B (MW-40 Dup)	NA	NA	NA	NA
DW-1	NI	NI	NI	NI
DW-2	NI	NI	NI	NI
DW-3	NI	NI	NI	NI
DW-4	NI	NI	NI	NI
DW-5	NI	NI	NI	NI
Field Blanks				
MW-100	NA	NA	NA	NA
MW-101	NA	NA	NA	NA
MW-102	NA	NA	NA	NA
MW-103	NA	NA	NA	NA
MW-104	NA	NA	NA	NA
MW-200	NA	NA	NA	NA

Data for pre-remedial investigation is qualitative and biased low.

Notes: LNAPL = LNAPL measured in well
NI = Well not installed

REIEC

TABLE 6-4 (cont.)
TPH ANALYTICAL RESULTS - GROUNDWATER
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

REMEDIAL INVESTIGATION DATA					
Sample ID:	PQL (mg/L)	WTPH-Diesel GC/FID (C10-C30) 11/93 (mg/L)	WTPH-D Extended GC/FID (C9-C36) 4/94 (mg/L)	WTPH-D Extended GC/FID (C9-C36) 8/94 (mg/L)	WTPH-D Extended GC/FID (C9-C36) 11/94 (mg/L)
MW-1	1.0	< 0.25 U	< 0.020 U	< 0.2 U	< 0.2 U
MW-60 (MW-1 Dup)	1.0	< 0.25 U	NA	NA	NA
MW-2	1.0	< 0.25 U	NA	NA	NA
MW-3	1.0	< 0.25 U	NA	1	< 0.2 U
MW-4	1.0	< 0.25 U	0.37	0.6	< 0.2 U
MW-53 / 4B (MW-4 Dup)	1.0	< 0.25 U	NA	1	NA
MW-5	1.0	< 0.25 U	0.31	0.1 J	0.69
MW-50 (MW-5 Dup)	1.0		< 0.020 U	NA	NA
MW-6		LNAPL	LNAPL	LNAPL	LNAPL
MW-7	1.0	0.43	NA	NA	NA
MW-8		LNAPL	LNAPL	LNAPL	LNAPL
MW-9	1.0	1.2	NA	NA	0.58
MW-10	1.0	< 0.25 U	NA	NA	NA
MW-11	1.0	4.6	NA	NA	37
MW-12	1.0	1.9	NA	NA	NA
MW-51	1.0	1.3	NA	NA	NA
MW-13	1.0	1.6	< 0.020 U	6.5	0.83
MW-14	1.0	< 0.25 U	1.4	NA	< 0.2 U
MW-140 (MW-12 Dup)	1.0	NA	1.4	NA	NA
MW-15	1.0	0.82	NA	NA	NA
MW-16	1.0	< 0.25 U	NA	NA	NA
MW-17		LNAPL	LNAPL	LNAPL	LNAPL
MW-18	1.0	< 0.25 U	NA	NA	NA
MW-19	1.0	< 0.25 U	< 0.020 U	0.2	< 0.2 U
MW-52 / 190 (MW-19 Dup)	1.0	< 0.25 U	NA	NA	< 0.2 U
MW-20		LNAPL	LNAPL	LNAPL	LNAPL
MW-21		LNAPL	LNAPL	LNAPL	LNAPL
MW-22		LNAPL	LNAPL	NA	LNAPL
MW-23	1.0	< 0.25 U	< 0.020 U	0.3	< 0.2 U
MW-23B (MW-23 Dup)	1.0	NA	NA	0.3	NA
MW-24	1.0	3.1	NA	NA	NA
MW-25		LNAPL	LNAPL	LNAPL	LNAPL
MW-26	1.0	NA	NA	NA	2.6
MW-27		LNAPL	LNAPL	NA	LNAPL
MW-28	1.0	5.4	1.6	2.5	NA
MW-29	1.0	< 0.25 U	NA	NA	NA
MW-30	1.0	< 0.25 U	NA	NA	NA
MW-31	1.0	< 0.25 U	NA	NA	NA
MW-101(MW-31 Dup)	1.0	< 0.25 U	NA	NA	NA
MW-102 (MW-31 Dup)	1.0	< 0.25 U	NA	NA	NA
MW-32	1.0	< 0.25 U	NA	NA	NA
MW-33	1.0	< 0.25 U	NA	NA	NA
MW-34	1.0	0.65	< 0.020 U	0.3	< 0.2 U
MW-35	1.0	< 0.25 U	0.41	0.4	0.32
MW-36	1.0	3.8	0.55	0.6	NA
MW-37	1.0	0.32	0.33	0.5	0.52
MW-370 (MW-37 Dup)	1.0	NA	NA	NA	0.43
MW-38	1.0	< 0.25 U	< 0.020 U	0.3	0.09 J
MW-39		LNAPL	LNAPL	LNAPL	LNAPL
MW-40	1.0	< 0.25 U	< 0.020 U	< 0.2 U	< 0.2 U
MW-400 / 40B (MW-40 Dup)	1.0		< 0.020 U	< 0.2 U	< 0.2 U
DW-1	1.0	< 0.25 U	< 0.020 U	< 0.3 U	NA
DW-2	1.0	< 0.25 U	< 0.020 U	< 0.2 U	NA
DW-3	1.0	< 0.25 U	NA	NA	NA
DW-4	1.0	< 0.25 U	< 0.020 U	< 0.2 U	NA
DW-5	1.0	< 0.25 U	< 0.020 U	< 0.2 U	NA
Field Blanks					
MW-100	1.0	NA	NA	< 0.2 U	< 0.2 U
MW-101	1.0	NA	< 0.020 U	< 0.2 U	NA
MW-102	1.0	NA	< 0.020 U	< 0.2 U	NA
MW-103	1.0	NA	< 0.020 U	NA	< 0.2 U
MW-104	1.0	NA	NA	NA	< 0.2 U
MW-200	1.0	< 0.25 U	NA	NA	NA

Data for pre-remedial investigation is qualitative and biased low.

Notes: LNAPL = LNAPL measured in well
NI = Well not installed

Table 6-5
SVOC Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	PQL / PQL-SVO / 0.0-0.0 / Groundwater / / / / Primary / EPA8270	MW-3 / MW-3-11-93 / 0.0-0.0 / Groundwater / 11/05/93 / Primary / EPA8270	MW-4 / MW-4-11-93 / 0.0-0.0 / Groundwater / 11/05/93 / Primary / EPA8270	MW-4 / MW-53-11-93 / 0.0-0.0 / Groundwater / 11/05/93 / Duplicate / EPA8270	MW-5 / MW-5-04-94 / 0.0-0.0 / Groundwater / 04/07/94 / Primary / EPA8270
Semi-Volatile Organic Compounds(ug/L)						
Phenol	108-95-2	10	<10U	<10U	<10U	<5U
bis(2-Chloroethyl) ether	111-44-4	10	<10U	<10U	<10U	<5U
2-Chlorophenol	95-57-8	10	<10U	<10U	<10U	<5U
1,3-Dichlorobenzene	541-73-1	10	<10U	<10U	<10U	<5U
1,4-Dichlorobenzene	106-46-7	10	<10U	<10U	<10U	<5U
Benzyl alcohol	100-51-6	10	<10U	<10U	<10U	<5U
1,2-Dichlorobenzene	95-50-1	10	<10U	<10U	<10U	<5U
2-Methylphenol	95-48-7	10	<10U	<10U	<10U	<5U
Bis(2-chloroisopropyl)ether	39638-32-9	10	<10U	<10U	<10U	<5U
4-Methylphenol	106-44-5	10	<10U	<10U	<10U	<5U
N-Nitroso-di-n-propylamine	621-64-7	10	<10U	<10U	<10U	<5U
Hexachloroethane	67-72-1	10	<10U	<10U	<10U	<5U
Nitrobenzene	98-95-3	10	<10U	<10U	<10U	<5U
Isophorone	78-59-1	10	<10U	<10U	<10U	<5U
2-Nitrophenol	88-75-5	10	<10U	<10U	<10U	<5U
2,4-Dimethylphenol	105-67-9	10	<50U	<50U	<50U	<25U
Benzoic acid	65-85-0	10	<10U	<10U	<10U	<5U
Bis(2-chloroethoxy)methane	111-91-1	10	<10U	<10U	<10U	<5U
2,4-Dichlorophenol	120-83-2	10	<10U	<10U	<10U	<5U
1,2,4-Trichlorobenzene	120-82-1	10	<10U	<10U	<10U	<5U
4-Chloroaniline	106-47-8	10	<10U	<10U	<10U	<5U
Hexachlorobutadiene	87-68-3	10	<10U	<10U	<10U	<5U
4-Chloro-3-methylphenol	59-50-7	20	<10U	<10U	<10U	<5U
2-Methylnaphthalene	91-57-6	10	<10U	<10U	<10U	<5U
Hexachlorocyclopentadiene	77-47-4	10	<10U	<10U	<10U	<5U
2,4,6-Trichlorophenol	88-06-2	10	<10U	<10U	<10U	<5U
2,4,5-Trichlorophenol	95-95-4	50	<50U	<50U	<50U	<25U
2-Chloronaphthalene	91-58-7	10	<10U	<10U	<10U	<5U
2-Nitroaniline	88-74-4	50	<50U	<50U	<50U	<25U
Dimethyl phthalate	131-11-3	10	<10U	<10U	<10U	<5U
2,6-Dinitrotoluene	606-20-2	50	<50U	<50U	<50U	<25U
3-Nitroaniline	99-09-2	50	<50U	<50U	<50U	<25U
N-Nitrosodimethylamine	62-75-9	10	<10U	<10U	<10U	<5U
2,4-Dinitrophenol	51-28-5	50	<50U	<50U	<50U	<25U
4-Nitrophenol	100-02-7	50	<50U	<50U	<50U	<25U
Dibenzofuran	132-64-9	10	<10U	<10U	<10U	<5U
2,4-Dinitrotoluene	121-14-2	10	<10U	<10U	<10U	<5U
Diethylphthalate	84-66-2	10	<10U	<10U	<10U	<5U
4-Chlorophenyl-phenylether	7005-72-3	10	<10U	<10U	<10U	<5U
4-Nitroaniline	100-01-6	50	<50U	<50U	<50U	<25U
4,6-Dinitro,2-methylphenol	534-52-1	50	<50U	<50U	<50U	<25U
N-Nitrosodiphenylamine	86-30-6	10	<10U	<10U	<10U	<5U
4-Bromophenyl-phenylether	101-55-3	10	<10U	<10U	<10U	<5U
Hexachlorobenzene	118-74-1	10	<10U	<10U	<10U	<5U
Pentachlorophenol	87-86-5	50	<50U	<50U	<50U	<25U
Di-n-butyl phthalate	84-74-2	10	<10U	<10U	<10U	<5U
Butylbenzylphthalate	85-68-7	10	<10U	<10U	<10U	<5U
3,3'-Dichlorobenzidine	91-94-1	20	<20U	<20U	<20U	<25U
Bis(2-ethylhexyl)phthalate	117-81-7	10	<10U	<10U	<10U	<5U
Di-n-octyl phthalate	117-84-0	10	<10U	<10U	<10U	<5U
Azobenzene	103-33-3	50	<50U	<50U	<50U	<25U
Naphthalene	91-20-3	10	<10U	<10U	<10U	<5U
Acenaphthylene	208-96-8	10	<10U	<10U	<10U	<5U
Acenaphthene	83-32-9	10	<10U	<10U	<10U	<5U
Fluorene	86-73-7	10	<10U	<10U	<10U	<5U
Phenanthrene	85-01-8	10	<10U	<10U	<10U	<5U
Anthracene	120-12-7	10	<10U	<10U	<10U	<5U
Fluoranthene	206-44-0	10	<10U	<10U	<10U	<5U
Pyrene	129-00-0	10	<10U	<10U	<10U	<5U
Benzo(a)anthracene	56-55-3	10	<10U	<10U	<10U	<5U
Chrysene	218-01-9	10	<10U	<10U	<10U	<5U
Benzo(b)fluoranthene	205-99-2	10	<10U	<10U	<10U	<5U
Benzo(k)fluoranthene	207-08-9	10	<10U	<10U	<10U	<5U
Benzo(a)pyrene	50-32-8	10	<10U	<10U	<10U	<5U
Indeno(1,2,3-cd)pyrene	193-39-5	10	<10U	<10U	<10U	<5U
Dibenzo(a,h)anthracene	53-70-3	10	<10U	<10U	<10U	<5U
Benzo(g,h,i)perylene	191-24-2	10	<10U	<10U	<10U	<5U
Sum of PAHs		160	0	0	0	0
Sum of Carcinogenic PAHs		70	0	0	0	0

Table 6-5
SVOC Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: Sample no: Depth(ft): Matrix: Sample Date: Type: Method: CAS NO.	MW-5 MW-500-04-94 0.0-0.0 Groundwater 04/07/94 Duplicate EPA8270	MW-5 MW-5-08-94 0.0-0.0 Groundwater 08/02/94 Primary EPA8310	MW-7 MW-7-11-93 0.0-0.0 Groundwater 11/02/93 Primary EPA8270	MW-9 MW-9-11-93 0.0-0.0 Groundwater 11/05/93 Primary EPA8270	MW-9 MW-9-04-94 0.0-0.0 Groundwater 04/05/94 Primary EPA8310
Semi-Volatile Organic Compounds(ug/L)						
Phenol	108-95-2	<5U	NA	<10U	<10U	NA
bis(2-Chloroethyl) ether	111-44-4	<5U	NA	<10U	<10U	NA
2-Chlorophenol	95-57-8	<5U	NA	<10U	<10U	NA
1,3-Dichlorobenzene	541-73-1	<5U	NA	<10U	<10U	NA
1,4-Dichlorobenzene	106-46-7	<5U	NA	<10U	<10U	NA
Benzyl alcohol	100-51-6	<5U	NA	<10U	<10U	NA
1,2-Dichlorobenzene	95-50-1	<5U	NA	<10U	<10U	NA
2-Methylphenol	95-48-7	<5U	NA	<10U	<10U	NA
Bis(2-chloroisopropyl)ether	39638-32-9	<5U	NA	<10U	<10U	NA
4-Methylphenol	106-44-5	<5U	NA	<10U	<10U	NA
N-Nitroso-di-n-propylamine	621-64-7	<5U	NA	<10U	<10U	NA
Hexachloroethane	67-72-1	<5U	NA	<10U	<10U	NA
Nitrobenzene	98-95-3	<5U	NA	<10U	<10U	NA
Isophorone	78-59-1	<5U	NA	<10U	<10U	NA
2-Nitrophenol	88-75-5	<5U	NA	<10U	<10U	NA
2,4-Dimethylphenol	105-67-9	<25U	NA	<50U	<50U	NA
Benzoic acid	65-85-0	<5U	NA	<10U	<10U	NA
Bis(2-chloroethoxy)methane	111-91-1	<5U	NA	<10U	<10U	NA
2,4-Dichlorophenol	120-83-2	<5U	NA	<10U	<10U	NA
1,2,4-Trichlorobenzene	120-82-1	<5U	NA	<10U	<10U	NA
4-Chloroaniline	106-47-8	<5U	NA	<10U	<10U	NA
Hexachlorobutadiene	87-68-3	<5U	NA	<10U	<10U	NA
4-Chloro-3-methylphenol	59-50-7	<5U	NA	<10U	<10U	NA
2-Methylnaphthalene	91-57-6	<5U	NA	<10U	<10U	NA
Hexachlorocyclopentadiene	77-47-4	<5U	NA	<10U	<10U	NA
2,4,6-Trichlorophenol	88-06-2	<5U	NA	<10U	<10U	NA
2,4,5-Trichlorophenol	95-95-4	<25U	NA	<50U	<50U	NA
2-Chloronaphthalene	91-58-7	<5U	NA	<10U	<10U	NA
2-Nitroaniline	88-74-4	<25U	NA	<50U	<50U	NA
Dimethyl phthalate	131-11-3	<5U	NA	<10U	<10U	NA
2,6-Dinitrotoluene	606-20-2	<25U	NA	<50U	<50U	NA
3-Nitroaniline	99-09-2	<25U	NA	<50U	<50U	NA
N-Nitrosodimethylamine	62-75-9	<5U	NA	<10U	<10U	NA
2,4-Dinitrophenol	51-28-5	<25U	NA	<50U	<50U	NA
4-Nitrophenol	100-02-7	<25U	NA	<50U	<50U	NA
Dibenzofuran	132-64-9	<5U	NA	<10U	<10U	NA
2,4-Dinitrotoluene	121-14-2	<5U	NA	<10U	<10U	NA
Diethylphthalate	84-66-2	<5U	NA	<10U	<10U	NA
4-Chlorophenyl-phenylether	7005-72-3	<5U	NA	<10U	<10U	NA
4-Nitroaniline	100-01-6	<25U	NA	<50U	<50U	NA
4,6-Dinitro,2-methylphenol	534-52-1	<25U	NA	<50U	<50U	NA
N-Nitrosodiphenylamine	86-30-6	<5U	NA	<10U	<10U	NA
4-Bromophenyl-phenylether	101-55-3	<5U	NA	<10U	<10U	NA
Hexachlorobenzene	118-74-1	<5U	NA	<10U	<10U	NA
Pentachlorophenol	87-86-5	<25U	NA	<50U	<50U	NA
Di-n-butyl phthalate	84-74-2	<5U	NA	<10U	<10U	NA
Butylbenzylphthalate	85-68-7	<5U	NA	<10U	<10U	NA
3,3'-Dichlorobenzidine	91-94-1	<25U	NA	<20U	<20U	NA
Bis(2-ethylhexyl)phthalate	117-81-7	<5U	NA	**3J**	<10U	NA
Di-n-octyl phthalate	117-84-0	<5U	NA	**3J**	<10U	NA
Azobenzene	103-33-3	<25U	NA	<50U	<50U	NA
Naphthalene	91-20-3	<5U	<1.8U	<10U	<10U	<1.8U
Acenaphthylene	208-96-8	<5U	<2.3U	<10U	<10U	<2.3U
Acenaphthene	83-32-9	<5U	<1.8U	<10U	<10U	<1.8U
Fluorene	86-73-7	<5U	**0.20J**	<10U	<10U	<0.21U
Phenanthrene	85-01-8	<5U	<0.64U	<10U	<10U	<0.64U
Anthracene	120-12-7	<5U	**0.50J**	<10U	<10U	**0.90J**
Fluoranthene	206-44-0	<5U	**0.15J**	<10U	<10U	<1.70U
Pyrene	129-00-0	<5U	<0.27U	<10U	<10U	<0.60U
Benzo(a)anthracene	56-55-3	<5U	**0.10**	<10U	<10U	<0.30U
Chrysene	218-01-9	<5U	<0.15U	<10U	<10U	<0.30U
Benzo(b)fluoranthene	205-99-2	<5U	<0.020U	<10U	<10U	<0.020U
Benzo(k)fluoranthene	207-08-9	<5U	<0.020U	<10U	<10U	<0.040U
Benzo(a)pyrene	50-32-8	<5U	<0.030U	<10U	<10U	<0.030U
Indeno(1,2,3-cd)pyrene	193-39-5	<5U	<0.050U	<10U	<10U	<0.050U
Dibenzo(a,h)anthracene	53-70-3	<5U	<0.030U	<10U	<10U	<0.030U
Benzo(g,h,i)perylene	191-24-2	<5U	<0.080U	<10U	<10U	<0.080U
Sum of PAHs		0	1	0	0	1
Sum of Carcinogenic PAHs		0	0	0	0	0

Table 6-5
SVOC Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REIEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	MW-9 / MW-9-08-94 / 0.0-0.0 / Groundwater / 08/02/94 / Primary / EPA8310	MW-10 / MW-10-11-93 / 0.0-0.0 / Groundwater / 11/08/93 / Primary / EPA8270	MW-11 / MW-11-04-94a / 0.0-0.0 / Groundwater / 04/05/94 / Primary / EPA8270	MW-11 / MW-11-04-94b / 0.0-0.0 / Groundwater / 04/06/94 / Primary / EPA8270	MW-11 / MW-11-08-94 / 0.0-0.0 / Groundwater / 08/02/94 / Primary / EPA8310
Semi-Volatile Organic Compounds(ug/L)						
Phenol	108-95-2	NA	<10U	<5U	NA	NA
bis(2-Chloroethyl) ether	111-44-4	NA	<10U	<5U	NA	NA
2-Chlorophenol	95-57-8	NA	<10U	<5U	NA	NA
1,3-Dichlorobenzene	541-73-1	NA	<10U	<5U	NA	NA
1,4-Dichlorobenzene	106-46-7	NA	<10U	<5U	NA	NA
Benzyl alcohol	100-51-6	NA	<10U	<5U	NA	NA
1,2-Dichlorobenzene	95-50-1	NA	<10U	<5U	NA	NA
2-Methylphenol	95-48-7	NA	<10U	<5U	NA	NA
Bis(2-chloroisopropyl)ether	39638-32-9	NA	<10U	<5U	NA	NA
4-Methylphenol	106-44-5	NA	<10U	<5U	NA	NA
N-Nitroso-di-n-propylamine	621-64-7	NA	<10U	<5U	NA	NA
Hexachloroethane	67-72-1	NA	<10U	<5U	NA	NA
Nitrobenzene	98-95-3	NA	<10U	<5U	NA	NA
Isophorone	78-59-1	NA	<10U	<5U	NA	NA
2-Nitrophenol	88-75-5	NA	<10U	<5U	NA	NA
2,4-Dimethylphenol	105-67-9	NA	<50U	<25U	NA	NA
Benzoic acid	65-85-0	NA	<10U	<5U	NA	NA
Bis(2-chloroethoxy)methane	111-91-1	NA	<10U	<5U	NA	NA
2,4-Dichlorophenol	120-83-2	NA	<10U	<5U	NA	NA
1,2,4-Trichlorobenzene	120-82-1	NA	<10U	<5U	NA	NA
4-Chloroaniline	106-47-8	NA	<10U	<5U	NA	NA
Hexachlorobutadiene	87-68-3	NA	<10U	<5U	NA	NA
4-Chloro-3-methylphenol	59-50-7	NA	<10U	<5U	NA	NA
2-Methylnaphthalene	91-57-6	NA	<10U	89	200	NA
Hexachlorocyclopentadiene	77-47-4	NA	<10U	<5U	NA	NA
2,4,6-Trichlorophenol	88-06-2	NA	<10U	<5U	NA	NA
2,4,5-Trichlorophenol	95-95-4	NA	<50U	<25U	NA	NA
2-Chloronaphthalene	91-58-7	NA	<10U	<5U	NA	NA
2-Nitroaniline	88-74-4	NA	<50U	<25U	NA	NA
Dimethyl phthalate	131-11-3	NA	<10U	<5U	NA	NA
2,6-Dinitrotoluene	606-20-2	NA	<50U	<25U	NA	NA
3-Nitroaniline	99-09-2	NA	<50U	<25U	NA	NA
N-Nitrosodimethylamine	62-75-9	NA	<10U	<5U	NA	NA
2,4-Dinitrophenol	51-28-5	NA	<50U	<25U	NA	NA
4-Nitrophenol	100-02-7	NA	<50U	<25U	NA	NA
Dibenzofuran	132-64-9	NA	<10U	<5U	19	NA
2,4-Dinitrotoluene	121-14-2	NA	<10U	<5U	NA	NA
Diethylphthalate	84-66-2	NA	<10U	<5U	NA	NA
4-Chlorophenyl-phenylether	7005-72-3	NA	<10U	<5U	NA	NA
4-Nitroaniline	100-01-6	NA	<50U	<25U	NA	NA
4,6-Dinitro,2-methylphenol	534-52-1	NA	<50U	<25U	NA	NA
N-Nitrosodiphenylamine	86-30-6	NA	<10U	<5U	NA	NA
4-Bromophenyl-phenylether	101-55-3	NA	<10U	<5U	NA	NA
Hexachlorobenzene	118-74-1	NA	<10U	<5U	NA	NA
Pentachlorophenol	87-86-5	NA	<50U	<25U	NA	NA
Di-n-butyl phthalate	84-74-2	NA	<10U	<5U	NA	NA
Butylbenzylphthalate	85-68-7	NA	<10U	<5U	NA	NA
3,3'-Dichlorobenzidine	91-94-1	NA	<20U	<25U	NA	NA
Bis(2-ethylhexyl)phthalate	117-81-7	NA	<10U	<5U	NA	NA
Di-n-octyl phthalate	117-84-0	NA	<10U	7	NA	NA
Azobenzene	103-33-3	NA	<50U	<25U	NA	NA
Naphthalene	91-20-3	<18U	<10U	31	32	<5.5U
Acenaphthylene	208-96-8	<23U	<10U	<5U	<6.6U	<7.0U
Acenaphthene	83-32-9	<18U	<10U	39	28	<5.5U
Fluorene	86-73-7	<2.1U	<10U	38	48	<1.2U
Phenanthrene	85-01-8	<6.4U	<10U	<5U	110	<3.8U
Anthracene	120-12-7	<6.6U	<10U	73	9.2	<1.2U
Fluoranthene	206-44-0	<2.1U	<10U	5	2.7J	52J
Pyrene	129-00-0	<2.7U	<10U	2J	3.9	<3.0U
Benzo(a)anthracene	56-55-3	3.0	<10U	<5U	<3.0U	0.61J
Chrysene	218-01-9	2.0	<10U	<5U	<3.0U	<0.45U
Benzo(b)fluoranthene	205-99-2	<0.20U	<10U	<5U	<3.0U	<0.061U
Benzo(k)fluoranthene	207-08-9	<0.20U	<10U	<5U	<3.0U	<0.061U
Benzo(a)pyrene	50-32-8	<0.30U	<10U	<5U	<3.0U	<0.091U
Indeno(1,2,3-cd)pyrene	193-39-5	<0.50U	<10U	<5U	<3.0U	<0.15U
Dibenzo(a,h)anthracene	53-70-3	<0.30U	<10U	<5U	<3.0U	<0.091U
Benzo(g,h,i)perylene	191-24-2	<0.80U	<10U	<5U	<3.0U	<0.24U
Sum of PAHs		5	0	188	234	53
Sum of Carcinogenic PAHs		5	0	0	0	1

Table 6-5
SVOC Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	MW-12 / MW-12-11-93 / 0.0-0.0 / Groundwater / 11/02/93 / Primary / EPA8270	MW-12 / MW-51-11-93 / 0.0-0.0 / Groundwater / 11/02/93 / Duplicate / EPA8270	MW-12 / MW-12-04-94 / 0.0-0.0 / Groundwater / 04/06/94 / Primary / EPA8310	MW-12 / MW-12-08-94 / 0.0-0.0 / Groundwater / 08/02/94 / Primary / EPA8310	MW-14 / MW-14-11-93 / 0.0-0.0 / Groundwater / 11/08/93 / Primary / EPA8270
Semi-Volatile Organic Compounds(ug/L)						
Phenol	108-95-2	<10U	<10U	NA	NA	<10U
bis(2-Chloroethyl) ether	111-44-4	<10U	<10U	NA	NA	<10U
2-Chlorophenol	95-57-8	<10U	<10U	NA	NA	<10U
1,3-Dichlorobenzene	541-73-1	<10U	<10U	NA	NA	<10U
1,4-Dichlorobenzene	106-46-7	<10U	<10U	NA	NA	<10U
Benzyl alcohol	100-51-6	<10U	<10U	NA	NA	<10U
1,2-Dichlorobenzene	95-50-1	<10U	<10U	NA	NA	<10U
2-Methylphenol	95-48-7	<10U	<10U	NA	NA	<10U
Bis(2-chloroisopropyl)ether	39638-32-9	<10U	<10U	NA	NA	<10U
4-Methylphenol	106-44-5	<10U	<10U	NA	NA	<10U
N-Nitroso-di-n-propylamine	621-64-7	<10U	<10U	NA	NA	<10U
Hexachloroethane	67-72-1	<10U	<10U	NA	NA	<10U
Nitrobenzene	98-95-3	<10U	<10U	NA	NA	<10U
Isophorone	78-59-1	<10U	<10U	NA	NA	<10U
2-Nitrophenol	88-75-5	<10U	<10U	NA	NA	<10U
2,4-Dimethylphenol	105-67-9	<50U	<50U	NA	NA	<50U
Benzoic acid	65-85-0	<10U	<10U	NA	NA	<10U
Bis(2-chloroethoxy)methane	111-91-1	<10U	<10U	NA	NA	<10U
2,4-Dichlorophenol	120-83-2	<10U	<10U	NA	NA	<10U
1,2,4-Trichlorobenzene	120-82-1	<10U	<10U	NA	NA	<10U
4-Chloroaniline	106-47-8	<10U	<10U	NA	NA	<10U
Hexachlorobutadiene	87-68-3	<10U	<10U	NA	NA	<10U
4-Chloro-3-methylphenol	59-50-7	<10U	<10U	NA	NA	<10U
2-Methylnaphthalene	91-57-6	<10U	<10U	NA	NA	<10U
Hexachlorocyclopentadiene	77-47-4	<10U	<10U	NA	NA	<10U
2,4,6-Trichlorophenol	88-06-2	<10U	<10U	NA	NA	<50U
2,4,5-Trichlorophenol	95-95-4	<50U	<50U	NA	NA	<10U
2-Chloronaphthalene	91-58-7	<10U	<10U	NA	NA	<50U
2-Nitroaniline	88-74-4	<50U	<50U	NA	NA	<10U
Dimethyl phthalate	131-11-3	<10U	<10U	NA	NA	<50U
2,6-Dinitrotoluene	606-20-2	<50U	<50U	NA	NA	<50U
3-Nitroaniline	99-09-2	<50U	<50U	NA	NA	<10U
N-Nitrosodimethylamine	62-75-9	<10U	<10U	NA	NA	<50U
2,4-Dinitrophenol	51-28-5	<50U	<50U	NA	NA	<50U
4-Nitrophenol	100-02-7	<50U	<50U	NA	NA	<10U
Dibenzofuran	132-64-9	<10U	<10U	NA	NA	<10U
2,4-Dinitrotoluene	121-14-2	<10U	<10U	NA	NA	<10U
Diethylphthalate	84-66-2	<10U	<10U	NA	NA	<10U
4-Chlorophenyl-phenylether	7005-72-3	<10U	<10U	NA	NA	<50U
4-Nitroaniline	100-01-6	<50U	<50U	NA	NA	<50U
4,6-Dinitro,2-methylphenol	534-52-1	<50U	<50U	NA	NA	<10U
N-Nitrosodiphenylamine	86-30-6	<10U	<10U	NA	NA	<10U
4-Bromophenyl-phenylether	101-55-3	<10U	<10U	NA	NA	<10U
Hexachlorobenzene	118-74-1	<10U	<10U	NA	NA	<50U
Pentachlorophenol	87-86-5	<50U	<50U	NA	NA	<10U
Di-n-butyl phthalate	84-74-2	<10U	<10U	NA	NA	<10U
Butylbenzylphthalate	85-68-7	<10U	<10U	NA	NA	<20U
3,3'-Dichlorobenzidine	91-94-1	<20U	<20U	NA	NA	<10U
Bis(2-ethylhexyl)phthalate	117-81-7	<10U	<10U	NA	NA	<10U
Di-n-octyl phthalate	117-84-0	<10U	<10U	NA	NA	<50U
Azobenzene	103-33-3	<50U	<50U	NA	NA	<10U
Naphthalene	91-20-3	<10U	<10U	<1.8U	<1.8U	<10U
Acenaphthylene	208-96-8	<10U	<10U	<2.3U	<2.3U	<10U
Acenaphthene	83-32-9	<10U	<10U	<1.8U	<1.8U	<10U
Fluorene	86-73-7	<10U	<10U	<0.21U	<0.21U	<10U
Phenanthrene	85-01-8	<10U	<10U	<0.64U	<0.64U	<10U
Anthracene	120-12-7	<10U	<10U	<0.66U	<0.66U	<10U
Fluoranthene	206-44-0	<10U	<10U	<0.21U	<0.50U	<10U
Pyrene	129-00-0	<10U	<10U	<0.50U	<0.27U	<10U
Benzo(a)anthracene	56-55-3	<10U	<10U	<0.10U	0.10	<10U
Chrysene	218-01-9	<10U	<10U	<0.15U	<0.15U	<10U
Benzo(b)fluoranthene	205-99-2	<10U	<10U	<0.030U	<0.20U	<10U
Benzo(k)fluoranthene	207-08-9	<10U	<10U	<0.060U	<0.020U	<10U
Benzo(a)pyrene	50-32-8	<10U	<10U	<0.030U	<0.20U	<10U
Indeno(1,2,3-cd)pyrene	193-39-5	<10U	<10U	<0.050U	0.200	<10U
Dibenzo(a,h)anthracene	53-70-3	<10U	<10U	<0.030U	0.080	<10U
Benzo(g,h,i)perylene	191-24-2	<10U	<10U	<0.080U	<0.080U	<10U
Sum of PAHs		0	0	0	0	0
Sum of Carcinogenic PAHs		0	0	0	0	0

Table 6-5
SVOC Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

	Sample location:	MW-19	MW-19	MW-23	MW-23	MW-23
	Sample no:	MW-19-11-93	MW-52-11-93	MW-23-11-93	MW-23-04-94	MW-23-08-94
	Depth(ft):	0.0-0.0	0.0-0.0	0.0-0.0	0.0-0.0	0.0-0.0
	Matrix:	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
	Sample Date:	11/04/93	11/04/93	11/04/93	04/05/94	08/02/94
	Type:	Primary	Duplicate	Primary	Primary	Primary
	Method:	EPA8270	EPA8270	EPA8270	EPA8310	EPA8310
Analyte	CAS NO.					
Semi-Volatile Organic Compounds(ug/L)						
Phenol	108-95-2	<10U	<10U	<10U	NA	NA
bis(2-Chloroethyl) ether	111-44-4	<10U	<10U	<10U	NA	NA
2-Chlorophenol	95-57-8	<10U	<10U	<10U	NA	NA
1,3-Dichlorobenzene	541-73-1	<10U	<10U	<10U	NA	NA
1,4-Dichlorobenzene	106-46-7	<10U	<10U	<10U	NA	NA
Benzyl alcohol	100-51-6	<10U	<10U	<10U	NA	NA
1,2-Dichlorobenzene	95-50-1	<10U	<10U	<10U	NA	NA
2-Methylphenol	95-48-7	<10U	<10U	<10U	NA	NA
Bis(2-chloroisopropyl)ether	39638-32-9	<10U	<10U	<10U	NA	NA
4-Methylphenol	106-44-5	<10U	<10U	<10U	NA	NA
N-Nitroso-di-n-propylamine	621-64-7	<10U	<10U	<10U	NA	NA
Hexachloroethane	67-72-1	<10U	<10U	<10U	NA	NA
Nitrobenzene	98-95-3	<10U	<10U	<10U	NA	NA
Isophorone	78-59-1	<10U	<10U	<10U	NA	NA
2-Nitrophenol	88-75-5	<10U	<10U	<10U	NA	NA
2,4-Dimethylphenol	105-67-9	<50U	<50U	<50U	NA	NA
Benzoic acid	65-85-0	<10U	<10U	<10U	NA	NA
Bis(2-chloroethoxy)methane	111-91-1	<10U	<10U	<10U	NA	NA
2,4-Dichlorophenol	120-83-2	<10U	<10U	<10U	NA	NA
1,2,4-Trichlorobenzene	120-82-1	<10U	<10U	<10U	NA	NA
4-Chloroaniline	106-47-8	<10U	<10U	<10U	NA	NA
Hexachlorobutadiene	87-68-3	<10U	<10U	<10U	NA	NA
4-Chloro-3-methylphenol	59-50-7	<10U	<10U	<10U	NA	NA
2-Methylnaphthalene	91-57-6	<10U	<10U	<10U	NA	NA
Hexachlorocyclopentadiene	77-47-4	<10U	<10U	<10U	NA	NA
2,4,6-Trichlorophenol	88-06-2	<10U	<10U	<10U	NA	NA
2,4,5-Trichlorophenol	95-95-4	<50U	<50U	<50U	NA	NA
2-Chloronaphthalene	91-58-7	<10U	<10U	<10U	NA	NA
2-Nitroaniline	88-74-4	<50U	<50U	<50U	NA	NA
Dimethyl phthalate	131-11-3	<10U	<10U	<10U	NA	NA
2,6-Dinitrotoluene	606-20-2	<50U	<50U	<50U	NA	NA
3-Nitroaniline	99-09-2	<50U	<50U	<50U	NA	NA
N-Nitrosodimethylamine	62-75-9	<10U	<10U	<10U	NA	NA
2,4-Dinitrophenol	51-28-5	<50U	<50U	<50U	NA	NA
4-Nitrophenol	100-02-7	<50U	<50U	<50U	NA	NA
Dibenzofuran	132-64-9	<10U	<10U	<10U	NA	NA
2,4-Dinitrotoluene	121-14-2	<10U	<10U	<10U	NA	NA
Diethylphthalate	84-66-2	<10U	<10U	<10U	NA	NA
4-Chlorophenyl-phenylether	7005-72-3	<10U	<10U	<10U	NA	NA
4-Nitroaniline	100-01-6	<50U	<50U	<50U	NA	NA
4,6-Dinitro,2-methylphenol	534-52-1	<50U	<50U	<50U	NA	NA
N-Nitrosodiphenylamine	86-30-6	<10U	<10U	<10U	NA	NA
4-Bromophenyl-phenylether	101-55-3	<10U	<10U	<10U	NA	NA
Hexachlorobenzene	118-74-1	<10U	<10U	<10U	NA	NA
Pentachlorophenol	87-86-5	<50U	<50U	<50U	NA	NA
Di-n-butyl phthalate	84-74-2	<10U	<10U	<10U	NA	NA
Butylbenzylphthalate	85-68-7	<10U	<10U	<10U	NA	NA
3,3'-Dichlorobenzidine	91-94-1	<20U	<20U	<20U	NA	NA
Bis(2-ethylhexyl)phthalate	117-81-7	<10U	<10U	<10U	NA	NA
Di-n-octyl phthalate	117-84-0	<10U	<10U	<10U	NA	NA
Azobenzene	103-33-3	<50U	<50U	<50U	NA	NA
Naphthalene	91-20-3	<10U	<10U	<10U	<1.8U	<1.8U
Acenaphthylene	208-96-8	<10U	<10U	<10U	<2.3U	<2.3U
Acenaphthene	83-32-9	<10U	<10U	<10U	<1.8U	<1.8U
Fluorene	86-73-7	<10U	<10U	<10U	<0.21U	<0.21U
Phenanthrene	85-01-8	<10U	<10U	<10U	<0.64U	<0.64U
Anthracene	120-12-7	<10U	<10U	<10U	<0.66U	<0.66U
Fluoranthene	206-44-0	<10U	<10U	<10U	<0.21U	<0.21U
Pyrene	129-00-0	<10U	<10U	<10U	<0.27U	<0.27U
Benzo(a)anthracene	56-55-3	<10U	<10U	<10U	<0.020U	<0.020U
Chrysene	218-01-9	<10U	<10U	<10U	<0.15U	<0.15U
Benzo(b)fluoranthene	205-99-2	<10U	<10U	<10U	<0.020U	<0.020U
Benzo(k)fluoranthene	207-08-9	<10U	<10U	<10U	<0.020U	<0.020U
Benzo(a)pyrene	50-32-8	<10U	<10U	<10U	<0.030U	<0.030U
Indeno(1,2,3-cd)pyrene	193-39-5	<10U	<10U	<10U	<0.050U	<0.050U
Dibenzo(a,h)anthracene	53-70-3	<10U	<10U	<10U	<0.030U	<0.030U
Benzo(g,h,i)perylene	191-24-2	<10U	<10U	<10U	<0.080U	<0.080U
Sum of PAHs		0	0	0	0	0
Sum of Carcinogenic PAHs		0	0	0	0	0

Table 6-5
SVOC Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	MW-23 / MW-23B-08-94 / 0.0-0.0 / Groundwater / 08/02/94 / Duplicate / EPA8310	MW-28 / MW-28-11-93 / 0.0-0.0 / Groundwater / 11/03/93 / Primary / EPA8270	MW-28 / MW-28-04-94 / 0.0-0.0 / Groundwater / 04/05/94 / Primary / EPA8270	MW-28 / MW-28-08-94 / 0.0-0.0 / Groundwater / 08/02/94 / Primary / EPA8310	MW-31 / MW-31-11-93 / 0.0-0.0 / Groundwater / 11/04/93 / Primary / EPA8270
Semi-Volatile Organic Compounds(ug/L)						
Phenol	108-95-2	NA	<50U	<20U	NA	<10U
bis(2-Chloroethyl) ether	111-44-4	NA	<50U	<20U	NA	<10U
2-Chlorophenol	95-57-8	NA	<50U	<20U	NA	<10U
1,3-Dichlorobenzene	541-73-1	NA	<50U	<20U	NA	<10U
1,4-Dichlorobenzene	106-46-7	NA	<50U	<20U	NA	<10U
Benzyl alcohol	100-51-6	NA	<50U	<20U	NA	<10U
1,2-Dichlorobenzene	95-50-1	NA	<50U	<20U	NA	<10U
2-Methylphenol	95-48-7	NA	<50U	<20U	NA	<10U
Bis(2-chloroisopropyl)ether	39638-32-9	NA	<50U	<20U	NA	<10U
4-Methylphenol	106-44-5	NA	<50U	<20U	NA	<10U
N-Nitroso-di-n-propylamine	621-64-7	NA	<50U	<20U	NA	<10U
Hexachloroethane	67-72-1	NA	<50U	<20U	NA	<10U
Nitrobenzene	98-95-3	NA	<50U	<20U	NA	<10U
Isophorone	78-59-1	NA	<50U	<20U	NA	<10U
2-Nitrophenol	88-75-5	NA	<50U	<20U	NA	<10U
2,4-Dimethylphenol	105-67-9	NA	<250U	<100U	NA	<50U
Benzoic acid	65-85-0	NA	<50U	<20U	NA	<10U
Bis(2-chloroethoxy)methane	111-91-1	NA	<50U	<20U	NA	<10U
2,4-Dichlorophenol	120-83-2	NA	<50U	<20U	NA	<10U
1,2,4-Trichlorobenzene	120-82-1	NA	<50U	<20U	NA	<10U
4-Chloroaniline	106-47-8	NA	<50U	<20U	NA	<10U
Hexachlorobutadiene	87-68-3	NA	<50U	<20U	NA	<10U
4-Chloro-3-methylphenol	59-50-7	NA	<50U	<20U	NA	<10U
2-Methylnaphthalene	91-57-6	NA	<50U	<20U	NA	<10U
Hexachlorocyclopentadiene	77-47-4	NA	<50U	<20U	NA	<10U
2,4,6-Trichlorophenol	88-06-2	NA	<50U	<20U	NA	<10U
2,4,5-Trichlorophenol	95-95-4	NA	<250U	<100U	NA	<50U
2-Chloronaphthalene	91-58-7	NA	<50U	<20U	NA	<10U
2-Nitroaniline	88-74-4	NA	<250U	<100U	NA	<50U
Dimethyl phthalate	131-11-3	NA	<50U	<20U	NA	<10U
2,6-Dinitrotoluene	606-20-2	NA	<250U	<100U	NA	<50U
3-Nitroaniline	99-09-2	NA	<250U	<100U	NA	<50U
N-Nitrosodimethylamine	62-75-9	NA	<50U	<20U	NA	<10U
2,4-Dinitrophenol	51-28-5	NA	<250U	<100U	NA	<50U
4-Nitrophenol	100-02-7	NA	<250U	<100U	NA	<50U
Dibenzofuran	132-64-9	NA	<50U	<20U	NA	<10U
2,4-Dinitrotoluene	121-14-2	NA	<50U	<20U	NA	<10U
Diethylphthalate	84-66-2	NA	<50U	<20U	NA	<10U
4-Chlorophenyl-phenylether	7005-72-3	NA	<50U	<20U	NA	<10U
4-Nitroaniline	100-01-6	NA	<250U	<100U	NA	<50U
4,6-Dinitro,2-methylphenol	534-52-1	NA	<250U	<100U	NA	<50U
N-Nitrosodiphenylamine	86-30-6	NA	<50U	<20U	NA	<10U
4-Bromophenyl-phenylether	101-55-3	NA	<50U	<20U	NA	<10U
Hexachlorobenzene	118-74-1	NA	<50U	<20U	NA	<10U
Pentachlorophenol	87-86-5	NA	<250U	<100U	NA	<50U
Di-n-butyl phthalate	84-74-2	NA	<50U	<20U	NA	<10U
Butylbenzylphthalate	85-68-7	NA	<50U	<20U	NA	<10U
3,3'-Dichlorobenzidine	91-94-1	NA	<100U	<100U	NA	<20U
Bis(2-ethylhexyl)phthalate	117-81-7	NA	<50U	<20U	NA	<10U
Di-n-octyl phthalate	117-84-0	NA	<50U	<20U	NA	<10U
Azobenzene	103-33-3	NA	<250U	<100U	NA	<50U
Naphthalene	91-20-3	<1.8U	<50U	<20U	<18U	<10U
Acenaphthylene	208-96-8	<2.3U	<50U	<20U	<23U	<10U
Acenaphthene	83-32-9	<1.8U	<50U	<20U	<18U	<10U
Fluorene	86-73-7	<0.21U	<50U	<20U	<2.1U	<10U
Phenanthrene	85-01-8	<0.64U	<50U	<20U	<6.4U	<10U
Anthracene	120-12-7	<0.66U	<50U	<20U	<6.6U	<10U
Fluoranthene	206-44-0	<0.21U	<50U	<20U	16	<10U
Pyrene	129-00-0	<0.27U	<50U	<20U	<2.7U	<10U
Benzo(a)anthracene	56-55-3	<0.020U	<50U	<20U	2.0	<10U
Chrysene	218-01-9	<0.15U	<50U	<20U	<1.5U	<10U
Benzo(b)fluoranthene	205-99-2	<0.020U	<50U	<20U	<0.20U	<10U
Benzo(k)fluoranthene	207-08-9	<0.020U	<50U	<20U	<0.20U	<10U
Benzo(a)pyrene	50-32-8	<0.030U	<50U	<20U	<0.30U	<10U
Indeno(1,2,3-cd)pyrene	193-39-5	<0.050U	<50U	<20U	<0.50U	<10U
Dibenzo(a,h)anthracene	53-70-3	<0.030U	<50U	<20U	<0.30U	<10U
Benzo(g,h,i)perylene	191-24-2	<0.080U	<50U	<20U	<0.80U	<10U
Sum of PAHs		0	0	0	18	0
Sum of Carcinogenic PAHs		0	0	0	2	0

Table 6-5
SVOC Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	MW-31 / MW-101-11-93 / 0.0-0.0 / Groundwater / 11/04/93 / Duplicate / EPA8270	MW-31 / MW-102-11-93 / 0.0-0.0 / Groundwater / 11/04/93 / Duplicate / EPA8270	MW-35 / MW-35-11-93 / 0.0-0.0 / Groundwater / 11/04/93 / Primary / EPA8270	MW-36 / MW-36-04-94 / 0.0-0.0 / Groundwater / 04/05/94 / Primary / EPA8310	MW-36 / MW-360-04-94 / 0.0-0.0 / Groundwater / 04/05/94 / Duplicate / EPA8310
Semi-Volatile Organic Compounds(ug/L)						
Phenol	108-95-2	<10U	<10U	<10U	NA	NA
bis(2-Chloroethyl) ether	111-44-4	<10U	<10U	<10U	NA	NA
2-Chlorophenol	95-57-8	<10U	<10U	<10U	NA	NA
1,3-Dichlorobenzene	541-73-1	<10U	<10U	<10U	NA	NA
1,4-Dichlorobenzene	106-46-7	<10U	<10U	<10U	NA	NA
Benzyl alcohol	100-51-6	<10U	<10U	<10U	NA	NA
1,2-Dichlorobenzene	95-50-1	<10U	<10U	<10U	NA	NA
2-Methylphenol	95-48-7	<10U	<10U	<10U	NA	NA
Bis(2-chloroisopropyl)ether	39638-32-9	<10U	<10U	<10U	NA	NA
4-Methylphenol	106-44-5	<10U	<10U	<10U	NA	NA
N-Nitroso-di-n-propylamine	621-64-7	<10U	<10U	<10U	NA	NA
Hexachloroethane	67-72-1	<10U	<10U	<10U	NA	NA
Nitrobenzene	98-95-3	<10U	<10U	<10U	NA	NA
Isophorone	78-59-1	<10U	<10U	<10U	NA	NA
2-Nitrophenol	88-75-5	<10U	<10U	<10U	NA	NA
2,4-Dimethylphenol	105-67-9	<50U	<50U	<50U	NA	NA
Benzoic acid	65-85-0	<10U	<10U	<10U	NA	NA
Bis(2-chloroethoxy)methane	111-91-1	<10U	<10U	<10U	NA	NA
2,4-Dichlorophenol	120-83-2	<10U	<10U	<10U	NA	NA
1,2,4-Trichlorobenzene	120-82-1	<10U	<10U	<10U	NA	NA
4-Chloroaniline	106-47-8	<10U	<10U	<10U	NA	NA
Hexachlorobutadiene	87-68-3	<10U	<10U	<10U	NA	NA
4-Chloro-3-methylphenol	59-50-7	<10U	<10U	<10U	NA	NA
2-Methylnaphthalene	91-57-6	<10U	<10U	<10U	NA	NA
Hexachlorocyclopentadiene	77-47-4	<10U	<10U	<10U	NA	NA
2,4,6-Trichlorophenol	88-06-2	<10U	<10U	<10U	NA	NA
2,4,5-Trichlorophenol	95-95-4	<50U	<50U	<50U	NA	NA
2-Chloronaphthalene	91-58-7	<10U	<10U	<10U	NA	NA
2-Nitroaniline	88-74-4	<50U	<50U	<50U	NA	NA
Dimethyl phthalate	131-11-3	<10U	<10U	<10U	NA	NA
2,6-Dinitrotoluene	606-20-2	<50U	<50U	<50U	NA	NA
3-Nitroaniline	99-09-2	<50U	<50U	<50U	NA	NA
N-Nitrosodimethylamine	62-75-9	<10U	<10U	<10U	NA	NA
2,4-Dinitrophenol	51-28-5	<50U	<50U	<50U	NA	NA
4-Nitrophenol	100-02-7	<50U	<50U	<50U	NA	NA
Dibenzofuran	132-64-9	<10U	<10U	<10U	NA	NA
2,4-Dinitrotoluene	121-14-2	<10U	<10U	<10U	NA	NA
Diethylphthalate	84-66-2	<10U	<10U	<10U	NA	NA
4-Chlorophenyl-phenylether	7005-72-3	<10U	<10U	<10U	NA	NA
4-Nitroaniline	100-01-6	<50U	<50U	<50U	NA	NA
4,6-Dinitro,2-methylphenol	534-52-1	<50U	<50U	<50U	NA	NA
N-Nitrosodiphenylamine	86-30-6	<10U	<10U	<10U	NA	NA
4-Bromophenyl-phenylether	101-55-3	<10U	<10U	<10U	NA	NA
Hexachlorobenzene	118-74-1	<10U	<10U	<10U	NA	NA
Pentachlorophenol	87-86-5	<50U	<50U	<50U	NA	NA
Di-n-butyl phthalate	84-74-2	<10U	<10U	<10U	NA	NA
Butylbenzylphthalate	85-68-7	<10U	<10U	<10U	NA	NA
3,3'-Dichlorobenzidine	91-94-1	<20U	<20U	<20U	NA	NA
Bis(2-ethylhexyl)phthalate	117-81-7	<10U	<10U	<10U	NA	NA
Di-n-octyl phthalate	117-84-0	<10U	<10U	<10U	NA	NA
Azobenzene	103-33-3	<50U	<50U	<50U	NA	NA
Naphthalene	91-20-3	<10U	<10U	<10U	<1.8U	<1.8U
Acenaphthylene	208-96-8	<10U	<10U	<10U	<2.3U	<2.3U
Acenaphthene	83-32-9	<10U	<10U	<10U	<1.8U	<1.8U
Fluorene	86-73-7	<10U	<10U	<10U	1.6	1.7
Phenanthrene	85-01-8	<10U	<10U	<10U	<0.64U	<0.64U
Anthracene	120-12-7	<10U	<10U	<10U	3.3	2.0J
Fluoranthene	206-44-0	<10U	<10U	<10U	<2.5U	<2.9U
Pyrene	129-00-0	<10U	<10U	<10U	<0.90U	<1.0U
Benzo(a)anthracene	56-55-3	<10U	<10U	<10U	<0.40U	<0.40U
Chrysene	218-01-9	<10U	<10U	<10U	<0.30U	<0.40U
Benzo(b)fluoranthene	205-99-2	<10U	<10U	<10U	<0.040U	<0.080U
Benzo(k)fluoranthene	207-08-9	<10U	<10U	<10U	<0.040U	<0.060U
Benzo(a)pyrene	50-32-8	<10U	<10U	<10U	<0.030U	<0.030U
Indeno(1,2,3-cd)pyrene	193-39-5	<10U	<10U	<10U	<0.050U	<0.050U
Dibenzo(a,h)anthracene	53-70-3	<10U	<10U	<10U	<0.030U	<0.030U
Benzo(g,h,i)perylene	191-24-2	<10U	<10U	<10U	<0.080U	<0.080U
Sum of PAHs		0	0	0	5	4
Sum of Carcinogenic PAHs		0	0	0	0	0

Table 6-5
SVOC Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	MW-36 / MW-36-08-94 / 0.0-0.0 / Groundwater / 08/02/94 / Primary / EPA8310	MW-37 / MW-37-04-94 / 0.0-0.0 / Groundwater / 04/05/94 / Primary / EPA8310	MW-37 / MW-37-08-94 / 0.0-0.0 / Groundwater / 08/02/94 / Primary / EPA8310	MW-38 / MW-38-11-93 / 0.0-0.0 / Groundwater / 11/04/93 / Primary / EPA8270	MW-40 / MW-40-11-93 / 0.0-0.0 / Groundwater / 11/04/93 / Primary / EPA8270
Semi-Volatile Organic Compounds(ug/L)						
Phenol	108-95-2	NA	NA	NA	<10U	<10U
bis(2-Chloroethyl) ether	111-44-4	NA	NA	NA	<10U	<10U
2-Chlorophenol	95-57-8	NA	NA	NA	<10U	<10U
1,3-Dichlorobenzene	541-73-1	NA	NA	NA	<10U	<10U
1,4-Dichlorobenzene	106-46-7	NA	NA	NA	<10U	<10U
Benzyl alcohol	100-51-6	NA	NA	NA	<10U	<10U
1,2-Dichlorobenzene	95-50-1	NA	NA	NA	<10U	<10U
2-Methylphenol	95-48-7	NA	NA	NA	<10U	<10U
Bis(2-chloroisopropyl)ether	39638-32-9	NA	NA	NA	<10U	<10U
4-Methylphenol	106-44-5	NA	NA	NA	<10U	<10U
N-Nitroso-di-n-propylamine	621-64-7	NA	NA	NA	<10U	<10U
Hexachloroethane	67-72-1	NA	NA	NA	<10U	<10U
Nitrobenzene	98-95-3	NA	NA	NA	<10U	<10U
Isophorone	78-59-1	NA	NA	NA	<10U	<10U
2-Nitrophenol	88-75-5	NA	NA	NA	<10U	<10U
2,4-Dimethylphenol	105-67-9	NA	NA	NA	<50U	<50U
Benzoic acid	65-85-0	NA	NA	NA	<10U	<10U
Bis(2-chloroethoxy)methane	111-91-1	NA	NA	NA	<10U	<10U
2,4-Dichlorophenol	120-83-2	NA	NA	NA	<10U	<10U
1,2,4-Trichlorobenzene	120-82-1	NA	NA	NA	<10U	<10U
4-Chloroaniline	106-47-8	NA	NA	NA	<10U	<10U
Hexachlorobutadiene	87-68-3	NA	NA	NA	<10U	<10U
4-Chloro-3-methylphenol	59-50-7	NA	NA	NA	<10U	<10U
2-Methylnaphthalene	91-57-6	NA	NA	NA	<10U	<10U
Hexachlorocyclopentadiene	77-47-4	NA	NA	NA	<10U	<10U
2,4,6-Trichlorophenol	88-06-2	NA	NA	NA	<10U	<10U
2,4,5-Trichlorophenol	95-95-4	NA	NA	NA	<50U	<50U
2-Chloronaphthalene	91-58-7	NA	NA	NA	<10U	<10U
2-Nitroaniline	88-74-4	NA	NA	NA	<50U	<50U
Dimethyl phthalate	131-11-3	NA	NA	NA	<10U	<10U
2,6-Dinitrotoluene	606-20-2	NA	NA	NA	<50U	<50U
3-Nitroaniline	99-09-2	NA	NA	NA	<50U	<50U
N-Nitrosodimethylamine	62-75-9	NA	NA	NA	<10U	<10U
2,4-Dinitrophenol	51-28-5	NA	NA	NA	<50U	<50U
4-Nitrophenol	100-02-7	NA	NA	NA	<50U	<50U
Dibenzofuran	132-64-9	NA	NA	NA	<10U	<10U
2,4-Dinitrotoluene	121-14-2	NA	NA	NA	<10U	<10U
Diethylphthalate	84-66-2	NA	NA	NA	<10U	<10U
4-Chlorophenyl-phenylether	7005-72-3	NA	NA	NA	<10U	<10U
4-Nitroaniline	100-01-6	NA	NA	NA	<50U	<50U
4,6-Dinitro,2-methylphenol	534-52-1	NA	NA	NA	<50U	<50U
N-Nitrosodiphenylamine	86-30-6	NA	NA	NA	<10U	<10U
4-Bromophenyl-phenylether	101-55-3	NA	NA	NA	<10U	<10U
Hexachlorobenzene	118-74-1	NA	NA	NA	<10U	<10U
Pentachlorophenol	87-86-5	NA	NA	NA	<50U	<50U
Di-n-butyl phthalate	84-74-2	NA	NA	NA	<10U	<10U
Butylbenzylphthalate	85-68-7	NA	NA	NA	<10U	<10U
3,3'-Dichlorobenzidine	91-94-1	NA	NA	NA	<20U	<20U
Bis(2-ethylhexyl)phthalate	117-81-7	NA	NA	NA	<10U	<10U
Di-n-octyl phthalate	117-84-0	NA	NA	NA	<10U	<10U
Azobenzene	103-33-3	NA	NA	NA	<50U	<50U
Naphthalene	91-20-3	<1.8U	<1.8U	<1.8U	<10U	<10U
Acenaphthylene	208-96-8	<2.3U	<2.3U	<2.3U	<10U	<10U
Acenaphthene	83-32-9	<1.8U	<1.8U	**1.3J**	<10U	<10U
Fluorene	86-73-7	**1.5**	**1.8**	**2.1**	<10U	<10U
Phenanthrene	85-01-8	<0.64U	<0.64U	**0.40J**	<10U	<10U
Anthracene	120-12-7	**1.5**	**1.0J**	**0.70**	<10U	<10U
Fluoranthene	206-44-0	**1.1**	<12U	**8.9**	<10U	<10U
Pyrene	129-00-0	**0.40**	<0.50U	<0.27U	<10U	<10U
Benzo(a)anthracene	56-55-3	**0.090**	<0.080U	**0.10**	<10U	<10U
Chrysene	218-01-9	**0.30**	<0.15U	<0.15U	<10U	<10U
Benzo(b)fluoranthene	205-99-2	**0.060**	<0.020U	<0.020U	<10U	<10U
Benzo(k)fluoranthene	207-08-9	**0.030**	<0.020U	<0.020U	<10U	<10U
Benzo(a)pyrene	50-32-8	<0.030U	<0.030U	<0.030U	<10U	<10U
Indeno(1,2,3-cd)pyrene	193-39-5	<0.050U	<0.050U	<0.050U	<10U	<10U
Dibenzo(a,h)anthracene	53-70-3	<0.030U	<0.030U	<0.030U	<10U	<10U
Benzo(g,h,i)perylene	191-24-2	<0.080U	<0.080U	<0.080U	<10U	<10U
Sum of PAHs		**5**	**3**	**14**	**0**	**0**
Sum of Carcinogenic PAHs		**0**	**0**	**0**	**0**	**0**

Table 6-5
SVOC Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte						
	Sample location:	DW-1	DW-2	DW-3	DW-4	DW-5
	Sample no:	DW-1-11-93	DW-2-11-93	DW-3-11-93	DW-4-11-93	DW-5-11-93
	Depth(ft):	0.0-0.0	0.0-0.0	0.0-0.0	0.0-0.0	0.0-0.0
	Matrix:	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
	Sample Date:	11/08/93	11/02/93	11/08/93	11/09/93	11/08/93
	Type:	Primary	Primary	Primary	Primary	Primary
	Method:	EPA8270	EPA8270	EPA8270	EPA8270	EPA8270
Analyte	CAS NO.					
Semi-Volatile Organic Compounds(ug/L)						
Phenol	108-95-2	<10U	<10U	<10U	<10U	<10U
bis(2-Chloroethyl) ether	111-44-4	<10U	<10U	<10U	<10U	<10U
2-Chlorophenol	95-57-8	<10U	<10U	<10U	<10U	<10U
1,3-Dichlorobenzene	541-73-1	<10U	<10U	<10U	<10U	<10U
1,4-Dichlorobenzene	106-46-7	<10U	<10U	<10U	<10U	<10U
Benzyl alcohol	100-51-6	<10U	<10U	<10U	<10U	<10U
1,2-Dichlorobenzene	95-50-1	<10U	<10U	<10U	<10U	<10U
2-Methylphenol	95-48-7	<10U	<10U	<10U	<10U	<10U
Bis(2-chloroisopropyl)ether	39638-32-9	<10U	<10U	<10U	<10U	<10U
4-Methylphenol	106-44-5	<10U	<10U	<10U	<10U	<10U
N-Nitroso-di-n-propylamine	621-64-7	<10U	<10U	<10U	<10U	<10U
Hexachloroethane	67-72-1	<10U	<10U	<10U	<10U	<10U
Nitrobenzene	98-95-3	<10U	<10U	<10U	<10U	<10U
Isophorone	78-59-1	<10U	<10U	<10U	<10U	<10U
2-Nitrophenol	88-75-5	<10U	<10U	<10U	<10U	<10U
2,4-Dimethylphenol	105-67-9	<50U	<50U	<50U	<50U	<50U
Benzoic acid	65-85-0	<10U	<10U	<10U	<10U	<10U
Bis(2-chloroethoxy)methane	111-91-1	<10U	<10U	<10U	<10U	<10U
2,4-Dichlorophenol	120-83-2	<10U	<10U	<10U	<10U	<10U
1,2,4-Trichlorobenzene	120-82-1	<10U	<10U	<10U	<10U	<10U
4-Chloroaniline	106-47-8	<10U	<10U	<10U	<10U	<10U
Hexachlorobutadiene	87-68-3	<10U	<10U	<10U	<10U	<10U
4-Chloro-3-methylphenol	59-50-7	<10U	<10U	<10U	<10U	<10U
2-Methylnaphthalene	91-57-6	<10U	<10U	<10U	<10U	<10U
Hexachlorocyclopentadiene	77-47-4	<10U	<10U	<10U	<10U	<10U
2,4,6-Trichlorophenol	88-06-2	<10U	<10U	<10U	<10U	<10U
2,4,5-Trichlorophenol	95-95-4	<50U	<50U	<50U	<50U	<50U
2-Chloronaphthalene	91-58-7	<10U	<10U	<10U	<10U	<10U
2-Nitroaniline	88-74-4	<50U	<50U	<50U	<50U	<50U
Dimethyl phthalate	131-11-3	<10U	<10U	<10U	<10U	<10U
2,6-Dinitrotoluene	606-20-2	<50U	<50U	<50U	<50U	<50U
3-Nitroaniline	99-09-2	<50U	<50U	<50U	<50U	<50U
N-Nitrosodimethylamine	62-75-9	<10U	<10U	<10U	<10U	<10U
2,4-Dinitrophenol	51-28-5	<50U	<50U	<50U	<50U	<50U
4-Nitrophenol	100-02-7	<50U	<50U	<50U	<50U	<50U
Dibenzofuran	132-64-9	<10U	<10U	<10U	<10U	<10U
2,4-Dinitrotoluene	121-14-2	<10U	<10U	<10U	<10U	<10U
Diethylphthalate	84-66-2	<10U	<10U	<10U	<10U	<10U
4-Chlorophenyl-phenylether	7005-72-3	<10U	<10U	<10U	<10U	<10U
4-Nitroaniline	100-01-6	<50U	<50U	<50U	<50U	<50U
4,6-Dinitro,2-methylphenol	534-52-1	<50U	<50U	<50U	<50U	<50U
N-Nitrosodiphenylamine	86-30-6	<10U	<10U	<10U	<10U	<10U
4-Bromophenyl-phenylether	101-55-3	<10U	<10U	<10U	<10U	<10U
Hexachlorobenzene	118-74-1	<10U	<10U	<10U	<10U	<10U
Pentachlorophenol	87-86-5	<50U	<50U	<50U	<50U	<50U
Di-n-butyl phthalate	84-74-2	<10U	<10U	<10U	<10U	<10U
Butylbenzylphthalate	85-68-7	<10U	<10U	<10U	<10U	<10U
3,3'-Dichlorobenzidine	91-94-1	<20U	<20U	<20U	<20U	<20U
Bis(2-ethylhexyl)phthalate	117-81-7	<10U	<10U	<10U	<10U	<10U
Di-n-octyl phthalate	117-84-0	<10U	<10U	<10U	<10U	<10U
Azobenzene	103-33-3	<50U	<50U	<50U	<50U	<50U
Naphthalene	91-20-3	<10U	<10U	<10U	<10U	<10U
Acenaphthylene	208-96-8	<10U	<10U	<10U	<10U	<10U
Acenaphthene	83-32-9	<10U	<10U	<10U	<10U	<10U
Fluorene	86-73-7	<10U	<10U	<10U	<10U	<10U
Phenanthrene	85-01-8	<10U	<10U	<10U	<10U	<10U
Anthracene	120-12-7	<10U	<10U	<10U	<10U	<10U
Fluoranthene	206-44-0	<10U	<10U	<10U	<10U	<10U
Pyrene	129-00-0	<10U	<10U	<10U	<10U	<10U
Benzo(a)anthracene	56-55-3	<10U	<10U	<10U	<10U	<10U
Chrysene	218-01-9	<10U	<10U	<10U	<10U	<10U
Benzo(b)fluoranthene	205-99-2	<10U	<10U	<10U	<10U	<10U
Benzo(k)fluoranthene	207-08-9	<10U	<10U	<10U	<10U	<10U
Benzo(a)pyrene	50-32-8	<10U	<10U	<10U	<10U	<10U
Indeno(1,2,3-cd)pyrene	193-39-5	<10U	<10U	<10U	<10U	<10U
Dibenzo(a,h)anthracene	53-70-3	<10U	<10U	<10U	<10U	<10U
Benzo(g,h,i)perylene	191-24-2	<10U	<10U	<10U	<10U	<10U
Sum of PAHs		0	0	0	0	0
Sum of Carcinogenic PAHs		0	0	0	0	0

Table 6-5
SVOC Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

Analyte	CAS NO.					
	Sample location:	FB-100	FB-101	FB-102	FB-200	
	Sample no:	MW-100-08-94	MW-101-04-94	MW-102-04-94	MW-200-11-93	
	Depth(ft):	0.0-0.0	0.0-0.0	0.0-0.0	0.0-0.0	
	Matrix:	Groundwater	Groundwater	Groundwater	Groundwater	
	Sample Date:	08/02/94	04/06/94	04/06/94	11/04/93	
	Type:	Field Blank	Field Blank	Field Blank	Field Blank	
	Method:	EPA8310	EPA8270	EPA8310	EPA8270	
Semi-Volatile Organic Compounds(ug/L)						
Phenol	108-95-2	NA	<5U	NA	<10U	
bis(2-Chloroethyl) ether	111-44-4	NA	<5U	NA	<10U	
2-Chlorophenol	95-57-8	NA	<5U	NA	<10U	
1,3-Dichlorobenzene	541-73-1	NA	<5U	NA	<10U	
1,4-Dichlorobenzene	106-46-7	NA	<5U	NA	<10U	
Benzyl alcohol	100-51-6	NA	<5U	NA	<10U	
1,2-Dichlorobenzene	95-50-1	NA	<5U	NA	<10U	
2-Methylphenol	95-48-7	NA	<5U	NA	<10U	
Bis(2-chloroisopropyl)ether	39638-32-9	NA	<5U	NA	<10U	
4-Methylphenol	106-44-5	NA	<5U	NA	<10U	
N-Nitroso-di-n-propylamine	621-64-7	NA	<5U	NA	<10U	
Hexachloroethane	67-72-1	NA	<5U	NA	<10U	
Nitrobenzene	98-95-3	NA	<5U	NA	<10U	
Isophorone	78-59-1	NA	<5U	NA	<10U	
2-Nitrophenol	88-75-5	NA	<5U	NA	<10U	
2,4-Dimethylphenol	105-67-9	NA	<25U	NA	<50U	
Benzoic acid	65-85-0	NA	<5U	NA	<10U	
Bis(2-chloroethoxy)methane	111-91-1	NA	<5U	NA	<10U	
2,4-Dichlorophenol	120-83-2	NA	<5U	NA	<10U	
1,2,4-Trichlorobenzene	120-82-1	NA	<5U	NA	<10U	
4-Chloroaniline	106-47-8	NA	<5U	NA	<10U	
Hexachlorobutadiene	87-68-3	NA	<5U	NA	<10U	
4-Chloro-3-methylphenol	59-50-7	NA	<5U	NA	<10U	
2-Methylnaphthalene	91-57-6	NA	<5U	NA	<10U	
Hexachlorocyclopentadiene	77-47-4	NA	<5U	NA	<10U	
2,4,6-Trichlorophenol	88-06-2	NA	<5U	NA	<10U	
2,4,5-Trichlorophenol	95-95-4	NA	<25U	NA	<50U	
2-Chloronaphthalene	91-58-7	NA	<5U	NA	<10U	
2-Nitroaniline	88-74-4	NA	<25U	NA	<50U	
Dimethyl phthalate	131-11-3	NA	<5U	NA	<10U	
2,6-Dinitrotoluene	606-20-2	NA	<25U	NA	<50U	
3-Nitroaniline	99-09-2	NA	<25U	NA	<50U	
N-Nitrosodimethylamine	62-75-9	NA	<5U	NA	<10U	
2,4-Dinitrophenol	51-28-5	NA	<25U	NA	<50U	
4-Nitrophenol	100-02-7	NA	<25U	NA	<50U	
Dibenzofuran	132-64-9	NA	<5U	NA	<10U	
2,4-Dinitrotoluene	121-14-2	NA	<5U	NA	<10U	
Diethylphthalate	84-66-2	NA	<5U	NA	<10U	
4-Chlorophenyl-phenylether	7005-72-3	NA	<5U	NA	<10U	
4-Nitroaniline	100-01-6	NA	<25U	NA	<50U	
4,6-Dinitro,2-methylphenol	534-52-1	NA	<25U	NA	<50U	
N-Nitrosodiphenylamine	86-30-6	NA	<5U	NA	<10U	
4-Bromophenyl-phenylether	101-55-3	NA	<5U	NA	<10U	
Hexachlorobenzene	118-74-1	NA	<5U	NA	<10U	
Pentachlorophenol	87-86-5	NA	<25U	NA	<50U	
Di-n-butyl phthalate	84-74-2	NA	<5U	NA	<10U	
Butylbenzylphthalate	85-68-7	NA	<5U	NA	<10U	
3,3'-Dichlorobenzidine	91-94-1	NA	<25U	NA	<20U	
Bis(2-ethylhexyl)phthalate	117-81-7	NA	<5U	NA	<10U	
Di-n-octyl phthalate	117-84-0	NA	<5U	NA	<10U	
Azobenzene	103-33-3	NA	<25U	NA	<50U	
Naphthalene	91-20-3	<1.8U	<5U	<1.8U	<10U	
Acenaphthylene	208-96-8	<2.3U	<5U	<2.3U	<10U	
Acenaphthene	83-32-9	<1.8U	<5U	<1.8U	<10U	
Fluorene	86-73-7	<0.21U	<5U	<0.21U	<10U	
Phenanthrene	85-01-8	<0.64U	<5U	<0.64U	<10U	
Anthracene	120-12-7	<0.66U	<5U	<0.66U	<10U	
Fluoranthene	206-44-0	<0.21U	<5U	<0.21U	<10U	
Pyrene	129-00-0	<0.27U	<5U	<0.27U	<10U	
Benzo(a)anthracene	56-55-3	<0.020U	<5U	<0.020U	<10U	
Chrysene	218-01-9	<0.15U	<5U	<0.15U	<10U	
Benzo(b)fluoranthene	205-99-2	<0.020U	<5U	<0.020U	<10U	
Benzo(k)fluoranthene	207-08-9	<0.020U	<5U	<0.020U	<10U	
Benzo(a)pyrene	50-32-8	<0.030U	<5U	<0.030U	<10U	
Indeno(1,2,3-cd)pyrene	193-39-5	<0.050U	<5U	<0.050U	<10U	
Dibenzo(a,h)anthracene	53-70-3	<0.030U	<5U	<0.030U	<10U	
Benzo(g,h,i)perylene	191-24-2	<0.080U	<5U	<0.080U	<10U	
Sum of PAHs		0	0	0	0	
Sum of Carcinogenic PAHs		0	0	0	0	

Table 6-6
VOC Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REIEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	PQL / PQL-TVP / 0.0-0.0 / Groundwater / / / / Primary / EPA8240	MW-3 / MW-3-11-93 / 0.0-0.0 / Groundwater / 11/05/93 / Primary / EPA8240	MW-4 / MW-4-11-93 / 0.0-0.0 / Groundwater / 11/05/93 / Primary / EPA8240	MW-4 / MW-53-11-93 / 0.0-0.0 / Groundwater / 11/05/93 / Duplicate / EPA8240	MW-7 / MW-7-04-94 / 0.0-0.0 / Groundwater / 04/05/94 / Primary / EPA8020
Volatile Organic Compounds(ug/L)						
Chloromethane	74-87-3	10	<10U	<10U	<10U	NA
Bromomethane	74-83-9	10	<10U	<10U	<10U	NA
Vinyl chloride	75-01-4	10	<10U	<10U	<10U	NA
Chloroethane	75-00-3	10	<10U	<10U	<10U	NA
Methylene chloride	75-09-2	5	**4JB**	**4JB**	**2JB**	NA
Acrolein	107-02-8	10	<10U	<10U	<10U	NA
Acrylonitrile	107-13-1	10	<10U	<10U	<10U	NA
Acetone	67-64-1	5	**10**	**7**	<5U	NA
Carbon disulfide	75-15-0	5	<5U	<5U	<5U	NA
1,1-Dichloroethene	75-35-4	5	<5U	<5U	<5U	NA
1,1-Dichloroethane	75-34-3	5	<5U	<5U	<5U	NA
1,2-Dichloroethene	540-59-0	5	<5U	<5U	<5U	NA
Chloroform	67-66-3	5	<5U	<5U	<5U	NA
1,2-Dichloroethane	107-06-2	5	<5U	<5U	<5U	NA
2-Butanone	78-93-3	10	<10U	<10U	<10U	NA
1,1,1-Trichloroethane	71-55-6	5	<5U	<5U	<5U	NA
Carbon tetrachloride	56-23-5	5	<5U	<5U	<5U	NA
Vinyl acetate	108-05-4	50	<10U	<10U	<10U	NA
Bromodichloromethane	75-27-4	5	<5U	<5U	<5U	NA
1,2-Dichloropropane	78-87-5	5	<5U	<5U	<5U	NA
cis-1,3-Dichloropropene	10061-01-5	5	<5U	<5U	<5U	NA
Trichloroethene	79-01-6	5	<5U	<5U	<5U	NA
Dibromochloromethane	124-48-1	5	<5U	<5U	<5U	NA
1,1,2-Trichloroethane	79-00-5	5	<5U	<5U	<5U	NA
trans-1,3-Dichloropropene	10061-02-6	5	<5U	<5U	<5U	NA
2-Chloroethylvinyl ether	110-75-8	5	<5U	<5U	<5U	NA
Bromoform	75-25-2	5	<5U	<5U	<5U	NA
4-Methyl-2-pentanone	108-10-1	10	<10U	<10U	<10U	NA
2-Hexanone	591-78-6	10	<10U	<10U	<10U	NA
Tetrachloroethene	127-18-4	5	<5U	<5U	<5U	NA
1,1,2,2-Tetrachloroethane	79-34-5	5	<5U	<5U	<5U	NA
Chlorobenzene	108-90-7	5	<5U	<5U	<5U	NA
Styrene	100-42-5	5	<5U	<5U	<5U	NA
Benzene	71-43-2	5	<5U	<5U	<5U	<0.50U
Toluene	108-88-3	5	<5U	<5U	<5U	<1.0U
Ethylbenzene	100-41-4	5	<5U	<5U	<5U	<1.0U
Total xylenes	1330-20-7	5	<5U	<5U	<5U	<1.0U

Table 6-6
VOC Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REIEC

Sample location:		MW-9	MW-10	MW-11	MW-11	MW-12
Sample no:		MW-9-11-93	MW-10-04-94	MW-11-11-93	MW-11-04-94	MW-12-11-93
Depth(ft):		0.0-0.0	0.0-0.0	0.0-0.0	0.0-0.0	0.0-0.0
Matrix:		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Sample Date:		11/05/93	04/05/94	11/09/93	04/05/94	11/02/93
Type:		Primary	Primary	Primary	Primary	Primary
Method:		EPA8240	EPA8020	EPA8240	EPA8020	EPA8240
Analyte	CAS NO.					
Volatile Organic Compounds(ug/L)						
Chloromethane	74-87-3	<10U	NA	<10U	NA	<10U
Bromomethane	74-83-9	<10U	NA	<10U	NA	<10U
Vinyl chloride	75-01-4	<10U	NA	<10U	NA	<10U
Chloroethane	75-00-3	<10U	NA	<10U	NA	<10U
Methylene chloride	75-09-2	**5B**	NA	**12B**	NA	**1JB**
Acrolein	107-02-8	<10U	NA	<10U	NA	<10U
Acrylonitrile	107-13-1	<10U	NA	<10U	NA	<10U
Acetone	67-64-1	**7**	NA	**8**	NA	**4JB**
Carbon disulfide	75-15-0	<5U	NA	<5U	NA	<5U
1,1-Dichloroethene	75-35-4	<5U	NA	**1J**	NA	<5U
1,1-Dichloroethane	75-34-3	<5U	NA	<5U	NA	<5U
1,2-Dichloroethene	540-59-0	<5U	NA	<5U	NA	<5U
Chloroform	67-66-3	<5U	NA	<5U	NA	<5U
1,2-Dichloroethane	107-06-2	<5U	NA	<5U	NA	<5U
2-Butanone	78-93-3	<10U	NA	<10U	NA	<10U
1,1,1-Trichloroethane	71-55-6	<5U	NA	<5U	NA	<5U
Carbon tetrachloride	56-23-5	<5U	NA	<5U	NA	<5U
Vinyl acetate	108-05-4	<10U	NA	<10U	NA	<10U
Bromodichloromethane	75-27-4	<5U	NA	<5U	NA	<5U
1,2-Dichloropropane	78-87-5	<5U	NA	<5U	NA	<5U
cis-1,3-Dichloropropene	10061-01-5	<5U	NA	<5U	NA	<5U
Trichloroethene	79-01-6	<5U	NA	<5U	NA	<5U
Dibromochloromethane	124-48-1	<5U	NA	<5U	NA	<5U
1,1,2-Trichloroethane	79-00-5	<5U	NA	<5U	NA	<5U
trans-1,3-Dichloropropene	10061-02-6	<5U	NA	<5U	NA	<5U
2-Chloroethylvinyl ether	110-75-8	<5U	NA	<5U	NA	<5U
Bromoform	75-25-2	<5U	NA	<5U	NA	<5U
4-Methyl-2-pentanone	108-10-1	<10U	NA	<10U	NA	<10U
2-Hexanone	591-78-6	<10U	NA	<10U	NA	<10U
Tetrachloroethene	127-18-4	<5U	NA	<5U	NA	<5U
1,1,2,2-Tetrachloroethane	79-34-5	<5U	NA	<5U	NA	<5U
Chlorobenzene	108-90-7	<5U	NA	<5U	NA	<5U
Styrene	100-42-5	<5U	NA	<5U	NA	<5U
Benzene	71-43-2	<5U	<0.50U	**1J**	**0.40J**	<5U
Toluene	108-88-3	<5U	<1.0U	**1J**	**1.0**	<5U
Ethylbenzene	100-41-4	<5U	<1.0U	**1J**	**5.0**	<5U
Total xylenes	1330-20-7	<5U	<1.0U	**1J**	**22**	<5U

Table 6-6
VOC Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REIEC

Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method:		MW-12	MW-13	MW-14	MW-19	MW-19
Sample no:		MW-51-11-93	MW-13-04-94	MW-14-11-93	MW-19-11-93	MW-52-11-93
Depth(ft):		0.0-0.0	0.0-0.0	0.0-0.0	0.0-0.0	0.0-0.0
Matrix:		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Sample Date:		11/02/93	04/05/94	11/08/93	11/04/93	11/04/93
Type:		Duplicate	Primary	Primary	Primary	Duplicate
Method:		EPA8240	EPA8020	EPA8240	EPA8240	EPA8240
Analyte	CAS NO.					
Volatile Organic Compounds(ug/L)						
Chloromethane	74-87-3	<10U	NA	<10U	<10U	<10U
Bromomethane	74-83-9	<10U	NA	<10U	<10U	<10U
Vinyl chloride	75-01-4	<10U	NA	<10U	<10U	<10U
Chloroethane	75-00-3	<10U	NA	<10U	<10U	<10U
Methylene chloride	75-09-2	<5U	NA	2JB	6B	6B
Acrolein	107-02-8	<10U	NA	<10U	<10U	<10U
Acrylonitrile	107-13-1	<10U	NA	<10U	<10U	<10U
Acetone	67-64-1	<5U	NA	<5U	8B	<5U
Carbon disulfide	75-15-0	<5U	NA	<5U	<5U	<5U
1,1-Dichloroethene	75-35-4	<5U	NA	<5U	<5U	<5U
1,1-Dichloroethane	75-34-3	<5U	NA	<5U	<5U	<5U
1,2-Dichloroethene	540-59-0	<5U	NA	<5U	<5U	<5U
Chloroform	67-66-3	<5U	NA	<5U	<5U	<5U
1,2-Dichloroethane	107-06-2	<5U	NA	<5U	<5U	<5U
2-Butanone	78-93-3	<10U	NA	<10U	<10U	<10U
1,1,1-Trichloroethane	71-55-6	<5U	NA	<5U	<5U	<5U
Carbon tetrachloride	56-23-5	<5U	NA	<5U	<5U	<5U
Vinyl acetate	108-05-4	<10U	NA	<10U	<10U	<10U
Bromodichloromethane	75-27-4	<5U	NA	<5U	<5U	<5U
1,2-Dichloropropane	78-87-5	<5U	NA	<5U	<5U	<5U
cis-1,3-Dichloropropene	10061-01-5	<5U	NA	<5U	<5U	<5U
Trichloroethene	79-01-6	<5U	NA	<5U	<5U	<5U
Dibromochloromethane	124-48-1	<5U	NA	<5U	<5U	<5U
1,1,2-Trichloroethane	79-00-5	<5U	NA	<5U	<5U	<5U
trans-1,3-Dichloropropene	10061-02-6	<5U	NA	<5U	<5U	<5U
2-Chloroethylvinyl ether	110-75-8	<5U	NA	<5U	<5U	<5U
Bromoform	75-25-2	<5U	NA	<5U	<5U	<5U
4-Methyl-2-pentanone	108-10-1	<10U	NA	<10U	<10U	<10U
2-Hexanone	591-78-6	<10U	NA	<10U	<10U	<10U
Tetrachloroethene	127-18-4	<5U	NA	<5U	<5U	<5U
1,1,2,2-Tetrachloroethane	79-34-5	<5U	NA	<5U	<5U	<5U
Chlorobenzene	108-90-7	<5U	NA	<5U	<5U	<5U
Styrene	100-42-5	<5U	NA	<5U	<5U	<5U
Benzene	71-43-2	<5U	<0.50U	<5U	<5U	<5U
Toluene	108-88-3	<5U	<1.0U	<5U	<5U	<5U
Ethylbenzene	100-41-4	<5U	<1.0U	<5U	<5U	<5U
Total xylenes	1330-20-7	<5U	<1.0U	<5U	<5U	<5U

Table 6-6
VOC Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REFEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	MW-23 / MW-23-11-93 / 0.0-0.0 / Groundwater / 11/04/93 / Primary / EPA8240	MW-23 / MW-23-04-94 / 0.0-0.0 / Groundwater / 04/05/94 / Primary / EPA8020	MW-31 / MW-31-11-93 / 0.0-0.0 / Groundwater / 11/04/93 / Primary / EPA8240	MW-34 / MW-34-11-93 / 0.0-0.0 / Groundwater / 11/03/93 / Primary / EPA8240	MW-35 / MW-35-11-93 / 0.0-0.0 / Groundwater / 11/04/93 / Primary / EPA8240
Volatile Organic Compounds(ug/L)						
Chloromethane	74-87-3	<10U	NA	<10U	<10U	<10U
Bromomethane	74-83-9	<10U	NA	<10U	<10U	<10U
Vinyl chloride	75-01-4	<10U	NA	<10U	<10U	<10U
Chloroethane	75-00-3	<10U	NA	<10U	<10U	<10U
Methylene chloride	75-09-2	**6B**	NA	**4JB**	**6B**	**7B**
Acrolein	107-02-8	<10U	NA	<10U	<10U	<10U
Acrylonitrile	107-13-1	<10U	NA	<10U	<10U	<10U
Acetone	67-64-1	<5U	NA	**6**	**10**	<5U
Carbon disulfide	75-15-0	<5U	NA	<5U	<5U	<5U
1,1-Dichloroethene	75-35-4	<5U	NA	<5U	<5U	<5U
1,1-Dichloroethane	75-34-3	<5U	NA	<5U	<5U	<5U
1,2-Dichloroethene	540-59-0	<5U	NA	<5U	<5U	<5U
Chloroform	67-66-3	<5U	NA	<5U	**6B**	<5U
1,2-Dichloroethane	107-06-2	<5U	NA	<5U	<5U	<5U
2-Butanone	78-93-3	<10U	NA	<10U	<10U	<10U
1,1,1-Trichloroethane	71-55-6	<5U	NA	<5U	<5U	<5U
Carbon tetrachloride	56-23-5	<5U	NA	<5U	<5U	<5U
Vinyl acetate	108-05-4	<10U	NA	<10U	<10U	<10U
Bromodichloromethane	75-27-4	<5U	NA	<5U	<5U	<5U
1,2-Dichloropropane	78-87-5	<5U	NA	<5U	<5U	<5U
cis-1,3-Dichloropropene	10061-01-5	<5U	NA	<5U	<5U	<5U
Trichloroethene	79-01-6	<5U	NA	<5U	<5U	<5U
Dibromochloromethane	124-48-1	<5U	NA	<5U	<5U	<5U
1,1,2-Trichloroethane	79-00-5	<5U	NA	<5U	<5U	<5U
trans-1,3-Dichloropropene	10061-02-6	<5U	NA	<5U	<5U	<5U
2-Chloroethylvinyl ether	110-75-8	<5U	NA	<5U	<5U	<5U
Bromoform	75-25-2	<5U	NA	<5U	<5U	<5U
4-Methyl-2-pentanone	108-10-1	<10U	NA	<10U	<10U	<10U
2-Hexanone	591-78-6	<10U	NA	<10U	<10U	<10U
Tetrachloroethene	127-18-4	<5U	NA	<5U	<5U	<5U
1,1,2,2-Tetrachloroethane	79-34-5	<5U	NA	<5U	<5U	<5U
Chlorobenzene	108-90-7	<5U	NA	<5U	<5U	<5U
Styrene	100-42-5	<5U	NA	<5U	<5U	<5U
Benzene	71-43-2	<5U	<0.50U	<5U	<5U	<5U
Toluene	108-88-3	<5U	<1.0U	<5U	<5U	<5U
Ethylbenzene	100-41-4	<5U	<1.0U	<5U	<5U	<5U
Total xylenes	1330-20-7	<5U	<1.0U	<5U	<5U	<5U

Table 6-6
VOC Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REIEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	MW-36 / MW-36-11-93 / 0.0-0.0 / Groundwater / 11/09/93 / Primary / EPA8240	MW-36 / MW-36-04-94 / 0.0-0.0 / Groundwater / 04/05/94 / Primary / EPA8020	MW-36 / MW-360-04-94 / 0.0-0.0 / Groundwater / 04/05/94 / Duplicate / EPA8020	MW-37 / MW-37-11-93 / 0.0-0.0 / Groundwater / 11/09/93 / Primary / EPA8240	MW-37 / MW-37-04-94 / 0.0-0.0 / Groundwater / 04/05/94 / Primary / EPA8020
Volatile Organic Compounds(ug/L)						
Chloromethane	74-87-3	<10U	NA	NA	**2J**	NA
Bromomethane	74-83-9	<10U	NA	NA	<10U	NA
Vinyl chloride	75-01-4	<10U	NA	NA	<10U	NA
Chloroethane	75-00-3	<10U	NA	NA	<10U	NA
Methylene chloride	75-09-2	**4JB**	NA	NA	**4JB**	NA
Acrolein	107-02-8	<10U	NA	NA	<10U	NA
Acrylonitrile	107-13-1	<10U	NA	NA	<10U	NA
Acetone	67-64-1	<5U	NA	NA	**9**	NA
Carbon disulfide	75-15-0	<5U	NA	NA	<5U	NA
1,1-Dichloroethene	75-35-4	<5U	NA	NA	<5U	NA
1,1-Dichloroethane	75-34-3	<5U	NA	NA	<5U	NA
1,2-Dichloroethene	540-59-0	<5U	NA	NA	<5U	NA
Chloroform	67-66-3	<5U	NA	NA	<5U	NA
1,2-Dichloroethane	107-06-2	<5U	NA	NA	<5U	NA
2-Butanone	78-93-3	<10U	NA	NA	<10U	NA
1,1,1-Trichloroethane	71-55-6	<5U	NA	NA	<5U	NA
Carbon tetrachloride	56-23-5	<5U	NA	NA	<5U	NA
Vinyl acetate	108-05-4	<10U	NA	NA	<10U	NA
Bromodichloromethane	75-27-4	<5U	NA	NA	<5U	NA
1,2-Dichloropropane	78-87-5	<5U	NA	NA	<5U	NA
cis-1,3-Dichloropropene	10061-01-5	<5U	NA	NA	<5U	NA
Trichloroethene	79-01-6	<5U	NA	NA	<5U	NA
Dibromochloromethane	124-48-1	<5U	NA	NA	<5U	NA
1,1,2-Trichloroethane	79-00-5	<5U	NA	NA	<5U	NA
trans-1,3-Dichloropropene	10061-02-6	<5U	NA	NA	<5U	NA
2-Chloroethylvinyl ether	110-75-8	<5U	NA	NA	<5U	NA
Bromoform	75-25-2	<5U	NA	NA	<5U	NA
4-Methyl-2-pentanone	108-10-1	<10U	NA	NA	<10U	NA
2-Hexanone	591-78-6	<10U	NA	NA	<10U	NA
Tetrachloroethene	127-18-4	<5U	NA	NA	<5U	NA
1,1,2,2-Tetrachloroethane	79-34-5	<5U	NA	NA	<5U	NA
Chlorobenzene	108-90-7	<5U	NA	NA	<5U	NA
Styrene	100-42-5	<5U	NA	NA	<5U	NA
Benzene	71-43-2	<5U	<0.50U	**0.30J**	<5U	<0.50U
Toluene	108-88-3	<5U	**1.0**	**0.50J**	<5U	**2.0**
Ethylbenzene	100-41-4	<5U	<1.0U	<1.0U	<5U	<1.0U
Total xylenes	1330-20-7	<5U	**5.0**	**4.0**	<5U	**5.0**

Table 6-6
VOC Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REIEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	FB-101 / MW-101-04-94 / 0.0-0.0 / Groundwater / 04/05/94 / Field Blank / EPA8020	TB-1 / TB10/20/93-1 / 0.0-0.0 / Groundwater / 10/20/93 / Trip Blank / EPA8240	TB-2 / TB10/20/93-2 / 0.0-0.0 / Groundwater / 10/20/93 / Trip Blank / EPA8240	TB-3 / TB11/03/93 / 0.0-0.0 / Groundwater / 11/03/93 / Trip Blank / EPA8240	TB-4 / TB11/04/93 / 0.0-0.0 / Groundwater / 11/04/93 / Trip Blank / EPA8240
Volatile Organic Compounds(ug/L)						
Chloromethane	74-87-3	NA	1J	<10U	<10U	<10U
Bromomethane	74-83-9	NA	<10U	<10U	<10U	<10U
Vinyl chloride	75-01-4	NA	<10U	<10U	<10U	<10U
Chloroethane	75-00-3	NA	<10U	<10U	<10U	<10U
Methylene chloride	75-09-2	NA	7B	4JB	8B	9B
Acrolein	107-02-8	NA	<10U	<10U	<10U	<10U
Acrylonitrile	107-13-1	NA	<10U	<10U	<10U	<10U
Acetone	67-64-1	NA	8	8	8	20B
Carbon disulfide	75-15-0	NA	<5U	<5U	<5U	<5U
1,1-Dichloroethene	75-35-4	NA	<5U	<5U	<5U	<5U
1,1-Dichloroethane	75-34-3	NA	<5U	<5U	<5U	<5U
1,2-Dichloroethene	540-59-0	NA	<5U	<5U	<5U	<5U
Chloroform	67-66-3	NA	<5U	<5U	<5U	<5U
1,2-Dichloroethane	107-06-2	NA	<5U	<5U	<5U	<5U
2-Butanone	78-93-3	NA	<10U	<10U	<10U	<10U
1,1,1-Trichloroethane	71-55-6	NA	<5U	<5U	<5U	<5U
Carbon tetrachloride	56-23-5	NA	<5U	<5U	<5U	<5U
Vinyl acetate	108-05-4	NA	<10U	<10U	<10U	<10U
Bromodichloromethane	75-27-4	NA	<5U	<5U	<5U	<5U
1,2-Dichloropropane	78-87-5	NA	<5U	<5U	<5U	<5U
cis-1,3-Dichloropropene	10061-01-5	NA	<5U	<5U	<5U	<5U
Trichloroethene	79-01-6	NA	<5U	<5U	<5U	<5U
Dibromochloromethane	124-48-1	NA	<5U	<5U	<5U	<5U
1,1,2-Trichloroethane	79-00-5	NA	<5U	<5U	<5U	<5U
trans-1,3-Dichloropropene	10061-02-6	NA	<5U	<5U	<5U	<5U
2-Chloroethylvinyl ether	110-75-8	NA	<5U	<5U	<5U	<5U
Bromoform	75-25-2	NA	<5U	<5U	<5U	<5U
4-Methyl-2-pentanone	108-10-1	NA	<10U	<10U	<10U	<10U
2-Hexanone	591-78-6	NA	<10U	<10U	<10U	<10U
Tetrachloroethene	127-18-4	NA	<5U	<5U	<5U	<5U
1,1,2,2-Tetrachloroethane	79-34-5	NA	<5U	<5U	<5U	<5U
Chlorobenzene	108-90-7	NA	<5U	<5U	<5U	<5U
Styrene	100-42-5	NA	<5U	<5U	<5U	<5U
Benzene	71-43-2	<0.50U	<5U	<5U	<5U	<5U
Toluene	108-88-3	<1.0U	<5U	<5U	<5U	<5U
Ethylbenzene	100-41-4	<1.0U	<5U	<5U	<5U	<5U
Total xylenes	1330-20-7	<1.0U	<5U	<5U	<5U	<5U

Table 6-6
VOC Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REiTEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	TB-5 / TB11/08/93 / 0.0-0.0 / Groundwater / 11/08/93 / Trip Blank / EPA8240	TB-6 / TB3/29/94 / 0.0-0.0 / Groundwater / 03/29/94 / Trip Blank / EPA8020			
Volatile Organic Compounds(ug/L)						
Chloromethane	74-87-3	<10U	NA			
Bromomethane	74-83-9	<10U	NA			
Vinyl chloride	75-01-4	<10U	NA			
Chloroethane	75-00-3	<10U	NA			
Methylene chloride	75-09-2	24B	NA			
Acrolein	107-02-8	<10U	NA			
Acrylonitrile	107-13-1	<10U	NA			
Acetone	67-64-1	20	NA			
Carbon disulfide	75-15-0	<5U	NA			
1,1-Dichloroethene	75-35-4	<5U	NA			
1,1-Dichloroethane	75-34-3	<5U	NA			
1,2-Dichloroethene	540-59-0	<5U	NA			
Chloroform	67-66-3	<5U	NA			
1,2-Dichloroethane	107-06-2	<5U	NA			
2-Butanone	78-93-3	<10U	NA			
1,1,1-Trichloroethane	71-55-6	<5U	NA			
Carbon tetrachloride	56-23-5	<5U	NA			
Vinyl acetate	108-05-4	<10U	NA			
Bromodichloromethane	75-27-4	<5U	NA			
1,2-Dichloropropane	78-87-5	<5U	NA			
cis-1,3-Dichloropropene	10061-01-5	<5U	NA			
Trichloroethene	79-01-6	<5U	NA			
Dibromochloromethane	124-48-1	<5U	NA			
1,1,2-Trichloroethane	79-00-5	<5U	NA			
trans-1,3-Dichloropropene	10061-02-6	<5U	NA			
2-Chloroethylvinyl ether	110-75-8	<5U	NA			
Bromoform	75-25-2	<5U	NA			
4-Methyl-2-pentanone	108-10-1	<10U	NA			
2-Hexanone	591-78-6	<10U	NA			
Tetrachloroethene	127-18-4	<5U	NA			
1,1,2,2-Tetrachloroethane	79-34-5	<5U	NA			
Chlorobenzene	108-90-7	<5U	NA			
Styrene	100-42-5	<5U	NA			
Benzene	71-43-2	<5U	<0.50U			
Toluene	108-88-3	<5U	<1.0U			
Ethylbenzene	100-41-4	<5U	<1.0U			
Total xylenes	1330-20-7	<5U	<1.0U			

Table 6-7
Metals and TSS Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REIEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	PQL / PQL-METAL / 0.0-0.0 / Groundwater / / / / Primary	MW-2 / MW-2-11-93 / 0.0-0.0 / Groundwater / 11/03/93 / Primary	MW-2 / MW-2-04-94 / 0.0-0.0 / Groundwater / 04/06/94 / Primary	MW-2 / MW-2-08-94 / 0.0-0.0 / Groundwater / 08/03/94 / Primary	MW-2 / MW-2-11-94 / 0.0-0.0 / Groundwater / 11/09/94 / Primary
Total Metals - EPA 6010(mg/L)						
Silver	7440-22-4	0.05	<0.01U	NA	NA	NA
Beryllium	7440-41-7	0.001	<0.005U	NA	NA	NA
Cadmium	7440-43-9	0.0005	0.0002	NA	NA	NA
Copper	7440-50-8	0.05	0.04	NA	NA	NA
Mercury	7439-97-6	0.0005	<0.0002U	NA	NA	NA
Nickel	7440-02-0	0.1	0.03	NA	NA	NA
Antimony	7440-36-0	0.005	0.002	NA	NA	NA
Selenium	7782-49-2	0.005	0.002	NA	NA	NA
Thallium	7440-28-0	0.010	<0.002U	NA	NA	NA
Zinc	7440-66-6	0.05	0.03	NA	NA	NA
Arsenic	7440-38-2	0.005	0.540	0.46	NA	NA
Chromium	7440-47-3	0.05	0.04	0.07	NA	NA
Lead	7439-92-1	0.005	0.018	0.028	NA	NA
Dissolved Metals - EPA 6010(mg/L)						
Arsenic (dissolved)	7440-38-2	0.005	NA	0.002	0.001	0.003
Chromium (dissolved)	7440-47-3	0.05	NA	<0.01U	<0.01U	<0.01U
Lead (dissolved)	7439-92-1	0.005	NA	<0.001U	<0.001U	<0.001U
Total Suspended Solids(mg/L)						
Total Suspended Solids	TSS	10	NA	380	394	360

Table 6-7
Metals and TSS Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	MW-3 / MW-3-11-93 / 0.0-0.0 / Groundwater / 11/05/93 / Primary	MW-4 / MW-4-11-93 / 0.0-0.0 / Groundwater / 11/05/93 / Primary	MW-4 / MW-53-11-93 / 0.0-0.0 / Groundwater / 11/05/93 / Duplicate	MW-5 / MW-5-04-94 / 0.0-0.0 / Groundwater / 04/05/94 / Primary	MW-5 / MW-500-04-94 / 0.0-0.0 / Groundwater / 04/05/94 / Duplicate
Total Metals - EPA 6010(mg/L)						
Silver	7440-22-4	<0.05U	<0.01U	<0.01U	NA	NA
Beryllium	7440-41-7	<0.025U	<0.005U	<0.005U	NA	NA
Cadmium	7440-43-9	<0.0005U	<0.0001U	<0.0001U	NA	NA
Copper	7440-50-8	<0.05U	**0.04**	**0.04**	NA	NA
Mercury	7439-97-6	<0.0002U	<0.0002U	<0.0002U	NA	NA
Nickel	7440-02-0	<0.1U	**0.03**	**0.03**	NA	NA
Antimony	7440-36-0	<0.005U	**0.005**	**0.005**	NA	NA
Selenium	7782-49-2	<0.005U	<0.001U	<0.001U	NA	NA
Thallium	7440-28-0	<0.01U	<0.002U	<0.002U	NA	NA
Zinc	7440-66-6	<0.05U	**0.06**	**0.06**	NA	NA
Arsenic	7440-38-2	**0.070**	**0.030**	**0.029**	**0.019**	NA
Chromium	7440-47-3	<0.05U	<0.01U	<0.01U	**0.04**	NA
Lead	7439-92-1	<0.001U	**0.016**	**0.016**	**0.032**	NA
Dissolved Metals - EPA 6010(mg/L)						
Arsenic (dissolved)	7440-38-2	NA	NA	NA	**0.003**	NA
Chromium (dissolved)	7440-47-3	NA	NA	NA	<0.01U	NA
Lead (dissolved)	7439-92-1	NA	NA	NA	<0.001U	NA
Total Suspended Solids(mg/L)						
Total Suspended Solids	TSS	NA	NA	NA	**262**	**414**

Table 6-7
Metals and TSS Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	MW-5 / MW-5-08-94 / 0.0-0.0 / Groundwater / 08/02/94 / Primary	MW-5 / MW-5-11-94 / 0.0-0.0 / Groundwater / 11/08/94 / Primary	MW-7 / MW-7-11-93 / 0.0-0.0 / Groundwater / 11/02/93 / Primary	MW-9 / MW-9-04-94 / 0.0-0.0 / Groundwater / 04/05/94 / Primary	MW-9 / MW-9-08-94 / 0.0-0.0 / Groundwater / 08/02/94 / Primary
Total Metals - EPA 6010(mg/L)						
Silver	7440-22-4	NA	NA	<0.01U	NA	NA
Beryllium	7440-41-7	NA	NA	<0.005U	NA	NA
Cadmium	7440-43-9	NA	NA	<0.0001U	NA	NA
Copper	7440-50-8	NA	NA	<0.01U	NA	NA
Mercury	7439-97-6	NA	NA	<0.0002U	NA	NA
Nickel	7440-02-0	NA	NA	<0.02U	NA	NA
Antimony	7440-36-0	NA	NA	<0.001U	NA	NA
Selenium	7782-49-2	NA	NA	<0.001U	NA	NA
Thallium	7440-28-0	NA	NA	<0.002U	NA	NA
Zinc	7440-66-6	NA	NA	<0.01U	NA	NA
Arsenic	7440-38-2	NA	NA	**0.006**	**0.014**	NA
Chromium	7440-47-3	NA	NA	<0.01U	<0.010U	NA
Lead	7439-92-1	NA	NA	<0.001U	**0.001**	NA
Dissolved Metals - EPA 6010(mg/L)						
Arsenic (dissolved)	7440-38-2	**0.005**	**0.009**	NA	**0.008**	**0.007**
Chromium (dissolved)	7440-47-3	<0.01U	<0.01U	NA	<0.01U	<0.01U
Lead (dissolved)	7439-92-1	<0.001U	<0.001U	NA	<0.001U	<0.001U
Total Suspended Solids(mg/L)						
Total Suspended Solids	TSS	**376**	**220**	NA	**202**	**514**

Table 6-7
Metals and TSS Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REIEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	MW-9 / MW-9-11-94 / 0.0-0.0 / Groundwater / 11/08/94 / Primary	MW-10 / MW-10-11-93 / 0.0-0.0 / Groundwater / 11/08/93 / Primary	MW-11 / MW-11-11-93 / 0.0-0.0 / Groundwater / 11/09/93 / Primary	MW-12 / MW-12-11-93 / 0.0-0.0 / Groundwater / 11/02/93 / Primary	MW-12 / MW-51-11-93 / 0.0-0.0 / Groundwater / 11/02/93 / Duplicate
Total Metals - EPA 6010(mg/L)						
Silver	7440-22-4	NA	<0.01U	<0.01U	<0.01U	<0.01U
Beryllium	7440-41-7	NA	<0.005U	<0.005U	<0.005U	<0.005U
Cadmium	7440-43-9	NA	**0.0002**	<0.0001U	<0.0001U	<0.0001U
Copper	7440-50-8	NA	**0.02**	<0.01U	<0.01U	<0.01U
Mercury	7439-97-6	NA	<0.0002U	<0.0002U	<0.0002U	<0.0002U
Nickel	7440-02-0	NA	**0.02**	<0.02U	<0.02U	<0.02U
Antimony	7440-36-0	NA	**0.001**	<0.001U	<0.001U	<0.001U
Selenium	7782-49-2	NA	<0.001U	<0.001U	<0.001U	<0.001U
Thallium	7440-28-0	NA	<0.002U	<0.002U	<0.002U	<0.002U
Zinc	7440-66-6	NA	**0.02**	**0.05**	<0.01U	<0.01U
Arsenic	7440-38-2	NA	**0.031**	**0.009**	**0.004**	**0.003**
Chromium	7440-47-3	NA	**0.03**	<0.01U	<0.01U	<0.01U
Lead	7439-92-1	NA	**0.006**	**0.004**	**0.005**	**0.002**
Dissolved Metals - EPA 6010(mg/L)						
Arsenic (dissolved)	7440-38-2	**0.006**	NA	NA	NA	NA
Chromium (dissolved)	7440-47-3	<0.01U	NA	NA	NA	NA
Lead (dissolved)	7439-92-1	<0.001U	NA	NA	NA	NA
Total Suspended Solids(mg/L)						
Total Suspended Solids	TSS	**320**	NA	NA	NA	NA

Table 6-7
Metals and TSS Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	MW-14 / MW-14-11-93 / 0.0-0.0 / Groundwater / 11/08/93 / Primary	MW-15 / MW-15-11-93 / 0.0-0.0 / Groundwater / 11/08/93 / Primary	MW-16 / MW-16-04-94 / 0.0-0.0 / Groundwater / 04/06/94 / Primary	MW-16 / MW-16-08-94 / 0.0-0.0 / Groundwater / 08/03/94 / Primary	MW-16 / MW-16-11-94 / 0.0-0.0 / Groundwater / 11/08/94 / Primary
Total Metals - EPA 6010(mg/L)						
Silver	7440-22-4	<0.01U	<0.01U	NA	NA	NA
Beryllium	7440-41-7	<0.005U	<0.005U	NA	NA	NA
Cadmium	7440-43-9	<0.0001U	<0.0001U	NA	NA	NA
Copper	7440-50-8	<0.01U	<0.01U	NA	NA	NA
Mercury	7439-97-6	<0.0002U	<0.0002U	NA	NA	NA
Nickel	7440-02-0	<0.02U	<0.02U	NA	NA	NA
Antimony	7440-36-0	<0.001U	<0.001U	NA	NA	NA
Selenium	7782-49-2	<0.001U	<0.001U	NA	NA	NA
Thallium	7440-28-0	<0.002U	<0.002U	NA	NA	NA
Zinc	7440-66-6	<0.01U	<0.01U	NA	NA	NA
Arsenic	7440-38-2	**0.002**	**0.005**	**0.12**	NA	NA
Chromium	7440-47-3	<0.01U	<0.01U	**0.13**	NA	NA
Lead	7439-92-1	**0.002**	**0.001**	**0.034**	NA	NA
Dissolved Metals - EPA 6010(mg/L)						
Arsenic (dissolved)	7440-38-2	NA	NA	<0.001U	<0.001U	<0.001U
Chromium (dissolved)	7440-47-3	NA	NA	<0.01U	<0.01U	**0.01B**
Lead (dissolved)	7439-92-1	NA	NA	<0.001U	<0.001U	<0.001U
Total Suspended Solids(mg/L)						
Total Suspended Solids	TSS	NA	NA	**984**	**1078**	**1100**

Table 6-7
Metals and TSS Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	MW-19 / MW-19-11-93 / 0.0-0.0 / Groundwater / 11/04/93 / Primary	MW-19 / MW-52-11-93 / 0.0-0.0 / Groundwater / 11/04/93 / Duplicate	MW-23 / MW-23-11-93 / 0.0-0.0 / Groundwater / 11/04/93 / Primary	MW-23 / MW-23-04-94 / 0.0-0.0 / Groundwater / 04/05/94 / Primary	MW-23 / MW-23-08-94 / 0.0-0.0 / Groundwater / 08/02/94 / Primary
Total Metals - EPA 6010(mg/L)						
Silver	7440-22-4	<0.01U	<0.01U	<0.1U	NA	NA
Beryllium	7440-41-7	<0.005U	<0.005U	<0.05U	NA	NA
Cadmium	7440-43-9	<0.0001U	<0.0001U	<0.001U	NA	NA
Copper	7440-50-8	**0.02**	**0.02**	<0.10U	NA	NA
Mercury	7439-97-6	<0.0002U	<0.0002U	**0.0002**	NA	NA
Nickel	7440-02-0	<0.02U	<0.02U	<0.2U	NA	NA
Antimony	7440-36-0	<0.001U	<0.001U	<0.01U	NA	NA
Selenium	7782-49-2	<0.001U	<0.001U	<0.01U	NA	NA
Thallium	7440-28-0	<0.002U	<0.002U	<0.02U	NA	NA
Zinc	7440-66-6	**0.02**	**0.02**	<0.1U	NA	NA
Arsenic	7440-38-2	**0.008**	**0.007**	**0.020**	**0.014**	NA
Chromium	7440-47-3	**0.02**	**0.02**	<0.10U	**0.05**	NA
Lead	7439-92-1	**0.006**	**0.006**	**0.02**	**0.013**	NA
Dissolved Metals - EPA 6010(mg/L)						
Arsenic (dissolved)	7440-38-2	NA	NA	NA	<0.001U	<0.001U
Chromium (dissolved)	7440-47-3	NA	NA	NA	<0.01U	<0.01U
Lead (dissolved)	7439-92-1	NA	NA	NA	<0.001U	<0.001U
Total Suspended Solids(mg/L)						
Total Suspended Solids	TSS	NA	NA	NA	**370**	**1566**

Table 6-7
Metals and TSS Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	MW-23 / MW-23B-08-94 / 0.0-0.0 / Groundwater / 08/02/94 / Duplicate	MW-23 / MW-23-11-94 / 0.0-0.0 / Groundwater / 11/08/94 / Primary	MW-28 / MW-28-11-93 / 0.0-0.0 / Groundwater / 11/03/93 / Primary	MW-31 / MW-31-11-93 / 0.0-0.0 / Groundwater / 11/04/93 / Primary	MW-31 / MW-31-04-94 / 0.0-0.0 / Groundwater / 04/06/94 / Primary
Total Metals - EPA 6010(mg/L)						
Silver	7440-22-4	NA	NA	<0.2U	<0.1U	NA
Beryllium	7440-41-7	NA	NA	<0.1U	<0.05U	NA
Cadmium	7440-43-9	NA	NA	<0.002U	<0.001U	NA
Copper	7440-50-8	NA	NA	**0.30**	**0.10**	NA
Mercury	7439-97-6	NA	NA	**0.0002**	**0.0005**	NA
Nickel	7440-02-0	NA	NA	<0.4U	<0.2U	NA
Antimony	7440-36-0	NA	NA	**0.02**	<0.01U	NA
Selenium	7782-49-2	NA	NA	<0.02U	<0.01U	NA
Thallium	7440-28-0	NA	NA	<0.04U	<0.02U	NA
Zinc	7440-66-6	NA	NA	<0.2U	**0.24**	NA
Arsenic	7440-38-2	NA	NA	**0.040**	**0.090**	**0.051**
Chromium	7440-47-3	NA	NA	<0.2U	**0.30**	**0.10**
Lead	7439-92-1	NA	NA	<0.02U	**0.07**	**0.037**
Dissolved Metals - EPA 6010(mg/L)						
Arsenic (dissolved)	7440-38-2	<0.001U	<0.001U	NA	NA	<0.001U
Chromium (dissolved)	7440-47-3	<0.01U	<0.01U	NA	NA	<0.01U
Lead (dissolved)	7439-92-1	<0.001U	<0.001U	NA	NA	<0.001U
Total Suspended Solids(mg/L)						
Total Suspended Solids	TSS	**1246**	**1600**	NA	NA	**2024**

Table 6-7
Metals and TSS Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REIEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	MW-31 / MW-31-08-94 / 0.0-0.0 / Groundwater / 08/03/94 / Primary	MW-31 / MW-31-11-94 / 0.0-0.0 / Groundwater / 11/09/94 / Primary	MW-35 / MW-35-11-93 / 0.0-0.0 / Groundwater / 11/03/93 / Primary	MW-35 / MW-35-04-94 / 0.0-0.0 / Groundwater / 04/06/94 / Primary	MW-35 / MW-35-08-94 / 0.0-0.0 / Groundwater / 08/03/94 / Primary
Total Metals - EPA 6010(mg/L)						
Silver	7440-22-4	NA	NA	<0.01U	NA	NA
Beryllium	7440-41-7	NA	NA	<0.005U	NA	NA
Cadmium	7440-43-9	NA	NA	0.0003	NA	NA
Copper	7440-50-8	NA	NA	0.06	NA	NA
Mercury	7439-97-6	NA	NA	<0.0002U	NA	NA
Nickel	7440-02-0	NA	NA	0.08	NA	NA
Antimony	7440-36-0	NA	NA	0.001	NA	NA
Selenium	7782-49-2	NA	NA	<0.001U	NA	NA
Thallium	7440-28-0	NA	NA	<0.002U	NA	NA
Zinc	7440-66-6	NA	NA	0.11	NA	NA
Arsenic	7440-38-2	NA	NA	0.017	0.043	NA
Chromium	7440-47-3	NA	NA	0.10	0.11	NA
Lead	7439-92-1	NA	NA	0.011	0.017	NA
Dissolved Metals - EPA 6010(mg/L)						
Arsenic (dissolved)	7440-38-2	<0.001U	<0.001U	NA	0.004	0.005
Chromium (dissolved)	7440-47-3	<0.01U	<0.01U	NA	<0.01U	<0.01U
Lead (dissolved)	7439-92-1	<0.001U	<0.001U	NA	<0.001U	<0.001U
Total Suspended Solids(mg/L)						
Total Suspended Solids	TSS	2504	2000	NA	2186	2308

Table 6-7
Metals and TSS Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	MW-35 / MW-35-11-94 / 0.0-0.0 / Groundwater / 11/08/94 / Primary	MW-36 / MW-36-04-94 / 0.0-0.0 / Groundwater / 04/05/94 / Primary	MW-36 / MW-360-04-94 / 0.0-0.0 / Groundwater / 04/05/94 / Duplicate	MW-36 / MW-36-08-94 / 0.0-0.0 / Groundwater / 08/02/94 / Primary	MW-37 / MW-37-04-94 / 0.0-0.0 / Groundwater / 04/05/94 / Primary
Total Metals - EPA 6010(mg/L)						
Silver	7440-22-4	NA	NA	NA	NA	NA
Beryllium	7440-41-7	NA	NA	NA	NA	NA
Cadmium	7440-43-9	NA	NA	NA	NA	NA
Copper	7440-50-8	NA	NA	NA	NA	NA
Mercury	7439-97-6	NA	NA	NA	NA	NA
Nickel	7440-02-0	NA	NA	NA	NA	NA
Antimony	7440-36-0	NA	NA	NA	NA	NA
Selenium	7782-49-2	NA	NA	NA	NA	NA
Thallium	7440-28-0	NA	NA	NA	NA	NA
Zinc	7440-66-6	NA	NA	NA	NA	NA
Arsenic	7440-38-2	NA	**0.015**	**0.015**	NA	**0.001**
Chromium	7440-47-3	NA	**0.02**	<0.01U	NA	<0.01U
Lead	7439-92-1	NA	**0.003**	**0.002**	NA	<0.001U
Dissolved Metals - EPA 6010(mg/L)						
Arsenic (dissolved)	7440-38-2	<0.001U	**0.006**	**0.005**	**0.011**	<0.001U
Chromium (dissolved)	7440-47-3	<0.01U	<0.01U	<0.01U	<0.01U	<0.01U
Lead (dissolved)	7439-92-1	<0.001U	**0.002**	<0.001U	<0.001U	<0.001U
Total Suspended Solids(mg/L)						
Total Suspended Solids	TSS	**550**	**192**	NA	**914**	<2U

Table 6-7
Metals and TSS Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REITEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	MW-37 / MW-37-08-94 / 0.0-0.0 / Groundwater / 08/02/94 / Primary	MW-37 / MW-37-11-94 / 0.0-0.0 / Groundwater / 11/08/94 / Primary	MW-37 / MW-370-11-94 / 0.0-0.0 / Groundwater / 11/08/94 / Duplicate	MW-38 / MW-38-04-94 / 0.0-0.0 / Groundwater / 04/06/94 / Primary	MW-38 / MW-380-04-94 / 0.0-0.0 / Groundwater / 04/06/94 / Duplicate
Total Metals - EPA 6010(mg/L)						
Silver	7440-22-4	NA	NA	NA	NA	NA
Beryllium	7440-41-7	NA	NA	NA	NA	NA
Cadmium	7440-43-9	NA	NA	NA	NA	NA
Copper	7440-50-8	NA	NA	NA	NA	NA
Mercury	7439-97-6	NA	NA	NA	NA	NA
Nickel	7440-02-0	NA	NA	NA	NA	NA
Antimony	7440-36-0	NA	NA	NA	NA	NA
Selenium	7782-49-2	NA	NA	NA	NA	NA
Thallium	7440-28-0	NA	NA	NA	NA	NA
Zinc	7440-66-6	NA	NA	NA	NA	NA
Arsenic	7440-38-2	NA	NA	NA	<0.001U	<0.001U
Chromium	7440-47-3	NA	NA	NA	<0.01U	<0.01U
Lead	7439-92-1	NA	NA	NA	<0.001U	<0.001U
Dissolved Metals - EPA 6010(mg/L)						
Arsenic (dissolved)	7440-38-2	**0.002**	**0.002**	**0.001**	<0.001U	<0.001U
Chromium (dissolved)	7440-47-3	<0.01U	<0.01U	<0.01U	<0.01U	<0.01U
Lead (dissolved)	7439-92-1	<0.001U	<0.001U	<0.001U	<0.001U	<0.001U
Total Suspended Solids(mg/L)						
Total Suspended Solids	TSS	**28**	**8**	<5U	**34**	**32**

Table 6-7
Metals and TSS Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	MW-38 / MW-38-08-94 / 0.0-0.0 / Groundwater / 08/03/94 / Primary	MW-38 / MW-38-11-94 / 0.0-0.0 / Groundwater / 11/08/94 / Primary	MW-40 / MW-40-04-94 / 0.0-0.0 / Groundwater / 04/07/94 / Primary	MW-40 / MW-40-08-94 / 0.0-0.0 / Groundwater / 08/04/94 / Primary	MW-40 / MW-40B-08-94 / 0.0-0.0 / Groundwater / 08/04/94 / Duplicate
Total Metals - EPA 6010(mg/L)						
Silver	7440-22-4	NA	NA	NA	NA	NA
Beryllium	7440-41-7	NA	NA	NA	NA	NA
Cadmium	7440-43-9	NA	NA	NA	NA	NA
Copper	7440-50-8	NA	NA	NA	NA	NA
Mercury	7439-97-6	NA	NA	NA	NA	NA
Nickel	7440-02-0	NA	NA	NA	NA	NA
Antimony	7440-36-0	NA	NA	NA	NA	NA
Selenium	7782-49-2	NA	NA	NA	NA	NA
Thallium	7440-28-0	NA	NA	NA	NA	NA
Zinc	7440-66-6	NA	NA	NA	NA	NA
Arsenic	7440-38-2	NA	NA	**0.045**	NA	NA
Chromium	7440-47-3	NA	NA	**0.18**	NA	NA
Lead	7439-92-1	NA	NA	**0.15**	NA	NA
Dissolved Metals - EPA 6010(mg/L)						
Arsenic (dissolved)	7440-38-2	<0.001U	<0.001U	<0.001U	<0.001U	<0.001U
Chromium (dissolved)	7440-47-3	<0.01U	<0.01U	<0.01U	<0.01U	<0.01U
Lead (dissolved)	7439-92-1	<0.001U	<0.001U	<0.001U	<0.001U	<0.001U
Total Suspended Solids(mg/L)						
Total Suspended Solids	TSS	**1432**	**210**	**1452**	**4910**	**2893**

Table 6-7
Metals and TSS Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	MW-40 / MW-40-11-94 / 0.0-0.0 / Groundwater / 11/08/94 / Primary	MW-40 / MW-400-11-94 / 0.0-0.0 / Groundwater / 11/08/94 / Duplicate	DW-2 / DW-2-11-93 / 0.0-0.0 / Groundwater / 11/02/93 / Primary	DW-2 / DW-2-04-94 / 0.0-0.0 / Groundwater / 04/07/94 / Primary	DW-2 / DW-2-08-94 / 0.0-0.0 / Groundwater / 08/04/94 / Primary
Total Metals - EPA 6010(mg/L)						
Silver	7440-22-4	NA	NA	<0.05U	NA	NA
Beryllium	7440-41-7	NA	NA	<0.02U	NA	NA
Cadmium	7440-43-9	NA	NA	<0.0012U	NA	NA
Copper	7440-50-8	NA	NA	0.32	NA	NA
Mercury	7439-97-6	NA	NA	0.0007	NA	NA
Nickel	7440-02-0	NA	NA	0.37	NA	NA
Antimony	7440-36-0	NA	NA	<0.005U	NA	NA
Selenium	7782-49-2	NA	NA	<0.005U	NA	NA
Thallium	7440-28-0	NA	NA	<0.01U	NA	NA
Zinc	7440-66-6	NA	NA	0.52	NA	NA
Arsenic	7440-38-2	NA	NA	0.071	0.028	NA
Chromium	7440-47-3	NA	NA	0.40	0.18	NA
Lead	7439-92-1	NA	NA	0.059	0.022	NA
Dissolved Metals - EPA 6010(mg/L)						
Arsenic (dissolved)	7440-38-2	0.002B	0.002B	NA	<0.001U	<0.001U
Chromium (dissolved)	7440-47-3	<0.01U	<0.01U	NA	<0.01U	<0.01U
Lead (dissolved)	7439-92-1	0.003B	0.003B	NA	<0.001U	<0.001U
Total Suspended Solids(mg/L)						
Total Suspended Solids	TSS	1100	NA	NA	1768	2190

Table 6-7
Metals and TSS Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	DW-2 / DW-2-11-94 / 0.0-0.0 / Groundwater / 11/09/94 / Primary	DW-3 / DW-3-04-94 / 0.0-0.0 / Groundwater / 04/07/94 / Primary	DW-3 / DW-3-08-94 / 0.0-0.0 / Groundwater / 08/04/94 / Primary	DW-3 / DW-3-11-94 / 0.0-0.0 / Groundwater / 11/09/94 / Primary	DW-4 / DW-4-11-93 / 0.0-0.0 / Groundwater / 11/09/93 / Primary
Total Metals - EPA 6010(mg/L)						
Silver	7440-22-4	NA	NA	NA	NA	<0.01U
Beryllium	7440-41-7	NA	NA	NA	NA	<0.005U
Cadmium	7440-43-9	NA	NA	NA	NA	<0.0001U
Copper	7440-50-8	NA	NA	NA	NA	<0.01U
Mercury	7439-97-6	NA	NA	NA	NA	<0.0002U
Nickel	7440-02-0	NA	NA	NA	NA	<0.02U
Antimony	7440-36-0	NA	NA	NA	NA	<0.001U
Selenium	7782-49-2	NA	NA	NA	NA	<0.001U
Thallium	7440-28-0	NA	NA	NA	NA	<0.002U
Zinc	7440-66-6	NA	NA	NA	NA	<0.01U
Arsenic	7440-38-2	NA	**0.003**	NA	NA	<0.001U
Chromium	7440-47-3	NA	**0.02**	NA	NA	<0.01U
Lead	7439-92-1	NA	**0.002**	NA	NA	<0.001U
Dissolved Metals - EPA 6010(mg/L)						
Arsenic (dissolved)	7440-38-2	<0.001U	<0.001U	<0.001U	<0.001U	NA
Chromium (dissolved)	7440-47-3	<0.01U	<0.01U	<0.01U	<0.01U	NA
Lead (dissolved)	7439-92-1	<0.001U	<0.001U	<0.001U	<0.001U	NA
Total Suspended Solids(mg/L)						
Total Suspended Solids	TSS	**1400**	**152**	**346**	**130**	NA

Table 6-7
Metals and TSS Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	FB-100 / MW-100-08-94 / 0.0-0.0 / Groundwater / 08/02/94 / Field Blank	FB-101 / MW-101-04-94 / 0.0-0.0 / Groundwater / 04/05/94 / Field Blank	FB-101 / MW-101-08-94 / 0.0-0.0 / Groundwater / 08/03/94 / Field Blank	FB-101 / MW-101-11-94 / 0.0-0.0 / Groundwater / 11/08/94 / Field Blank	FB-102 / MW-102-04-94 / 0.0-0.0 / Groundwater / 04/06/94 / Field Blank
Total Metals - EPA 6010(mg/L)						
Silver	7440-22-4	NA	NA	NA	NA	NA
Beryllium	7440-41-7	NA	NA	NA	NA	NA
Cadmium	7440-43-9	NA	NA	NA	NA	NA
Copper	7440-50-8	NA	NA	NA	NA	NA
Mercury	7439-97-6	NA	NA	NA	NA	NA
Nickel	7440-02-0	NA	NA	NA	NA	NA
Antimony	7440-36-0	NA	NA	NA	NA	NA
Selenium	7782-49-2	NA	NA	NA	NA	NA
Thallium	7440-28-0	NA	NA	NA	NA	NA
Zinc	7440-66-6	NA	NA	NA	NA	NA
Arsenic	7440-38-2	NA	<0.001U	NA	NA	**0.001**
Chromium	7440-47-3	NA	<0.01U	NA	NA	<0.01U
Lead	7439-92-1	NA	<0.001U	NA	NA	<0.001U
Dissolved Metals - EPA 6010(mg/L)						
Arsenic (dissolved)	7440-38-2	<0.001U	<0.001U	<0.001U	<0.001U	<0.001U
Chromium (dissolved)	7440-47-3	<0.01U	<0.01U	<0.01U	<0.01U	<0.01U
Lead (dissolved)	7439-92-1	<0.001U	<0.001U	<0.001U	<0.001U	<0.001U
Total Suspended Solids(mg/L)						
Total Suspended Solids	TSS	<2U	<2U	<2U	<5U	<2U

Table 6-7
Metals and TSS Analytical Results - Groundwater
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REIEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	FB-102 / MW-102-08-94 / 0.0-0.0 / Groundwater / 08/04/94 / Field Blank	FB-103 / MW-103-11-94 / 0.0-0.0 / Groundwater / 11/09/94 / Field Blank	FB-200 / MW-200-11-93 / 0.0-0.0 / Groundwater / 11/04/93 / Field Blank		
Total Metals - EPA 6010(mg/L)						
Silver	7440-22-4	NA	NA	<0.01U		
Beryllium	7440-41-7	NA	NA	<0.005U		
Cadmium	7440-43-9	NA	NA	<0.0001U		
Copper	7440-50-8	NA	NA	<0.01U		
Mercury	7439-97-6	NA	NA	<0.0002U		
Nickel	7440-02-0	NA	NA	<0.02U		
Antimony	7440-36-0	NA	NA	<0.001U		
Selenium	7782-49-2	NA	NA	<0.001U		
Thallium	7440-28-0	NA	NA	<0.002U		
Zinc	7440-66-6	NA	NA	<0.01U		
Arsenic	7440-38-2	NA	NA	<0.001U		
Chromium	7440-47-3	NA	NA	<0.01U		
Lead	7439-92-1	NA	NA	<0.001U		
Dissolved Metals - EPA 6010(mg/L)						
Arsenic (dissolved)	7440-38-2	<0.001U	<0.001U	NA		
Chromium (dissolved)	7440-47-3	<0.01U	<0.01U	NA		
Lead (dissolved)	7439-92-1	<0.001U	<0.001U	NA		
Total Suspended Solids(mg/L)						
Total Suspended Solids	TSS	**10**	<5U	NA		

TABLE 6-8
PCB ANALYTICAL RESULTS – GROUNDWATER
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

REIIEC

Sample ID:	Date:	PQL (µg/L)	PCBs (EPA Method 8080)						
			Aroclor 1016 (µg/L)	Aroclor 1221 (µg/L)	Aroclor 1232 (µg/L)	Aroclor 1242 (µg/L)	Aroclor 1248 (µg/L)	Aroclor 1254 (µg/L)	Aroclor 1260 (µg/L)
First Quarter									
MW-4	11/5/93	0.5	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.00 U	< 1.00 U
MW-53 (MW-4 Dup)	11/5/93	0.5	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.00 U	< 1.00 U
MW-7	11/2/93	0.5	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.00 U	< 1.00 U
MW-12	11/2/93	0.5	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.00 U	< 1.00 U
MW-51 (MW-12 Dup)	11/2/93	0.5	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.00 U	< 1.00 U
MW-14	11/8/93	0.5	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.00 U	< 1.00 U
MW-16	11/8/93	0.5	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.00 U	< 1.00 U
MW-19	11/4/93	0.5	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.00 U	< 1.00 U
MW-52 (MW-19 Dup)	11/4/93	0.5	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.00 U	< 1.00 U
MW-31	11/4/93	0.5	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.00 U	< 1.00 U
MW-101 (Dup. of MW-31)	11/4/93	0.5	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.00 U	< 1.00 U
MW-102 (MW-31 Dup)	11/4/93	0.5	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.00 U	< 1.00 U
MW-32	11/4/93	0.5	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.00 U	< 1.00 U
MW-40	11/9/93	0.5	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.00 U	< 1.00 U
DW-2	11/2/93	0.5	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.00 U	< 1.00 U
DW-3	11/8/93	0.5	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.00 U	< 1.00 U
Field Blank									
MW-200	11/4/93	0.5	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.00 U	< 1.00 U
Second Quarter									
MW-9	4/5/94	0.5	< 0.050 U	< 0.050 U	< 0.050 U	< 0.050 U	< 0.050 U	< 0.050 U	< 0.050 U
MW-90 (MW-9 Dup)	4/5/94	0.5	< 0.050 U	< 0.050 U	< 0.050 U	< 0.050 U	< 0.050 U	< 0.050 U	< 0.050 U
MW-19	4/5/94	0.5	< 0.050 U	< 0.050 U	< 0.050 U	< 0.050 U	< 0.050 U	< 0.050 U	< 0.050 U
MW-32	4/5/94	0.5	< 0.050 U	< 0.050 U	< 0.050 U	< 0.050 U	< 0.050 U	< 0.050 U	< 0.050 U
Field Blank									
MW-101	4/5/94	0.5	< 0.050 U	< 0.050 U	< 0.050 U	< 0.050 U	< 0.050 U	< 0.050 U	< 0.050 U
Third Quarter									
MW-9	8/2/94	0.5	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.00 U	< 1.00
MW-19	8/2/94	0.5	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.00 U	< 1.00
MW-19B (Dup of MW-19)	8/2/94	0.5	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.00 U	< 1.00
Field Blank									
MW-100	8/2/94	0.5	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 1.00 U	< 1.00

TABLE 6-9
GROUND AND SURFACE WATER GENERAL CHEMISTRY
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

REIEC

Well ID	Sampling Event	pH (S.U.)	Conductivity (μmos/cm)	Temperature (°C)	D.O. (mg/L)
MW-1	November 1993	5.57	83	9.7	5.2
	April 1994	6.1	53	6.1	NR
	August 1994	NR	332	7.6	NR
	November 1994	6.97	50	9.6	NR
MW-2	November 1993	5.85	51	10	2.5
	April 1994	5.77	62	5.5	NR
	August 1994	NR	293	9.2	NR
	November 1994	5.99	84	10.2	NR
MW-3	November 1993	6.52	98	13	1.6
	August 1994	NR	322	10.1	NR
	November 1994	5.93	51	11.8	NR
MW-4	November 1993	6.87	98	11	2.6
	April 1994	5.96	42	5.2	NR
	August 1994	NR	307	6.2	NR
	November 1994	6.62	30	8.1	NR
MW-5	November 1993	7.07	101	10.6	1.4
	April 1994	6.21	40	5.2	NR
	August 1994	NR	337	10.9	NR
	November 1994	6.84	46	9.6	NR
MW-7	April 1994	6.4	48	6.8	NR
MW-9	November 1993	6.8	108	9.6	1.4
	April 1994	6.29	73	8.3	NR
	August 1994	NR	362	9.1	NR
	November 1994	6.36	113	9	NR
MW-10	November 1993	6.37	64	10.4	3
	April 1994	6.16	53	7.1	NR
MW-11	November 1993	5.91	110	10.4	1.4
	April 1994	6.22	102	7.6	NR
	August 1994	NR	352	10.2	NR
	November 1994	5.91	114	10.6	NR
MW-12	April 1994	6.1	43	6.4	NR
	August 1994	NR	355	10.2	NR
	November 1994	6.65	17	5.3	NR
MW-13	November 1993	6.08	66	9.9	3.9
	April 1994	6.25	42	7.6	NR
	August 1994	NR	289	7	NR
	November 1994	6.85	19	6.3	NR
MW-14	November 1993	5.69	65	10.9	3
	April 1994	6	49	6.3	NR
	November 1994	6.84	19	6.3	NR

TABLE 6-9 (Continued)
GROUND AND SURFACE WATER GENERAL CHEMISTRY
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

REIEC

Well ID	Sampling Event	pH (S.U.)	Conductivity (μmos/cm)	Temperature (°C)	D.O. (mg/L)
MW-15	November 1993	6.27	56	10.1	4
MW-16	November 1993	6.77	120	11.7	4.6
	April 1994	5.77	62	5.8	NR
	August 1994	NR	311	9.7	NR
	November 1994	6.09	58	11.1	NR
MW-18	November 1993	5.96	70	9.8	2.7
MW-19	November 1993	6.02	59	10.4	3.4
	April 1994	5.63	48	6.5	NR
	August 1994	NR	331	10.7	NR
	November 1994	6.51	32	10.1	NR
MW-23	November 1993	6.15	86	10.1	2.9
	April 1994	6.3	78	7.6	NR
	August 1994	NR	367	10.6	NR
	November 1994	6.55	68	10.4	NR
MW-24	November 1993	6.19	168	10.5	2.3
MW-26	November 1994	6.68	92	11	NR
MW-28	November 1993	6.6	205	10.1	6.4
	April 1994	6.08	133	6.9	NR
	August 1994	NR	490	11	NR
MW-29	November 1993	6.55	42	8.3	6
MW-30	November 1993	6.37	62	10.1	3.6
MW-31	November 1993	6.22	63	10.9	4.6
	April 1994	6.14	62	5.8	NR
	August 1994	NR	331	9.8	NR
	November 1994	6.57	58	11.3	NR
MW-32	November 1993	6.12	126	10.5	2.8
	April 1994	5.62	80	5.7	NR
MW-33	November 1993	6.94	72	8.8	5.5
MW-34	November 1993	6.38	59	10	2.1
	April 1994	5.89	72	7.2	NR
	August 1994	NR	335	5.1	NR
	November 1994	5.63	41	10.4	NR
MW-35	November 1993	6.37	79	11.9	1.4
	April 1994	6.08	109	7.5	NR
	August 1994	NR	340	12	NR
	November 1994	5.92	82	12.2	NR
MW-36	November 1993	6.22	222	12.7	1.3
	April 1994	6.28	138	7.7	NR
	August 1994	NR	550	13.5	NR

TABLE 6-9 (Continued)
GROUND AND SURFACE WATER GENERAL CHEMISTRY
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

REIIEC

Well ID	Sampling Event	pH (S.U.)	Conductivity (µmos/cm)	Temperature (°C)	D.O. (mg/L)
MW-37	November 1993	6.11	120	10	1.5
	April 1994	6.17	50	6.4	NR
	August 1994	NR	324	10.3	NR
	November 1994	6.41	49	10.1	NR
MW-38	November 1993	7.05	63	7.3	4.6
	April 1994	6.4	74	7.7	NR
	August 1994	NR	319	9	NR
	November 1994	6.23	50	7.7	NR
MW-40	November 1993	6.15	60	10.5	5.1
	April 1994	6.03	62	5.6	NR
	August 1994	6.43	263	8.7	NR
	November 1994	6.72	22	7.4	NR
DW-1	November 1993	6.44	80	7.2	8.5
	April 1994	6.38	82	7.2	NR
	August 1994	6.82	287	8	NR
DW-2	April 1994	6.88	78	6.9	NR
	August 1994	6.85	272	6.5	NR
	November 1994	6.94	49	7.7	NR
DW-3	November 1993	NR	80	10.5	8.2
	April 1994	7.02	63	8.3	NR
	August 1994	7.56	322	7.6	NR
	November 1994	6.94	51	6.7	NR
DW-4	November 1993	NR	120	7.7	5.8
	April 1994	6.44	372	7.5	NR
	August 1994	6.38	296	7.3	NR
DW-5	November 1993	NR	81	8.3	8.1
	April 1994	6.57	96	7.2	NR
	August 1994	6.56	320	8	NR
SW-1	November 1993	9.65	25	5.3	9.9
SW-2	November 1993	9.33	40	5.8	9.5
SW-3	November 1993	8.23	50	5.4	9.1
	April 1994	7.2	42	5.6	NR
	August 1994	NR	332	16.3	NR
SW-4	November 1993	11.2	50	7.2	9.3
SW-5	November 1993	10.44	32	6.6	9.9
	April 1994	6.96	38	6.6	NR
	August 1994	NR	338	11.9	NR
	November 1994	7.12	22	6.4	NR
SW-6	November 1993	9.99	32	7	9
	April 1994	6.56	42	6.8	NR
	August 1994	NR	285	15.7	NR
	November 1994	6.99	36	7.2	NR
SW-7	April 1994	7.06	39	8.1	NR
	November 1994	7.27	23	7	NR

NR=Data Not Recorded

TABLE 6−10
PRODUCT THICKNESS DATA
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

WELL NO.	Date 10/1/90	10/18/90	11/29/90	3/19/91	10/2/91	11/7/91	12/17/91	3/4/92	4/17/92	5/10/93	6/16/93	6/30/93	7/15/93	11/1−3/93	12/29/93	4/4/94	6/3/94	8/1/94	11/7/94
MW−1	0	0	0	0	0	−−	0	0	0	0	0	0	0	0	0	0	0	0	0
MW−2	0	0	0	0	0	−−	0	0	0	0	0	0	0	0	0	0	0	0	0
MW−3	0	0	0	0	0	−−	0	0	0	0	0	0	0	0	0	0	0	0	0
MW−4	0	0	0	0	0	−−	0	0	0	0	0	0	0	0	0	0	0	0	0
MW−5	0	0	0	0	0	−−	0	0	0	0	0	0	0	0	0	0	0	0	0
MW−6	Trace	0	Trace	0.01	0.4	−−	0.3	0.1	0.25	Product	−−	−−	0.04	Product	Product	Trace	0.35	Product	Product
MW−7	Trace	0	0	0	0	−−	0	0	0	0	0	0	0	0	0	0	0	0	0
MW−8	Product	Trace	0.03	0.59	0.8	−−	0.1	0.01	Trace	Product	−−	−−	0.08	Product	Product	0.04	0.15	Product	Product
MW−9	Trace	0	0	Trace	0	−−	0	0	0	0	0	0	0	0	0	0	0	0	0
MW−10	0	0	0	0	0	−−	0	0	0	0	0	0	0	0	0	0	0	0	0
MW−11	0	0	0	0	0	−−	0	0	0	0.06	0	0	0	0	0.05	0.02	0	0	0
MW−12	Trace	0	0	0	Trace	−−	0	0	0	0	0	0	0	0	0	0	0	0	0
MW−13	0	0	0	0	0	−−	0	0	0	0	0	0	0	0	0	0	0	0	0
MW−14	0	0	0	0	0	−−	0	0	0	0	0	0	0	0	0	0	0	0	0
MW−15	0	0	0	Trace	0.2	−−	0.03	0	0	0	0	Trace	0	Trace	0	0	0	0.02	0
MW−16	0	0	0	0	0	−−	0	0	0	−−	−−	−−	−−	0	0	0	0	0	0
MW−17	Trace	0	0.04	0.3	0.8	−−	0.4	0.3	0	Product	−−	−−	2.47	Product	Product	Product	0.06	Product	Product
MW−18	0	0	0	0	0	−−	0	0	0	0	0	0	0	0	0	0	0	0	0
MW−19	Trace	Trace	0	0	0	−−	0	0	0	0	0	0	0	0	0	0	0	0	0
MW−20	Trace	0	0	Trace	0	−−	0	0	0	−−	−−	−−	−−	Product	2.48	0.25	−−	Product	Product
MW−21	Trace	0	0.03	0.9	0.9	−−	0.1	0.1	0.17	Product	−−	−−	0.25	Product	Product	0.05	1.58	Product	Product
MW−22	Trace	Trace	−−	0.6	0.6	−−	0.3	0.05	Trace	Product	Trace	0.05	0.93	Product	−−	Product	Product	−−	0.38
MW−23	0	Trace	0	0	0	−−	0	0	0	0	0	0	0	0	−−	0	0	0	0
MW−24	Trace	Trace	0	0	0	−−	0	0	0	0	0	0	0	−−	−−	0	0	0	0
MW−25	Trace	Trace	−−	0.4	0.7	−−	−−	0.05	0.08	Product	Trace	0	0.04	Product	−−	0.04	Product	Product	Product
MW−26	0.01	0	0	0	0	−−	−−	0	0	−−	−−	−−	−−	−−	−−	0	−−	−−	0
MW−27	Trace	0	0	0.7	0.8	−−	0.8	0.3	0.33	Product	Trace	0.05	0.04	Product	−−	Product	−−	−−	Product
MW−28	−−	−−	−−	−−	−−	0	0	0	0	0	0	0	0	0	0	0	0	0	0.08
MW−29	−−	−−	−−	−−	−−	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MW−30	−−	−−	−−	−−	−−	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 6–10 (Continued)
PRODUCT THICKNESS DATA
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

WELL NO.	Date																		
	10/1/90	10/18/90	11/29/90	3/19/91	10/2/91	11/7/91	12/17/91	3/4/92	4/17/92	5/10/93	6/16/93	6/30/93	7/15/93	11/1–3/93	12/29/93	4/4/94	6/3/94	8/1/94	11/7/94
MW–31	--	--	--	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MW–32	--	--	--	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MW–33	--	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	0	0	0
MW–34	--	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	0	0	0
MW–35	--	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	0	0	0
MW–36	--	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	0	0	Product
MW–37	--	--	--	--	--	--	--	--	--	--	--	--	--	0	--	0	0	0	0
MW–38	--	--	--	--	--	--	--	--	--	--	--	--	--	0	--	0	0	0	0
MW–39	--	--	--	--	--	--	--	--	--	--	--	--	--	Product	Product	Product	Product	Product	Product
MW–40	--	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	0	0	0
DW–1	--	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	0	0	0
DW–2	--	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	0	0	0
DW–3	--	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	0	0	0
DW–4	--	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	0	0	0
DW–5	--	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	0	0	0

NOTES:

All thickness data in feet
-- = Not Gauged or not measured
Trace = Product present in form of droplets but not a measureable thickness
Product = Product present but thickness not measured

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TABLE 6-11
PRODUCT CHARACTERIZATION
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Analysis	Units	Sample			
		River	MW-22	MW-27	MW-39
Surface Tension ASTM D1331 at 68°F	dynes/cm	39	33	35	38
Interfacial Tension ASTM D1331 at 68°F	dynes/cm	27	49	81	25
Specific Gravity ASTM D70 at 45°F	dimensionless	0.9818	0.9740	0.9676	0.9922
Viscosity ASTM D2196 at 45-46°F	centipoise (cP)	2,730	5,783	1,035	95,350
Hydrocarbons as Gasoline (>C6-C12)	mg/kg	<10,000	<10,000	<10,000	<10,000
Hydrocarbons as Diesel (C12-C28)	mg/kg	490,000	430,000	480,000	210,000
Hydrocarbons as Heavy Oil (>C28) WTPH-HCID by GC/FID *	mg/kg	<50,000	<50,000	<50,000	<50,000

* The WTPH-HCID analysis detected hydrocarbons in the C9 to C32 range; however, concentrations were high enough for quantification only on the diesel range.

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TABLE 7-1
TPH ANALYTICAL RESULTS - SURFACE WATER
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Sample ID:	PQL (mg/L)	WTPH-Diesel GC/FID (C10-C30) 11/93 (mg/kg)	WTPH by 418.1 IR (C8 - C30+) 11/93 (mg/kg)	WTPH-D Extended GC/FID (C9-C36) 4/94 (mg/kg)	WTPH-D Extended GC/FID (C9-C36) 8/94 (mg/kg)	WTPH-D Extended GC/FID (C9-C36) 11/94 (mg/kg)
SW-1	1.0	NA	1 U	NA	NA	NA
SW-2	1.0	NA	1 U	NA	NA	NA
SW-3	1.0	NA	1 U	< 0.020 U	< 0.2 U	NA
SW-4	1.0	NA	1 U	NA	NA	NA
SW-5	1.0	NA	1 U	< 0.020 U	0.1 J	< 0.2 U
SW-6	1.0	NA	1 U	< 0.020 U	0.1 J	< 0.2 U
SW-60 (SW-6 Dup)	1.0	NA	1 U	NA	NA	NA
SW-7	1.0	NA	NA	< 0.020 U	NA	< 0.2 U
Field Blank						
MW-100	1.0	NA	NA	NA	< 0.2 U	< 0.2 U
MW-101	1.0	NA	NA	< 0.020 U	< 0.2 U	NA
MW-102	1.0	NA	NA	< 0.020 U	< 0.2 U	< 0.2 U
MW-103	1.0	NA	NA	< 0.020 U	NA	< 0.2 U
MW-200	1.0	0.25 U	NA	NA	NA	NA

Table 7-2
SVOC Analytical Results - Surface Water
BNRR Maintenance And Fueling Facility
Skykomish, Washington

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Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	PQL / PQL-SV / 0.0-0.0 / Surface Water / / / / Primary / EPA8270	SW-1 / SW-1-11-93 / 0.0-0.0 / Surface Water / 11/05/93 / Primary / EPA8270	SW-2 / SW-2-11-93 / 0.0-0.0 / Surface Water / 11/05/93 / Primary / EPA8270	SW-3 / SW-3-11-93 / 0.0-0.0 / Surface Water / 11/05/93 / Primary / EPA8270	SW-4 / SW-4-11-93 / 0.0-0.0 / Surface Water / 11/05/93 / Primary / EPA8270
Semi-Volatile Organic Compounds(ug/L)						
Phenol	108-95-2	10	<10U	<10U	<10U	<10U
bis(2-Chloroethyl) ether	111-44-4	10	<10U	<10U	<10U	<10U
2-Chlorophenol	95-57-8	10	<10U	<10U	<10U	<10U
1,3-Dichlorobenzene	541-73-1	10	<10U	<10U	<10U	<10U
1,4-Dichlorobenzene	106-46-7	10	<10U	<10U	<10U	<10U
Benzyl alcohol	100-51-6	10	<10U	<10U	<10U	<10U
1,2-Dichlorobenzene	95-50-1	10	<10U	<10U	<10U	<10U
2-Methylphenol	95-48-7	10	<10U	<10U	<10U	<10U
Bis(2-chloroisopropyl)ether	39638-32-9	10	<10U	<10U	<10U	<10U
4-Methylphenol	106-44-5	10	<10U	<10U	<10U	<10U
N-Nitroso-di-n-propylamine	621-64-7	10	<10U	<10U	<10U	<10U
Hexachloroethane	67-72-1	10	<10U	<10U	<10U	<10U
Nitrobenzene	98-95-3	10	<10U	<10U	<10U	<10U
Isophorone	78-59-1	10	<10U	<10U	<10U	<10U
2-Nitrophenol	88-75-5	10	<10U	<10U	<10U	<10U
2,4-Dimethylphenol	105-67-9	50	<50U	<50U	<50U	<50U
Benzoic acid	65-85-0	10	<10U	<10U	<10U	<10U
Bis(2-chloroethoxy)methane	111-91-1	10	<10U	<10U	<10U	<10U
2,4-Dichlorophenol	120-83-2	10	<10U	<10U	<10U	<10U
1,2,4-Trichlorobenzene	120-82-1	10	<10U	<10U	<10U	<10U
4-Chloroaniline	106-47-8	10	<10U	<10U	<10U	<10U
Hexachlorobutadiene	87-68-3	10	<10U	<10U	<10U	<10U
4-Chloro-3-methylphenol	59-50-7	20	<10U	<10U	<10U	<10U
2-Methylnaphthalene	91-57-6	10	<10U	<10U	<10U	<10U
Hexachlorocyclopentadiene	77-47-4	10	<10U	<10U	<10U	<10U
2,4,6-Trichlorophenol	88-06-2	10	<10U	<10U	<10U	<10U
2,4,5-Trichlorophenol	95-95-4	50	<50U	<50U	<50U	<50U
2-Chloronaphthalene	91-58-7	10	<10U	<10U	<10U	<10U
2-Nitroaniline	88-74-4	50	<50U	<50U	<50U	<50U
Dimethyl phthalate	131-11-3	10	<10U	<10U	<10U	<10U
2,6-Dinitrotoluene	606-20-2	50	<50U	<50U	<50U	<50U
3-Nitroaniline	99-09-2	50	<50U	<50U	<50U	<50U
N-Nitrosodimethylamine	62-75-9	10	<10U	<10U	<10U	<10U
2,4-Dinitrophenol	51-28-5	50	<50U	<50U	<50U	<50U
4-Nitrophenol	100-02-7	50	<50U	<50U	<50U	<50U
Dibenzofuran	132-64-9	10	<10U	<10U	<10U	<10U
2,4-Dinitrotoluene	121-14-2	10	<10U	<10U	<10U	<10U
Diethylphthalate	84-66-2	10	<10U	<10U	<10U	<10U
4-Chlorophenyl-phenylether	7005-72-3	10	<10U	<10U	<10U	<10U
4-Nitroaniline	100-01-6	50	<50U	<50U	<50U	<50U
4,6-Dinitro,2-methylphenol	534-52-1	50	<50U	<50U	<50U	<50U
N-Nitrosodiphenylamine	86-30-6	10	<10U	<10U	<10U	<10U
4-Bromophenyl-phenylether	101-55-3	10	<10U	<10U	<10U	<10U
Hexachlorobenzene	118-74-1	10	<10U	<10U	<10U	<10U
Pentachlorophenol	87-86-5	50	<50U	<50U	<50U	<50U
Di-n-butyl phthalate	84-74-2	10	<10U	<10U	<10U	<10U
Butylbenzylphthalate	85-68-7	10	<10U	<10U	<10U	<10U
3,3'-Dichlorobenzidine	91-94-1	20	<20U	<20U	<20U	<20U
Bis(2-ethylhexyl)phthalate	117-81-7	10	<10U	<10U	<10U	<10U
Di-n-octyl phthalate	117-84-0	10	<10U	<10U	<10U	<10U
Azobenzene	103-33-3	50	<50U	<50U	<50U	<50U
Naphthalene	91-20-3	10	<10U	<10U	<10U	<10U
Acenaphthylene	208-96-8	10	<10U	<10U	<10U	<10U
Acenaphthene	83-32-9	10	<10U	<10U	<10U	<10U
Fluorene	86-73-7	10	<10U	<10U	<10U	<10U
Phenanthrene	85-01-8	10	<10U	<10U	<10U	<10U
Anthracene	120-12-7	10	<10U	<10U	<10U	<10U
Fluoranthene	206-44-0	10	<10U	<10U	<10U	<10U
Pyrene	129-00-0	10	<10U	<10U	<10U	<10U
Benzo(a)anthracene	56-55-3	10	<10U	<10U	<10U	<10U
Chrysene	218-01-9	10	<10U	<10U	<10U	<10U
Benzo(b)fluoranthene	205-99-2	10	<10U	<10U	<10U	<10U
Benzo(k)fluoranthene	207-08-9	10	<10U	<10U	<10U	<10U
Benzo(a)pyrene	50-32-8	10	<10U	<10U	<10U	<10U
Indeno(1,2,3-cd)pyrene	193-39-5	10	<10U	<10U	<10U	<10U
Dibenzo(a,h)anthracene	53-70-3	10	<10U	<10U	<10U	<10U
Benzo(g,h,i)perylene	191-24-2	10	<10U	<10U	<10U	<10U
Sum of PAHs		160	0	0	0	0
Sum of Carcinogenic PAHs		70	0	0	0	0

Table 7-2
SVOC Analytical Results - Surface Water
BNRR Maintenance And Fueling Facility
Skykomish, Washington

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Analyte	CAS NO.					
	Sample location:	SW-5	SW-5	SW-5	SW-6	SW-6
	Sample no:	SW-5-11-93	SW-5-04-94	SW-5-08-94	SW-6-11-93	SW-60-11-93
	Depth(ft):	0.0-0.0	0.0-0.0	0.0-0.0	0.0-0.0	0.0-0.0
	Matrix:	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
	Sample Date:	11/05/93	04/06/94	08/02/94	11/05/93	11/05/93
	Type:	Primary	Primary	Primary	Primary	Duplicate
	Method:	EPA8270	EPA8310	EPA8310	EPA8270	EPA8270
Semi-Volatile Organic Compounds(ug/L)						
Phenol	108-95-2	<10U	NA	NA	<10U	<10U
bis(2-Chloroethyl) ether	111-44-4	<10U	NA	NA	<10U	<10U
2-Chlorophenol	95-57-8	<10U	NA	NA	<10U	<10U
1,3-Dichlorobenzene	541-73-1	<10U	NA	NA	<10U	<10U
1,4-Dichlorobenzene	106-46-7	<10U	NA	NA	<10U	<10U
Benzyl alcohol	100-51-6	<10U	NA	NA	<10U	<10U
1,2-Dichlorobenzene	95-50-1	<10U	NA	NA	<10U	<10U
2-Methylphenol	95-48-7	<10U	NA	NA	<10U	<10U
Bis(2-chloroisopropyl)ether	39638-32-9	<10U	NA	NA	<10U	<10U
4-Methylphenol	106-44-5	<10U	NA	NA	<10U	<10U
N-Nitroso-di-n-propylamine	621-64-7	<10U	NA	NA	<10U	<10U
Hexachloroethane	67-72-1	<10U	NA	NA	<10U	<10U
Nitrobenzene	98-95-3	<10U	NA	NA	<10U	<10U
Isophorone	78-59-1	<10U	NA	NA	<10U	<10U
2-Nitrophenol	88-75-5	<10U	NA	NA	<10U	<10U
2,4-Dimethylphenol	105-67-9	<50U	NA	NA	<50U	<50U
Benzoic acid	65-85-0	<10U	NA	NA	<10U	<10U
Bis(2-chloroethoxy)methane	111-91-1	<10U	NA	NA	<10U	<10U
2,4-Dichlorophenol	120-83-2	<10U	NA	NA	<10U	<10U
1,2,4-Trichlorobenzene	120-82-1	<10U	NA	NA	<10U	<10U
4-Chloroaniline	106-47-8	<10U	NA	NA	<10U	<10U
Hexachlorobutadiene	87-68-3	<10U	NA	NA	<10U	<10U
4-Chloro-3-methylphenol	59-50-7	<10U	NA	NA	<10U	<10U
2-Methylnaphthalene	91-57-6	<10U	NA	NA	<10U	<10U
Hexachlorocyclopentadiene	77-47-4	<10U	NA	NA	<10U	<10U
2,4,6-Trichlorophenol	88-06-2	<10U	NA	NA	<10U	<10U
2,4,5-Trichlorophenol	95-95-4	<50U	NA	NA	<50U	<50U
2-Chloronaphthalene	91-58-7	<10U	NA	NA	<10U	<10U
2-Nitroaniline	88-74-4	<50U	NA	NA	<50U	<50U
Dimethyl phthalate	131-11-3	<10U	NA	NA	<10U	<10U
2,6-Dinitrotoluene	606-20-2	<50U	NA	NA	<50U	<50U
3-Nitroaniline	99-09-2	<50U	NA	NA	<50U	<50U
N-Nitrosodimethylamine	62-75-9	<10U	NA	NA	<10U	<10U
2,4-Dinitrophenol	51-28-5	<50U	NA	NA	<50U	<50U
4-Nitrophenol	100-02-7	<50U	NA	NA	<50U	<50U
Dibenzofuran	132-64-9	<10U	NA	NA	<10U	<10U
2,4-Dinitrotoluene	121-14-2	<10U	NA	NA	<10U	<10U
Diethylphthalate	84-66-2	<10U	NA	NA	<10U	<10U
4-Chlorophenyl-phenylether	7005-72-3	<10U	NA	NA	<10U	<10U
4-Nitroaniline	100-01-6	<50U	NA	NA	<50U	<50U
4,6-Dinitro,2-methylphenol	534-52-1	<50U	NA	NA	<50U	<50U
N-Nitrosodiphenylamine	86-30-6	<10U	NA	NA	<10U	<10U
4-Bromophenyl-phenylether	101-55-3	<10U	NA	NA	<10U	<10U
Hexachlorobenzene	118-74-1	<10U	NA	NA	<10U	<10U
Pentachlorophenol	87-86-5	<50U	NA	NA	<50U	<50U
Di-n-butyl phthalate	84-74-2	<10U	NA	NA	<10U	<10U
Butylbenzylphthalate	85-68-7	<10U	NA	NA	<10U	<10U
3,3'-Dichlorobenzidine	91-94-1	<20U	NA	NA	<20U	<20U
Bis(2-ethylhexyl)phthalate	117-81-7	<10U	NA	NA	23	180
Di-n-octyl phthalate	117-84-0	<10U	NA	NA	<10U	<10U
Azobenzene	103-33-3	<50U	NA	NA	<50U	<50U
Naphthalene	91-20-3	<10U	<1.8U	<1.8U	<10U	<10U
Acenaphthylene	208-96-8	<10U	<2.3U	<2.3U	<10U	<10U
Acenaphthene	83-32-9	<10U	<1.8U	<1.8U	<10U	<10U
Fluorene	86-73-7	<10U	<0.21U	<0.21U	<10U	<10U
Phenanthrene	85-01-8	<10U	<0.64U	<0.64U	<10U	<10U
Anthracene	120-12-7	<10U	<0.66U	<0.66U	<10U	<10U
Fluoranthene	206-44-0	<10U	<0.21U	0.40	<10U	<10U
Pyrene	129-00-0	<10U	<0.27U	<0.27U	<10U	<10U
Benzo(a)anthracene	56-55-3	<10U	<0.020U	<0.020U	<10U	<10U
Chrysene	218-01-9	<10U	<0.15U	<0.15U	<10U	<10U
Benzo(b)fluoranthene	205-99-2	<10U	<0.020U	<0.020U	<10U	<10U
Benzo(k)fluoranthene	207-08-9	<10U	<0.020U	<0.020U	<10U	<10U
Benzo(a)pyrene	50-32-8	<10U	<0.030U	<0.030U	<10U	<10U
Indeno(1,2,3-cd)pyrene	193-39-5	<10U	<0.050U	<0.050U	<10U	<10U
Dibenzo(a,h)anthracene	53-70-3	<10U	<0.030U	<0.030U	<10U	<10U
Benzo(g,h,i)perylene	191-24-2	<10U	<0.080U	<0.080U	<10U	<10U
Sum of PAHs		0	0	0	0	0
Sum of Carcinogenic PAHs		0	0	0	0	0

Table 7-2
SVOC Analytical Results - Surface Water
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	FB-100 / MW-100-08-94 / 0.0-0.0 / Surface Water / 08/02/94 / Field Blank / EPA8310	FB-102 / MW-102-04-94 / 0.0-0.0 / Surface Water / 04/06/94 / Field Blank / EPA8310	FB-200 / MW-200-11-93 / 0.0-0.0 / Surface Water / 11/04/93 / Field Blank / EPA8270		
Semi-Volatile Organic Compounds(ug/L)						
Phenol	108-95-2	NA	NA	<10U		
bis(2-Chloroethyl) ether	111-44-4	NA	NA	<10U		
2-Chlorophenol	95-57-8	NA	NA	<10U		
1,3-Dichlorobenzene	541-73-1	NA	NA	<10U		
1,4-Dichlorobenzene	106-46-7	NA	NA	<10U		
Benzyl alcohol	100-51-6	NA	NA	<10U		
1,2-Dichlorobenzene	95-50-1	NA	NA	<10U		
2-Methylphenol	95-48-7	NA	NA	<10U		
Bis(2-chloroisopropyl)ether	39638-32-9	NA	NA	<10U		
4-Methylphenol	106-44-5	NA	NA	<10U		
N-Nitroso-di-n-propylamine	621-64-7	NA	NA	<10U		
Hexachloroethane	67-72-1	NA	NA	<10U		
Nitrobenzene	98-95-3	NA	NA	<10U		
Isophorone	78-59-1	NA	NA	<10U		
2-Nitrophenol	88-75-5	NA	NA	<10U		
2,4-Dimethylphenol	105-67-9	NA	NA	<50U		
Benzoic acid	65-85-0	NA	NA	<10U		
Bis(2-chloroethoxy)methane	111-91-1	NA	NA	<10U		
2,4-Dichlorophenol	120-83-2	NA	NA	<10U		
1,2,4-Trichlorobenzene	120-82-1	NA	NA	<10U		
4-Chloroaniline	106-47-8	NA	NA	<10U		
Hexachlorobutadiene	87-68-3	NA	NA	<10U		
4-Chloro-3-methylphenol	59-50-7	NA	NA	<10U		
2-Methylnaphthalene	91-57-6	NA	NA	<10U		
Hexachlorocyclopentadiene	77-47-4	NA	NA	<10U		
2,4,6-Trichlorophenol	88-06-2	NA	NA	<10U		
2,4,5-Trichlorophenol	95-95-4	NA	NA	<50U		
2-Chloronaphthalene	91-58-7	NA	NA	<10U		
2-Nitroaniline	88-74-4	NA	NA	<50U		
Dimethyl phthalate	131-11-3	NA	NA	<10U		
2,6-Dinitrotoluene	606-20-2	NA	NA	<50U		
3-Nitroaniline	99-09-2	NA	NA	<50U		
N-Nitrosodimethylamine	62-75-9	NA	NA	<10U		
2,4-Dinitrophenol	51-28-5	NA	NA	<50U		
4-Nitrophenol	100-02-7	NA	NA	<50U		
Dibenzofuran	132-64-9	NA	NA	<10U		
2,4-Dinitrotoluene	121-14-2	NA	NA	<10U		
Diethylphthalate	84-66-2	NA	NA	<10U		
4-Chlorophenyl-phenylether	7005-72-3	NA	NA	<10U		
4-Nitroaniline	100-01-6	NA	NA	<50U		
4,6-Dinitro,2-methylphenol	534-52-1	NA	NA	<50U		
N-Nitrosodiphenylamine	86-30-6	NA	NA	<10U		
4-Bromophenyl-phenylether	101-55-3	NA	NA	<10U		
Hexachlorobenzene	118-74-1	NA	NA	<10U		
Pentachlorophenol	87-86-5	NA	NA	<50U		
Di-n-butyl phthalate	84-74-2	NA	NA	<10U		
Butylbenzylphthalate	85-68-7	NA	NA	<10U		
3,3'-Dichlorobenzidine	91-94-1	NA	NA	<20U		
Bis(2-ethylhexyl)phthalate	117-81-7	NA	NA	<10U		
Di-n-octyl phthalate	117-84-0	NA	NA	<10U		
Azobenzene	103-33-3	NA	NA	<50U		
Naphthalene	91-20-3	<1.8U	<1.8U	<10U		
Acenaphthylene	208-96-8	<2.3U	<2.3U	<10U		
Acenaphthene	83-32-9	<1.8U	<1.8U	<10U		
Fluorene	86-73-7	<0.21U	<0.21U	<10U		
Phenanthrene	85-01-8	<0.64U	<0.64U	<10U		
Anthracene	120-12-7	<0.66U	<0.66U	<10U		
Fluoranthene	206-44-0	<0.21U	<0.21U	<10U		
Pyrene	129-00-0	<0.27U	<0.27U	<10U		
Benzo(a)anthracene	56-55-3	<0.020U	<0.020U	<10U		
Chrysene	218-01-9	<0.15U	<0.15U	<10U		
Benzo(b)fluoranthene	205-99-2	<0.020U	<0.020U	<10U		
Benzo(k)fluoranthene	207-08-9	<0.020U	<0.020U	<10U		
Benzo(a)pyrene	50-32-8	<0.030U	<0.030U	<10U		
Indeno(1,2,3-cd)pyrene	193-39-5	<0.050U	<0.050U	<10U		
Dibenzo(a,h)anthracene	53-70-3	<0.030U	<0.030U	<10U		
Benzo(g,h,i)perylene	191-24-2	<0.080U	<0.080U	<10U		
Sum of PAHs		0	0	0		
Sum of Carcinogenic PAHs		0	0	0		

Table 7-3
Metals and TSS Analytical Results - Surface Water
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: Sample no: Depth(ft): Matrix: Sample Date: Type: CAS NO.	PQL PQL-METAL 0.0-0.0 Surface Water / / Primary	SW-1 SW-1-11-93 0.0-0.0 Surface Water 11/05/93 Primary	SW-2 SW-2-11-93 0.0-0.0 Surface Water 11/05/93 Primary	SW-3 SW-3-11-93 0.0-0.0 Surface Water 11/05/93 Primary	SW-3 SW-3-04-94 0.0-0.0 Surface Water 04/07/94 Primary
Total Metals - EPA 6010(mg/L)						
Silver	7440-22-4	0.05	<0.01U	<0.01U	<0.01U	NA
Beryllium	7440-41-7	0.001	<0.005U	<0.005U	<0.005U	NA
Cadmium	7440-43-9	0.0005	<0.0001U	<0.0001U	<0.0001U	NA
Copper	7440-50-8	0.05	<0.01U	<0.01U	<0.01U	NA
Mercury	7439-97-6	0.0005	<0.0002U	<0.0002U	<0.0002U	NA
Nickel	7440-02-0	0.1	<0.02U	<0.02U	<0.02U	NA
Antimony	7440-36-0	0.005	<0.001U	<0.001U	<0.001U	NA
Selenium	7782-49-2	0.005	<0.001U	<0.001U	<0.001U	NA
Thallium	7440-28-0	0.010	<0.002U	<0.002U	<0.002U	NA
Zinc	7440-66-6	0.05	<0.01U	<0.01U	<0.01U	NA
Arsenic	7440-38-2	0.005	<0.001U	<0.001U	<0.001U	<0.001U
Chromium	7440-47-3	0.05	<0.01U	<0.01U	<0.01U	<0.01U
Lead	7439-92-1	0.005	<0.001U	<0.001U	<0.001U	<0.001U
Dissolved Metals - EPA 6010(mg/L)						
Arsenic (dissolved)	7440-38-2	0.005	NA	NA	NA	<0.001U
Chromium (dissolved)	7440-47-3	0.05	NA	NA	NA	<0.01U
Lead (dissolved)	7439-92-1	0.005	NA	NA	NA	<0.001U
Total Suspended Solids(mg/L)						
Total Suspended Solids	TSS	10	NA	NA	NA	<2U

Table 7-3
Metals and TSS Analytical Results - Surface Water
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	SW-3 / SW-3-08-94 / 0.0-0.0 / Surface Water / 08/02/94 / Primary	SW-4 / SW-4-11-93 / 0.0-0.0 / Surface Water / 11/05/93 / Primary	SW-5 / SW-5-11-93 / 0.0-0.0 / Surface Water / 11/05/93 / Primary	SW-5 / SW-5-04-94 / 0.0-0.0 / Surface Water / 04/06/94 / Primary	SW-5 / SW-5-08-94 / 0.0-0.0 / Surface Water / 08/02/94 / Primary
Total Metals - EPA 6010(mg/L)						
Silver	7440-22-4	NA	<0.01U	<0.01U	NA	NA
Beryllium	7440-41-7	NA	<0.005U	<0.005U	NA	NA
Cadmium	7440-43-9	NA	<0.0001U	<0.0001U	NA	NA
Copper	7440-50-8	NA	<0.01U	<0.01U	NA	NA
Mercury	7439-97-6	NA	<0.0002U	<0.0002U	NA	NA
Nickel	7440-02-0	NA	<0.02U	<0.02U	NA	NA
Antimony	7440-36-0	NA	<0.001U	<0.001U	NA	NA
Selenium	7782-49-2	NA	<0.001U	<0.001U	NA	NA
Thallium	7440-28-0	NA	<0.002U	<0.002U	NA	NA
Zinc	7440-66-6	NA	<0.01U	<0.01U	NA	NA
Arsenic	7440-38-2	<0.001U	<0.001U	<0.001U	<0.001U	<0.001U
Chromium	7440-47-3	<0.01U	<0.01U	<0.01U	<0.01U	<0.01U
Lead	7439-92-1	<0.001U	<0.001U	<0.001U	<0.001U	<0.001U
Dissolved Metals - EPA 6010(mg/L)						
Arsenic (dissolved)	7440-38-2	NA	NA	NA	<0.001U	NA
Chromium (dissolved)	7440-47-3	NA	NA	NA	<0.01U	NA
Lead (dissolved)	7439-92-1	NA	NA	NA	<0.001U	NA
Total Suspended Solids(mg/L)						
Total Suspended Solids	TSS	8	NA	NA	10	12

Table 7-3
Metals and TSS Analytical Results - Surface Water
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REIEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	SW-6 / SW-6-11-93 / 0.0-0.0 / Surface Water / 11/05/93 / Primary	SW-6 / SW-60-11-93 / 0.0-0.0 / Surface Water / 11/05/93 / Duplicate	SW-6 / SW-6-04-94 / 0.0-0.0 / Surface Water / 04/07/94 / Primary	SW-6 / SW-6-08-94 / 0.0-0.0 / Surface Water / 08/02/94 / Primary	SW-7 / SW-7-04-94 / 0.0-0.0 / Surface Water / 04/07/94 / Primary
Total Metals - EPA 6010(mg/L)						
Silver	7440-22-4	<0.01U	<0.01U	NA	NA	NA
Beryllium	7440-41-7	<0.005U	<0.005U	NA	NA	NA
Cadmium	7440-43-9	<0.0001U	<0.0001U	NA	NA	NA
Copper	7440-50-8	<0.01U	<0.01U	NA	NA	NA
Mercury	7439-97-6	<0.0002U	<0.0002U	NA	NA	NA
Nickel	7440-02-0	<0.02U	<0.02U	NA	NA	NA
Antimony	7440-36-0	<0.001U	<0.001U	NA	NA	NA
Selenium	7782-49-2	<0.001U	<0.001U	NA	NA	NA
Thallium	7440-28-0	<0.002U	<0.002U	NA	NA	NA
Zinc	7440-66-6	<0.01U	<0.01U	NA	NA	NA
Arsenic	7440-38-2	<0.001U	<0.001U	<0.001U	<0.001U	<0.001U
Chromium	7440-47-3	<0.01U	<0.01U	<0.01U	<0.01U	<0.01U
Lead	7439-92-1	<0.001U	<0.001U	<0.001U	<0.001U	<0.001U
Dissolved Metals - EPA 6010(mg/L)						
Arsenic (dissolved)	7440-38-2	NA	NA	<0.001U	NA	<0.001U
Chromium (dissolved)	7440-47-3	NA	NA	<0.01U	NA	<0.01U
Lead (dissolved)	7439-92-1	NA	NA	<0.001U	NA	<0.001U
Total Suspended Solids(mg/L)						
Total Suspended Solids	TSS	NA	NA	<2U	2	2

Table 7-3
Metals and TSS Analytical Results - Surface Water
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REIEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	FB-101 / MW-101-04-94 / 0.0-0.0 / Surface Water / 04/05/94 / Field Blank	FB-102 / MW-102-04-94 / 0.0-0.0 / Surface Water / 04/06/94 / Field Blank	FB-200 / MW-200-11-93 / 0.0-0.0 / Surface Water / 11/04/93 / Field Blank		
Total Metals - EPA 6010(mg/L)						
Silver	7440-22-4	NA	NA	<0.01U		
Beryllium	7440-41-7	NA	NA	<0.005U		
Cadmium	7440-43-9	NA	NA	<0.0001U		
Copper	7440-50-8	NA	NA	<0.01U		
Mercury	7439-97-6	NA	NA	<0.0002U		
Nickel	7440-02-0	NA	NA	<0.02U		
Antimony	7440-36-0	NA	NA	<0.001U		
Selenium	7782-49-2	NA	NA	<0.001U		
Thallium	7440-28-0	NA	NA	<0.002U		
Zinc	7440-66-6	NA	NA	<0.01U		
Arsenic	7440-38-2	<0.001U	**0.001**	<0.001U		
Chromium	7440-47-3	<0.01U	<0.01U	<0.01U		
Lead	7439-92-1	<0.001U	<0.001U	<0.001U		
Dissolved Metals - EPA 6010(mg/L)						
Arsenic (dissolved)	7440-38-2	<0.001U	<0.001U	NA		
Chromium (dissolved)	7440-47-3	<0.01U	<0.01U	NA		
Lead (dissolved)	7439-92-1	<0.001U	<0.001U	NA		
Total Suspended Solids(mg/L)						
Total Suspended Solids	TSS	<2U	<2U	NA		

RETEC

TABLE 7-4
TPH ANALYTICAL RESULTS – SEDIMENT
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

ANALYSIS				WTPH by 418.1 IR (C8 – C30+)		
Sample ID:	Lab Sample ID:	Sample Date:	Sample Depth: (feet bgs)	Conc.: (mg/kg)	MDL	Q
Sediments						
SED-1	588-2927	10/07/93	0		106	U
SED-2	588-2928	10/07/93	0		116	U
SED-3	588-2930	10/07/93	0		111	U
SED-10	588-2929	10/07/93	0		111	U
(SED-3 Dup)						
SED-4	588-2931	10/07/93	0	6900	1,869	
SED-5	588-2932	10/07/93	0	990	117	
SED-6	588-2933	10/07/93	0	97	145	J
SED-7	590-2936	10/07/93	0	99	143	J

Table 7-5
SVOC Analytical Results - Sediment
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	PQL / PQL-SV / 0.0-0.0 / Sediment / / / / Primary / EPA8270	SED-1 / SED-1 / 0.0-0.0 / Sediment / 10/07/93 / Primary / EPA8270	SED-2 / SED-2 / 0.0-0.0 / Sediment / 10/07/93 / Primary / EPA8270	SED-3 / SED-3 / 0.0-0.0 / Sediment / 10/07/93 / Primary / EPA8270	SED-3 / SED-10 / 0.0-0.0 / Sediment / 10/07/93 / Duplicate / EPA8270
Semi-Volatile Organic Compounds(ug/Kg)						
Phenol	108-95-2	660	<1051U	<382U	<365U	<736U
bis(2-Chloroethyl) ether	111-44-4	660	<1051U	<382U	<365U	<736U
2-Chlorophenol	95-57-8	660	<1051U	<382U	<365U	<736U
1,3-Dichlorobenzene	541-73-1	660	<1051U	<382U	<365U	<736U
1,4-Dichlorobenzene	106-46-7	660	<1051U	<382U	<365U	<736U
Benzyl alcohol	100-51-6	660	<1051U	<382U	<365U	<736U
1,2-Dichlorobenzene	95-50-1	660	<1051U	<382U	<365U	<736U
2-Methylphenol	95-48-7	660	<1051U	<382U	<365U	<736U
Bis(2-chloroisopropyl)ether	39638-32-9	660	<1051U	<382U	<365U	<736U
4-Methylphenol	106-44-5	660	<1051U	<382U	<365U	<736U
N-Nitroso-di-n-propylamine	621-64-7	660	<1051U	<382U	<365U	<736U
Hexachloroethane	67-72-1	660	<1051U	<382U	<365U	<736U
Nitrobenzene	98-95-3	660	<1051U	<382U	<365U	<736U
Isophorone	78-59-1	660	<1051U	<382U	<365U	<736U
2-Nitrophenol	88-75-5	660	<1051U	<382U	<365U	<736U
2,4-Dimethylphenol	105-67-9	660	<5255U	<1908U	<1827U	<3679U
Benzoic acid	65-85-0	660	<1051U	<382U	<365U	<736U
Bis(2-chloroethoxy)methane	111-91-1	660	<1051U	<382U	<365U	<736U
2,4-Dichlorophenol	120-83-2	660	<1051U	<382U	<365U	<736U
1,2,4-Trichlorobenzene	120-82-1	660	<1051U	<382U	<365U	<736U
4-Chloroaniline	106-47-8	660	<1051U	<382U	<365U	<736U
Hexachlorobutadiene	87-68-3	660	<1051U	<382U	<365U	<736U
4-Chloro-3-methylphenol	59-50-7	1300	<1051U	<382U	<365U	<736U
2-Methylnaphthalene	91-57-6	660	<1051U	<382U	<365U	<736U
Hexachlorocyclopentadiene	77-47-4	660	<1051U	<382U	<365U	<736U
2,4,6-Trichlorophenol	88-06-2	660	<1051U	<382U	<365U	<736U
2,4,5-Trichlorophenol	95-95-4	3300	<5255U	<1908U	<1827U	<3679U
2-Chloronaphthalene	91-58-7	660	<1051U	<382U	<365U	<736U
2-Nitroaniline	88-74-4	3300	<5255U	<1908U	<1827U	<3679U
Dimethyl phthalate	131-11-3	660	<1051U	<382U	<365U	<736U
2,6-Dinitrotoluene	606-20-2	3300	<5255U	<1908U	<1827U	<3679U
3-Nitroaniline	99-09-2	3300	<5255U	<1908U	<1827U	<3679U
N-Nitrosodimethylamine	62-75-9	660	<1051U	<382U	<365U	<736U
2,4-Dinitrophenol	51-28-5	3300	<5255U	<1908U	<1827U	<3679U
4-Nitrophenol	100-02-7	3300	<5255U	<1908U	<1827U	<3679U
Dibenzofuran	132-64-9	660	<1051U	<382U	<365U	<736U
2,4-Dinitrotoluene	121-14-2	660	<1051U	<382U	<365U	<736U
Diethylphthalate	84-66-2	660	<1051U	<382U	<365U	<736U
4-Chlorophenyl-phenylether	7005-72-3	660	<1051U	<382U	<365U	<736U
4-Nitroaniline	100-01-6	3300	<5255U	<1908U	<1827U	<3679U
4,6-Dinitro,2-methylphenol	534-52-1	3300	<5255U	<1908U	<1827U	<3679U
N-Nitrosodiphenylamine	86-30-6	660	<1051U	<382U	<365U	<736U
4-Bromophenyl-phenylether	101-55-3	660	<1051U	<382U	<365U	<736U
Hexachlorobenzene	118-74-1	660	<1051U	<382U	<365U	<736U
Pentachlorophenol	87-86-5	3300	<5255U	<1908U	<1827U	<3679U
Di-n-butyl phthalate	84-74-2	660	<1051U	<382U	<365U	<736U
Butylbenzylphthalate	85-68-7	660	<1051U	<382U	<365U	<736U
3,3'-Dichlorobenzidine	91-94-1	1300	<2102U	<763U	<731U	<1472U
Bis(2-ethylhexyl)phthalate	117-81-7	660	<1051U	<382U	<365U	<736U
Di-n-octyl phthalate	117-84-0	660	<1051U	<382U	<365U	<736U
Azobenzene	103-33-3	3300	<5255U	<1908U	<1827U	<3679U
Naphthalene	91-20-3	660	<1051U	<382U	<365U	<736U
Acenaphthylene	208-96-8	660	<1051U	<382U	<365U	<736U
Acenaphthene	83-32-9	660	<1051U	<382U	<365U	<736U
Fluorene	86-73-7	660	<1051U	<382U	<365U	<736U
Phenanthrene	85-01-8	660	<1051U	<382U	<365U	<736U
Anthracene	120-12-7	660	<1051U	<382U	<365U	<736U
Fluoranthene	206-44-0	660	<1051U	<382U	<365U	<736U
Pyrene	129-00-0	660	<1051U	<382U	<365U	<736U
Benzo(a)anthracene	56-55-3	660	<1051U	<382U	<365U	<736U
Chrysene	218-01-9	660	<1051U	<382U	<365U	<736U
Benzo(b)fluoranthene	205-99-2	660	<1051U	<382U	<365U	<736U
Benzo(k)fluoranthene	207-08-9	660	<1051U	<382U	<365U	<736U
Benzo(a)pyrene	50-32-8	660	<1051U	<382U	<365U	<736U
Indeno(1,2,3-cd)pyrene	193-39-5	660	<1051U	<382U	<365U	<736U
Dibenzo(a,h)anthracene	53-70-3	660	<1051U	<382U	<365U	<736U
Benzo(g,h,i)perylene	191-24-2	660	<1051U	<382U	<365U	<736U
Sum of PAHs		10560	0	0	0	0
Sum of Carcinogenic PAHs		4620	0	0	0	0

Table 7-5
SVOC Analytical Results - Sediment
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REI EC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	SED-4 / SED-4 / 0.0-0.0 / Sediment / 10/07/93 / Primary / EPA8270	SED-5 / SED-5 / 0.0-0.0 / Sediment / 10/07/93 / Primary / EPA8270	SED-6 / SED-6 / 0.0-0.0 / Sediment / 10/07/93 / Primary / EPA8270	SED-7 / SED-7 / 0.0-0.0 / Sediment / 10/07/93 / Primary / EPA8270	
Semi-Volatile Organic Compounds(ug/Kg)						
Phenol	108-95-2	<3855U	<2310U	<1910U	<9442U	
bis(2-Chloroethyl) ether	111-44-4	<3855U	<2310U	<1910U	<9442U	
2-Chlorophenol	95-57-8	<3855U	<2310U	<1910U	<9442U	
1,3-Dichlorobenzene	541-73-1	<3855U	<2310U	<1910U	<9442U	
1,4-Dichlorobenzene	106-46-7	<3855U	<2310U	<1910U	<9442U	
Benzyl alcohol	100-51-6	<3855U	<2310U	<1910U	<9442U	
1,2-Dichlorobenzene	95-50-1	<3855U	<2310U	<1910U	<9442U	
2-Methylphenol	95-48-7	<3855U	<2310U	<1910U	<9442U	
Bis(2-chloroisopropyl)ether	39638-32-9	<3855U	<2310U	<1910U	<9442U	
4-Methylphenol	106-44-5	<3855U	<2310U	<1910U	<9442U	
N-Nitroso-di-n-propylamine	621-64-7	<3855U	<2310U	<1910U	<9442U	
Hexachloroethane	67-72-1	<3855U	<2310U	<1910U	<9442U	
Nitrobenzene	98-95-3	<3855U	<2310U	<1910U	<9442U	
Isophorone	78-59-1	<3855U	<2310U	<1910U	<9442U	
2-Nitrophenol	88-75-5	<3855U	<2310U	<1910U	<9442U	
2,4-Dimethylphenol	105-67-9	<19276U	<11552U	<9551U	<47210U	
Benzoic acid	65-85-0	<3855U	<2310U	<1910U	<9442U	
Bis(2-chloroethoxy)methane	111-91-1	<3855U	<2310U	<1910U	<9442U	
2,4-Dichlorophenol	120-83-2	<3855U	<2310U	<1910U	<9442U	
1,2,4-Trichlorobenzene	120-82-1	<3855U	<2310U	<1910U	<9442U	
4-Chloroaniline	106-47-8	<3855U	<2310U	<1910U	<9442U	
Hexachlorobutadiene	87-68-3	<3855U	<2310U	<1910U	<9442U	
4-Chloro-3-methylphenol	59-50-7	<3855U	<2310U	<1910U	<9442U	
2-Methylnaphthalene	91-57-6	<3855U	<2310U	<1910U	<9442U	
Hexachlorocyclopentadiene	77-47-4	<3855U	<2310U	<1910U	<9442U	
2,4,6-Trichlorophenol	88-06-2	<3855U	<2310U	<1910U	<9442U	
2,4,5-Trichlorophenol	95-95-4	<19276U	<11552U	<9551U	<47210U	
2-Chloronaphthalene	91-58-7	<3855U	<2310U	<1910U	<9442U	
2-Nitroaniline	88-74-4	<19276U	<11552U	<9551U	<47210U	
Dimethyl phthalate	131-11-3	<3855U	<2310U	<1910U	<9442U	
2,6-Dinitrotoluene	606-20-2	<19276U	<11552U	<9551U	<47210U	
3-Nitroaniline	99-09-2	<19276U	<11552U	<9551U	<47210U	
N-Nitrosodimethylamine	62-75-9	<3855U	<2310U	<1910U	<9442U	
2,4-Dinitrophenol	51-28-5	<19276U	<11552U	<9551U	<47210U	
4-Nitrophenol	100-02-7	<19276U	<11552U	<9551U	<47210U	
Dibenzofuran	132-64-9	<3855U	<2310U	<1910U	<9442U	
2,4-Dinitrotoluene	121-14-2	<3855U	<2310U	<1910U	<9442U	
Diethylphthalate	84-66-2	<3855U	<2310U	<1910U	<9442U	
4-Chlorophenyl-phenylether	7005-72-3	<3855U	<2310U	<1910U	<9442U	
4-Nitroaniline	100-01-6	<19276U	<11552U	<9551U	<47210U	
4,6-Dinitro,2-methylphenol	534-52-1	<19276U	<11552U	<9551U	<47210U	
N-Nitrosodiphenylamine	86-30-6	<3855U	<2310U	<1910U	<9442U	
4-Bromophenyl-phenylether	101-55-3	<3855U	<2310U	<1910U	<9442U	
Hexachlorobenzene	118-74-1	<3855U	<2310U	<1910U	<9442U	
Pentachlorophenol	87-86-5	<19276U	<11552U	<9551U	<47210U	
Di-n-butyl phthalate	84-74-2	<3855U	<2310U	<1910U	<9442U	
Butylbenzylphthalate	85-68-7	<3855U	<2310U	<1910U	<9442U	
3,3'-Dichlorobenzidine	91-94-1	<7710U	<4621U	<3821U	<18884U	
Bis(2-ethylhexyl)phthalate	117-81-7	<3855U	<2310U	<1910U	<9442U	
Di-n-octyl phthalate	117-84-0	<3855U	<2310U	<1910U	<9442U	
Azobenzene	103-33-3	<19276U	<11552U	<9551U	<47210U	
Naphthalene	91-20-3	<3855U	<2310U	<1910U	<9442U	
Acenaphthylene	208-96-8	<3855U	<2310U	<1910U	<9442U	
Acenaphthene	83-32-9	<3855U	<2310U	<1910U	<9442U	
Fluorene	86-73-7	<3855U	<2310U	<1910U	<9442U	
Phenanthrene	85-01-8	<3855U	<2310U	<1910U	<9442U	
Anthracene	120-12-7	<3855U	<2310U	<1910U	<9442U	
Fluoranthene	206-44-0	<3855U	<2310U	<1910U	<9442U	
Pyrene	129-00-0	<3855U	<2310U	<1910U	<9442U	
Benzo(a)anthracene	56-55-3	<3855U	<2310U	<1910U	<9442U	
Chrysene	218-01-9	<3855U	<2310U	<1910U	<9442U	
Benzo(b)fluoranthene	205-99-2	<3855U	<2310U	<1910U	<9442U	
Benzo(k)fluoranthene	207-08-9	<3855U	<2310U	<1910U	<9442U	
Benzo(a)pyrene	50-32-8	<3855U	<2310U	<1910U	<9442U	
Indeno(1,2,3-cd)pyrene	193-39-5	<3855U	<2310U	<1910U	<9442U	
Dibenzo(a,h)anthracene	53-70-3	<3855U	<2310U	<1910U	<9442U	
Benzo(g,h,i)perylene	191-24-2	<3855U	<2310U	<1910U	<9442U	
Sum of PAHs		0	0	0	0	
Sum of Carcinogenic PAHs		0	0	0	0	

Table 7-6
VOC Analytical Results - Sediment
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REITEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	PQL / PQL-TVP / 0.0-0.0 / Sediment / / / / Primary / EPA8240	SED-1 / SED-1 / 0.0-0.0 / Sediment / 10/07/93 / Primary / EPA8240	SED-2 / SED-2 / 0.0-0.0 / Sediment / 10/07/93 / Primary / EPA8240	SED-3 / SED-3 / 0.0-0.0 / Sediment / 10/07/93 / Primary / EPA8240	SED-3 / SED-10 / 0.0-0.0 / Sediment / 10/07/93 / Duplicate / EPA8240
Volatile Organic Compounds(ug/Kg)						
Chloromethane	74-87-3	10	<11U	<12U	<11U	<11U
Bromomethane	74-83-9	10	<11U	<12U	<11U	<11U
Vinyl chloride	75-01-4	10	<11U	<12U	<11U	<11U
Chloroethane	75-00-3	10	<11U	<12U	<11U	<11U
Methylene chloride	75-09-2	5	3JB	3JB	5J	3JB
Acrolein	107-02-8	10	<11U	<12U	<11U	<11U
Acrylonitrile	107-13-1	10	<11U	<12U	<11U	<11U
Acetone	67-64-1	5	5J	<6U	5J	5J
Carbon disulfide	75-15-0	5	<5U	<6U	<6U	<6U
1,1-Dichloroethene	75-35-4	5	<5U	<6U	<6U	<6U
1,1-Dichloroethane	75-34-3	5	<5U	<6U	<6U	<6U
1,2-Dichloroethene	540-59-0	5	<5U	<6U	<6U	<6U
Chloroform	67-66-3	5	<5U	<6U	<6U	<6U
1,2-Dichloroethane	107-06-2	5	<5U	<6U	<6U	<6U
2-Butanone	78-93-3	5	<11U	<12U	<11U	<11U
1,1,1-Trichloroethane	71-55-6	5	<5U	<6U	<6U	<6U
Carbon tetrachloride	56-23-5	5	<5U	<6U	<6U	<6U
Vinyl acetate	108-05-4	5	<11U	<12U	<11U	<11U
Bromodichloromethane	75-27-4	5	<5U	<6U	<6U	<6U
1,2-Dichloropropane	78-87-5	5	<5U	<6U	<6U	<6U
cis-1,3-Dichloropropene	10061-01-5	5	<5U	<6U	<6U	<6U
Trichloroethene	79-01-6	5	<5U	<6U	<6U	<6U
Dibromochloromethane	124-48-1	5	<5U	<6U	<6U	<6U
1,1,2-Trichloroethane	79-00-5	5	<5U	<6U	<6U	<6U
trans-1,3-Dichloropropene	10061-02-6	5	<5U	<6U	<6U	<6U
2-Chloroethylvinyl ether	110-75-8	5	<5U	<6U	<6U	<6U
Bromoform	75-25-2	5	<5U	<6U	<6U	<6U
4-Methyl-2-pentanone	108-10-1	10	<11U	<12U	<11U	<11U
2-Hexanone	591-78-6	10	<11U	<12U	<11U	<11U
Tetrachloroethene	127-18-4	5	<5U	<6U	<6U	<6U
1,1,2,2-Tetrachloroethane	79-34-5	5	<5U	<6U	<6U	<6U
Chlorobenzene	108-90-7	5	<5U	<6U	<6U	<6U
Styrene	100-42-5	5	<5U	<6U	<6U	<6U
Benzene	71-43-2	5	<5U	<6U	<6U	<6U
Toluene	108-88-3	5	<5U	<6U	<6U	<6U
Ethylbenzene	100-41-4	5	<5U	<6U	<6U	<6U
Total xylenes	1330-20-7	5	<5U	<6U	<6U	<6U

Table 7-6
VOC Analytical Results - Sediment
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / Method: / CAS NO.	SED-4 / SED-4 / 0.0-0.0 / Sediment / 10/07/93 / Primary / EPA8240	SED-5 / SED-5 / 0.0-0.0 / Sediment / 10/07/93 / Primary / EPA8240	SED-6 / SED-6 / 0.0-0.0 / Sediment / 10/07/93 / Primary / EPA8240	SED-7 / SED-7 / 0.0-0.0 / Sediment / 10/07/93 / Primary / EPA8240	
Volatile Organic Compounds(ug/Kg)						
Chloromethane	74-87-3	<58U	<12U	<14U	<14U	
Bromomethane	74-83-9	<58U	<12U	<14U	<14U	
Vinyl chloride	75-01-4	<58U	<12U	<14U	<14U	
Chloroethane	75-00-3	<58U	<12U	<14U	<14U	
Methylene chloride	75-09-2	**28JB**	**5JB**	**6JB**	**6JB**	
Acrolein	107-02-8	<58U	<12U	<14U	<14U	
Acrylonitrile	107-13-1	<58U	<12U	<14U	<14U	
Acetone	67-64-1	**44B**	**7B**	**9B**	<7U	
Carbon disulfide	75-15-0	<29U	<6U	<7U	<7U	
1,1-Dichloroethene	75-35-4	<29U	<6U	<7U	<7U	
1,1-Dichloroethane	75-34-3	<29U	<6U	<7U	<7U	
1,2-Dichloroethene	540-59-0	<29U	<6U	<7U	<7U	
Chloroform	67-66-3	<29U	<6U	<7U	<7U	
1,2-Dichloroethane	107-06-2	<29U	<6U	<7U	<7U	
2-Butanone	78-93-3	<58U	<12U	<14U	<14U	
1,1,1-Trichloroethane	71-55-6	<29U	<6U	<7U	<7U	
Carbon tetrachloride	56-23-5	<29U	<6U	<7U	<7U	
Vinyl acetate	108-05-4	<58U	<12U	<14U	<14U	
Bromodichloromethane	75-27-4	<29U	<6U	<7U	<7U	
1,2-Dichloropropane	78-87-5	<29U	<6U	<7U	<7U	
cis-1,3-Dichloropropene	10061-01-5	<29U	<6U	<7U	<7U	
Trichloroethene	79-01-6	<29U	<6U	<7U	<7U	
Dibromochloromethane	124-48-1	<29U	<6U	<7U	<7U	
1,1,2-Trichloroethane	79-00-5	<29U	<6U	<7U	<7U	
trans-1,3-Dichloropropene	10061-02-6	<29U	<6U	<7U	<7U	
2-Chloroethylvinyl ether	110-75-8	<29U	<6U	<7U	<7U	
Bromoform	75-25-2	<29U	<6U	<7U	<7U	
4-Methyl-2-pentanone	108-10-1	<58U	<12U	<14U	<14U	
2-Hexanone	591-78-6	**320**	**20**	<14U	<14U	
Tetrachloroethene	127-18-4	<29U	<6U	<7U	<7U	
1,1,2,2-Tetrachloroethane	79-34-5	<29U	<6U	<7U	<7U	
Chlorobenzene	108-90-7	<29U	<6U	<7U	<7U	
Styrene	100-42-5	<29U	<6U	<7U	<7U	
Benzene	71-43-2	<29U	<6U	<7U	<7U	
Toluene	108-88-3	<29U	<6U	<7U	<7U	
Ethylbenzene	100-41-4	<29U	<6U	<7U	<7U	
Total xylenes	1330-20-7	<29U	<6U	<7U	<7U	

Table 7-7
Metals Analytical Results - Sediment
BNRR Maintenance And Fueling Facility
Skykomish, Washington

REIEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	PQL / PQL-METAL / 0.0-0.0 / Sediment / / / / Primary	SED-1 / SED-1 / 0.0-0.0 / Sediment / 10/07/93 / Primary	SED-2 / SED-2 / 0.0-0.0 / Sediment / 10/07/93 / Primary	SED-3 / SED-3 / 0.0-0.0 / Sediment / 10/07/93 / Primary	SED-3 / SED-10 / 0.0-0.0 / Sediment / 10/07/93 / Duplicate
Total Metals - EPA 6010(mg/Kg)						
Silver	7440-22-4	1.0	<1U	<1.1U	<1U	<1.1U
Beryllium	7440-41-7	0.05	<0.5U	<0.5U	<0.5U	<0.5U
Cadmium	7440-43-9	0.5	<0.6U	<0.6U	<0.6U	<0.6U
Copper	7440-50-8	1.0	15.5	13.7	10.9	15.7
Mercury	7439-97-6	0.01	<0.02U	<0.02U	<0.02U	<0.02U
Nickel	7440-02-0	2.0	33.5	22.2	17.6	25.6
Antimony	7440-36-0	0.01	<0.2U	<0.2U	<0.2U	<0.2U
Selenium	7782-49-2	0.10	<0.1U	<0.1U	<0.1U	<0.1U
Thallium	7440-28-0	0.20	<0.2U	0.2	<0.2U	<0.2U
Zinc	7440-66-6	1.0	40.4	42.1	30.2	32.4
Arsenic	7440-38-2	0.10	6	50	3	10
Chromium	7440-47-3	1.0	34	22.9	19.7	25.2
Lead	7439-92-1	2.0	8.3	6.1	2.8	4.4

Table 7-7
Metals Analytical Results - Sediment
BNRR Maintenance And Fueling Facility
Skykomish, Washington

RETEC

Analyte	Sample location: / Sample no: / Depth(ft): / Matrix: / Sample Date: / Type: / CAS NO.	SED-4 / SED-4 / 0.0-0.0 / Sediment / 10/07/93 / Primary	SED-5 / SED-5 / 0.0-0.0 / Sediment / 10/07/93 / Primary	SED-6 / SED-6 / 0.0-0.0 / Sediment / 10/07/93 / Primary	SED-7 / SED-7 / 0.0-0.0 / Sediment / 10/07/93 / Primary	
Total Metals - EPA 6010(mg/Kg)						
Silver	7440-22-4	<1.1U	<1.2U	<1.4U	<3U	
Beryllium	7440-41-7	<0.1U	<0.6U	<0.7U	<1.5U	
Cadmium	7440-43-9	<0.6U	<0.6U	<0.7U	<1.5U	
Copper	7440-50-8	13.2	14.4	36.4	34.6	
Mercury	7439-97-6	<0.02U	<0.02U	0.05	0.04	
Nickel	7440-02-0	19.4	18.3	39.9	24	
Antimony	7440-36-0	<0.2U	<0.2U	<0.2U	<0.2U	
Selenium	7782-49-2	<0.1U	<0.1U	<0.1U	0.1	
Thallium	7440-28-0	0.3	<0.2U	<0.3U	<0.3U	
Zinc	7440-66-6	34	33.6	105	150	
Arsenic	7440-38-2	5	2	8	20	
Chromium	7440-47-3	26	20	30.1	24.3	
Lead	7439-92-1	2.7	4.5	26.8	64.1	

TABLE 7-8
PCB ANALYTICAL RESULTS – SEDIMENT
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

COMPOUND			PCBs (EPA Method 8080)																				
			Aroclor 1016			Aroclor 1221			Aroclor 1232			Aroclor 1242			Aroclor 1248			Aroclor 1254			Aroclor 1260		
Sample ID	Laboratory Sample ID	Sample Date	Conc. (µg/kg)	MDL	Q	Conc. (µg/kg)	MDL	Q	Conc. (µg/kg)	MDL	Q	Conc. (µg/kg)	MDL	Q	Conc. (µg/kg)	MDL	Q	Conc. (µg/kg)	MDL	Q	Conc. (µg/kg)	MDL	Q
Sediments																							
SED-1	588-2927	10/7/93		85	U		85	U		85	U		85	U		85	U		170	U		170	U
SED-2	588-2928	10/7/93		92	U		92	U		92	U		92	U		92	U		185	U		185	U
SED-3	588-2930	10/7/93		89	U		89	U		89	U		89	U		89	U		177	U		177	U
SED-10 (SED-3 Dup)	588-2929	10/7/93		89	U		89	U		89	U		89	U		89	U		178	U		178	U
SED-4	588-2931	10/7/93		93	U		93	U		93	U		93	U		93	U		187	U		187	U
SED-5	588-2932	10/7/93		93	U		93	U		93	U		93	U		93	U		187	U		187	U
SED-6	588-2933	10/7/93		116	U		116	U		116	U		116	U		116	U		232	U		232	U
SED-7	590-2936	10/7/93		114	U		114	U		114	U		114	U		114	U		229	U		229	U

RETEC

TABLE 8-1
AIR MONITORING RESULTS FROM DRILLING AND SOIL SAMPLING
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Date and Time	Sampling Location	PID Reading (ppm)	Field Activity
9/29/93			
1139	Breathing Zone[1]	0.0	HSA[2] Drilling through LNAPL @ B-10
1148	Breathing Zone	0.0	HSA Drilling through LNAPL @ B-10
1148	**Ground Surface**	**3.0**	**HSA Drilling through LNAPL @ B-10**
1159	Breathing Zone	0.0	Well Installation @ B-10
1159	Ground Surface	0.0	Well Installation @ B-10
1540	Breathing Zone	0.0	Surface Soil Sampling @ SS-28
9/30/93			
0935	Breathing Zone	0.0	Surface Soil Sampling @ SS-30
0953	Breathing Zone	0.0	Surface Soil Sampling @ SS-32
1009	Breathing Zone	0.0	Surface Soil Sampling @ SS-31
1042	Breathing Zone	0.0	Surface Soil Sampling @ SS-29
1102	Breathing Zone	0.0	Surface Soil Sampling @ SS-27
1127	Breathing Zone	0.0	Surface Soil Sampling @ SS-13
1302	Breathing Zone	0.0	Surface Soil Sampling @ SS-14
1322	Breathing Zone	0.0	Surface Soil Sampling @ SS-15
1342	Breathing Zone	0.0	Surface Soil Sampling @ SS-16
1402	Breathing Zone	0.0	Surface Soil Sampling @ SS-18
1433	Breathing Zone	0.0	Surface Soil Sampling @ SS-17
1451	Breathing Zone	0.0	Surface Soil Sampling @ SS-19
1506	Breathing Zone	0.0	Surface Soil Sampling @ SS-19.1
1624	Breathing Zone	0.0	Surface Soil Sampling @ SS-21
1705	Breathing Zone	0.0	Surface Soil Sampling @ SS-23
1721	Breathing Zone	0.0	Surface Soil Sampling @ SS-24
10/01/93			
1136	Breathing Zone	0.0	Surface Soil Sampling @ BG-1
1158	Breathing Zone	0.0	Surface Soil Sampling @ SS-20
1219	Breathing Zone	0.0	Surface Soil Sampling @ SS-26
10/07/93			
1112	Breathing Zone	0.0	Sediment Sampling @ SED-1
1146	Breathing Zone	0.0	Sediment Sampling @ SED-2
1210	Breathing Zone	0.0	Sediment Sampling @ SED-3
1250	**Breathing Zone**	**0.5**	**Sediment Sampling @ SED-4. Free Product**
1325	**Breathing Zone**	**1.0**	**Sediment Sampling @ SED-5. Free Product**
1405	Breathing Zone	0.0	Sediment Sampling @ SED-6
1425	Breathing Zone	0.0	Sediment Sampling @ SED-7
1505	Breathing Zone	0.0	Hand Auger Sampling @ HA-2
1540	Breathing Zone	0.0	Hand Auger Sampling @ HA-1
1615	Breathing Zone	0.0	Hand Auger Sampling @ HA-4
1645	Breathing Zone	0.0	Hand Auger Sampling @ HA-3

REITEC

TABLE 8-1 (Continued)
AIR MONITORING RESULTS FROM DRILLING AND SOIL SAMPLING
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Date and Time	Sampling Location	PID Reading (ppm)	Field Activity
10/18/93			
1147	Breathing Zone	0.0	Air Rotary Drilling through LNAPL @ B-10B
10/19/93			
0917	Breathing Zone	0.0	Air Rotary Drilling through LNAPL @ B-6
0917	Cyclone	0.0	Air Rotary Drilling through LNAPL @ B-6
1200	Breathing Zone	0.0	Air Rotary Drilling @ MW-39
1225	Breathing Zone	0.0	Air Rotary Drilling through LNAPL @ MW-39
1227	Breathing Zone	0.0	Air Rotary Drilling through LNAPL @ MW-39
10/20/93			
1237	Breathing Zone	0.0	Air Rotary Drilling through LNAPL @ B-8
1548	Breathing Zone	0.0	Air Rotary Drilling through LNAPL @ DW-4B
10/21/93			
1545	Breathing Zone	0.0	Air Rotary Drilling through LNAPL @ MW-36
10/22/93			
0818	Breathing Zone	0.0	Air Rotary Drilling @ MW-37
1528	**Top of Casing**	**6.0**	**Air Rotary Drilling through LNAPL @ B-7**

NOTES: [1] Breathing Zone is 5 to 6 feet above ground level
[2] HSA = Hollow Stem Auger

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TABLE 8-2
AIR MONITORING RESULTS FROM GROUNDWATER SAMPLING/GAUGING EVENTS
BNRR FORMER MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

WELL NUMBER	SAMPLING/GAUGING EVENT		
	NOV. 1993 PID READING [1] (ppm)	DEC. 1993 PID READING [2] (ppm)	JUN. 1994 PID READING [3] (ppm)
MW-1	BBG	BBG	BBG
MW-2	NR	BBG	BBG
MW-3	NR	BBG	BBG
MW-4	NR	BBG	BBG
MW-5	NR	BBG	BBG
MW-6	NR	BBG	6
MW-7	NR	BBG	BBG
MW-8	NR	1	12
MW-9	NR	BBG	BBG
MW-10	NR	BBG	BBG
MW-11	NR	5	BBG
MW-12	NR	BBG	BBG
MW-13	BBG	BBG	BBG
MW-14	BBG	BBG	BBG
MW-15	NR	BBG	BBG
MW-16	28	BBG	BBG
MW-17	NR	7	12
MW-18	NR	BBG	BBG
MW-19	BBG	BBG	BBG
MW-20	NR	1	NR
MW-21	NR	7	30
MW-22	NR	NR	9
MW-23	NR	NR	BBG
MW-24	NR	NR	BBG
MW-25	NR	NR	7.5
MW-26	NR	NR	NR
MW-27	NR	NR	NR
MW-28	NR	BBG	BBG
MW-29	NR	BBG	BBG
MW-30	BBG	BBG	BBG
MW-31	BBG	BBG	BBG
MW-32	BBG	BBG	BBG
MW-33	BBG	BBG	BBG
MW-34	BBG	BBG	BBG
MW-35	BBG	BBG	BBG
MW-36	NR	BBG	BBG
MW-37	NR	NR	3
MW-38	BBG	NR	BBG
MW-39	BBG	4	10.6
MW-40	BBG	BBG	BBG
DW-1	BBG	BBG	BBG
DW-2	BBG	BBG	BBG
DW-3	BBG	BBG	BBG
DW-4	BBG	BBG	BBG
DW-5	BBG	BBG	BBG

NOTES:

BBG = below background levels
NR = no measurement taken
[1] no background value supplied
[2] background was 0.9 ppm
[3] background was 1.5 ppm

RETEC

TABLE 8–3
ESTIMATED AIR CONCENTRATIONS FOR THE BNRR FORMER MAINTENANCE AND FUELING FACILITY SKYKOMISH, WASHINGTON

Compound	South Site Surface Soil Exposure Concentration				North Site Surface Soil Exposure Concentration			
	95% UCL µg/kg	Volatiles mg/m³	Dust mg/m³	Total mg/m³	95% UCL µg/kg	Volatiles mg/m³	Dust mg/m³	Total mg/m³
Antimony	1800	0.00E+00	1.49E−09	1.49E−09	149	0.00E+00	1.23E−10	1.23E−10
Arsenic	15500	2.42E−09	1.28E−08	1.52E−08	0	0.00E+00	0.00E+00	0.00E+00
Beryllium	642	0.00E+00	5.30E−10	5.30E−10	0	0.00E+00	0.00E+00	0.00E+00
Cadmium	845	1.38E−12	6.98E−10	6.99E−10	0	0.00E+00	0.00E+00	0.00E+00
Chromium	30800	4.80E−09	2.54E−08	3.02E−08	42600	6.65E−09	3.52E−08	4.18E−08
Copper	95100	1.48E−08	7.85E−08	9.33E−08	36200	5.65E−09	2.99E−08	3.55E−08
Lead	488000	3.55E−09	4.03E−07	4.07E−07	730000	5.31E−09	6.03E−07	6.08E−07
Mercury	75	1.53E−05	6.19E−11	1.53E−05	90	1.84E−05	7.43E−11	1.84E−05
Nickel	32400	0.00E+00	2.67E−08	2.67E−08	33500	0.00E+00	2.77E−08	2.77E−08
Selenium	159	0.00E+00	1.31E−10	1.31E−10	178	0.00E+00	1.47E−10	1.47E−10
Thallium	149	0.00E+00	1.23E−10	1.23E−10	0	0.00E+00	0.00E+00	0.00E+00
Zinc	164000	2.56E−08	1.35E−07	1.61E−07	164000	2.56E−08	1.35E−07	1.61E−07
Aroclor 1254	171	2.25E−07	1.41E−10	2.25E−07	0	0.00E+00	0.00E+00	0.00E+00
Aroclor 1260	90.7	1.20E−07	7.49E−11	1.20E−07	0	0.00E+00	0.00E+00	0.00E+00
2−Methylnaphthalene	2292	8.26E−05	1.89E−09	8.26E−05	0	0.00E+00	0.00E+00	0.00E+00
Phenanthrene	2050	4.02E−06	6.98E−11	4.02E−06	0	0.00E+00	0.00E+00	0.00E+00
Di−n−butyl phthalate	115	2.81E−09	9.49E−11	2.90E−09	0	0.00E+00	0.00E+00	0.00E+00
Butyl benzyl phthalate	300	5.82E−05	2.48E−10	5.82E−05	0	0.00E+00	0.00E+00	0.00E+00
Di−n−octyl phthalate	337	0.00E+00	2.78E−10	2.78E−10	0	0.00E+00	0.00E+00	0.00E+00
Toluene	223	4.89E−06	7.60E−12	4.89E−06	0	0.00E+00	0.00E+00	0.00E+00
Ethylbenzene	768	8.25E−06	2.62E−11	8.25E−06	0	0.00E+00	0.00E+00	0.00E+00
Xylenes	962	1.29E−05	1.09E−11	1.29E−05	0	0.00E+00	0.00E+00	0.00E+00

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TABLE 11-1
SUMMARY OF PRE-RI AND RI SOIL SAMPLES AND PARAMETERS ANALYZED
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Location	Date Sampled	TPH EPA 418.1	TPH as Diesel EPA 8015 mod.	TPH as Gasoline EPA 8015 mod.	Total Metals EPA 6010/7000	PCBs EPA 8080	Semivolatiles EPA 8270	Volatiles EPA 8240 EPA 8020*
SOUTH SITE								
TP1-1	11/8/91				X			
TP2-1	11/8/91				X			
TP-2-5-10	11/08/91	X			X			
B1-4	11/7/91				X			
B1-12.5	11/04/91	X	X					
B2-4	11/7/91				X			
B2-9.5	11/05/91	X	X					
B3-4	11/7/91				X			
B3-14.5	11/05/91	X	X					
B4-0	9/28/93				X	X		
B4-2	9/28/93					X		
B4-10	9/28/93	X				X	X	X
B5-0	10/24/93				X	X		
B5-7	10/24/93	X					X	
B6-0	10/18/93				X	X		
B6-8	10/18/93	X	X				X	X
B6-10.5	10/19/93	X	X		X	X	X	
B7-0	10/22/93				X	X		
B7-11	10/22/93	X	X					
B8-0	10/20/93				X	X		
B8-12	10/20/93	X	X					
B9-0	10/18/93				X	X		
B9-7.5	10/18/93	X	X				X	X
B9-12.5	10/18/93	X						
B10-0	9/29/93				X	X		
B10-10	9/29/93	X	X					
B10-15	9/29/93	X	X					
B12-0	10/29/93				X			
B12-7.5	10/29/93	X	X	X			X	X
B12-12.5	10/29/93	X						
MW1-3.5	09/17/90	X	X					BTEX
MW2-9.5	09/18/90	X	X					BTEX
MW3-9.5	09/18/90	X	X					BTEX
MW4-9.5	09/18/90	X	X					BTEX
MW5-4	09/19/90	X	X					BTEX
MW6-9	09/19/90	X						
MW6-14	09/19/90	X	X					BTEX
MW7-9	09/19/90	X	X					BTEX
MW8-2	09/19/90	X	X					BTEX
MW9-4	09/20/90	X	X					BTEX
MW10-9	09/20/90	X	X					BTEX
MW11-9	09/20/90	X	X					BTEX
MW12-9.5	09/20/90	X	X					
MW13-9.5	09/20/90	X	X					
MW14-4	09/21/90	X	X					BTEX
MW15-4	09/21/90	X	X					
MW15-9.5	09/21/90	X	X					BTEX
MW16-4	09/21/90	X	X					BTEX
MW17-9.5	09/24/90	X	X					
MW18-4	09/24/90	X	X					BTEX
MW19-4	09/26/90	X	X					BTEX
MW20-4	09/26/90	X	X					
MW21-9	09/25/90	X	X					
MW29-4	11/7/91				X			
MW29-11.5	11/05/91	X	X					

TABLE 11-1 (Continued)
SUMMARY OF PRE-RI AND RI SOIL SAMPLES AND PARAMETERS ANALYZED
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

RETEC

Location	Date Sampled	TPH EPA 418.1	TPH as Diesel EPA 8015 mod.	TPH as Gasoline EPA 8015 mod.	Total Metals EPA 6010/7000	PCBs EPA 8080	Semivolatiles EPA 8270	Volatiles EPA 8240 EPA 8020*
MW30-4	11/06/91	X	X		X			
MW30-4	11/7/91				X			
MW31-4	11/7/91							
MW31-4.5	11/06/91	X	X					
MW31-14.5	11/06/91	X	X					
MW32-8(TP-1-4)	11/08/91	X						
MW33-0	9/28/93				X			
MW33-2.5	9/28/93	X	X	X			X	
MW33-5	9/28/93							X
MW33-12.5	9/28/93	X						
MW34-0	9/28/93				X			
MW34-7.5	9/28/93							X
MW34-10	9/28/93	X	X				X	
MW37-0	10/21/93				X			
MW37-7.5	10/22/93	X	X	X				X
MW37-12.5	10/24/93		X					
MW38-0	10/23/93				X			
MW38-7.5	10/24/93	X	X					X
MW39-0	10/19/93				X			
MW39-6	10/19/93	X	X	X			X	X
MW39-10	10/18/93	X	X					
MW40-0	9/27/93				X			
MW40-5	9/27/93		X	X		X	X	X
MW40-12.5	9/27/93	X						
DW1-0	9/28/93				X			
DW1-5	9/28/93	X	X					
DW2-0	9/27/93				X	X		
DW2-2	9/27/93					X		
DW2-5	9/27/93	X	X				X	
DW2-10	9/27/93							X
DW2-12.5	9/27/93	X						
DW3-0	9/29/93	X			X	X		
DW3-2	9/29/93					X		
DW3-7.5	9/29/93	X	X					
SS4-0.5	10/4/90				X			
SS5-0.5	10/4/90				X			
SS-7	04/11/91					X		
SS-8	04/11/91					X		
SS-9	04/11/91					X		
SS10-0	4/11/91				Lead only			
SS11-0	4/11/91				Lead only			
SS13-0	9/30/93	X			X	X		
SS14-0	9/30/93	X			X	X		
SS15-0	9/30/93	X			X	X		
SS16-0	9/30/93	X			X	X		
SS17-0	9/30/93	X			X	X		
SS18-0	9/30/93	X			X	X		
SS19-0	9/30/93	X			X	X		
SS19.1-0	9/30/93	X			X	X		
SS20-0	10/1/93	X			X	X		
SS21-0	9/30/93	X			X	X		
SS22-0	9/30/93	X			X	X		
SS23-0	9/30/93	X			X	X		
SS24-0	9/30/93	X			X	X		
SS25-0	10/1/93	X			X	X		

TABLE 11-1 (Continued)
SUMMARY OF PRE-RI AND RI SOIL SAMPLES
AND PARAMETERS ANALYZED
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

REIEC

Location	Date Sampled	TPH EPA 418.1	TPH as Diesel EPA 8015 mod.	TPH as Gasoline EPA 8015 mod.	Total Metals EPA 6010/7000	PCBs EPA 8080	Semivolatiles EPA 8270	Volatiles EPA 8240 EPA 8020*
SS26-0	10/1/93	X			X	X		
SS27-0	9/30/93	X			X	X		
SS28-0	9/29/93	X			X	X		
SS29-0	9/30/93	X			X	X		
SS30-0	9/30/93	X			X	X		
SS31-0	9/30/93	X			X	X		
SS32-0	9/30/93	X			X	X		
NORTH SITE								
B11-0	9/27/93				X			
B110-0	9/27/93				X			
B11-5	9/27/93	X	X					
B11-10	9/27/93	X						
MW22-4.5	09/24/90	X	X					BTEX
MW23-4	09/25/90	X	X					
MW24-4.5	09/25/90	X	X					BTEX
MW25-4	09/25/90	X	X					BTEX
MW26-9.5	09/26/90	X	X					
MW27-4.5	09/26/90	X	X					
MW35-0	9/28/93				X			
MW35-7.5	9/28/93							X
MW35-10	9/28/93	X	X					
MW36-0	10/21/93				X			
MW36-6	10/21/93	X	X					X
MW36-7.5	10/21/93	X	X					
DW4-0	9/27/93				X			
DW4-2.5	9/27/93	X	X					
DW4-7.5	9/27/93	X	X					
DW5-0	10/23/93				X			
DW5-12	10/23/93	X	X					
HA1-2	10/7/93	X			X		X	X
HA2-1	10/7/93	X					X	X
HA3-1	10/7/93	X			X		X	X
HA4-0	10/7/93	X			X		X	X
BACKGROUND								
BG1-0	10/1/93	X			X	X		
BG2-0	9/30/93	X			X	X		

NOTES:

* EPA 8020 is the analytical method for BTEX (Benzene/Toluene/Ethylbenzene/Xylene)

TABLE 11-2
SUMMARY OF DATA
NORTH SITE SOIL
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

REITEC

Compounds	Number of Samples	Number of Detects	Number BDL	Minimum Quantitation Limit	Maximum Quantitation Limit	Minimum Detected Concentration	Maximum Detected Concentration	Location Of Maximum Detected Concentration
TOTAL METALS (mg/kg)								
Antimony	8	2	6	0.100	0.300	0.1	0.2	DW4-0
Arsenic	8	7	1	0.200	0.200	0.1	12	HA3-1
Beryllium	8	0	8	0.500	1.200	ND	ND	ND
Cadmium	8	0	8	0.500	1.200	ND	ND	ND
Chromium	8	8	0	NA	NA	24.3	58.3	HA3-1
Copper	8	8	0	NA	NA	16.6	41.6	HA4-0
Lead	8	8	0	NA	NA	3.6	1,897	B11-0
Mercury	8	5	3	0.020	0.020	0.02	0.16	B11-0
Nickel	8	8	0	NA	NA	22	37.8	HA3-1
Selenium	8	3	5	0.100	0.200	0.1	0.3	B11-0
Silver	8	0	8	1.000	2.400	ND	ND	ND
Thallium	8	0	8	0.200	0.200	ND	ND	ND
Zinc	8	8	0	NA	NA	34.7	222	HA4-0
SEMIVOLATILES (μg/kg)								
Phenol	4	0	4	346	2791	ND	ND	ND
bis-(2-Chloroethyl)ether	4	0	4	346	2791	ND	ND	ND
2-Chlorophenol	4	0	4	346	2791	ND	ND	ND
1,3-Dichlorobenzene	4	0	4	346	2791	ND	ND	ND
1,4-Dichlorobenzene	4	0	4	346	2791	ND	ND	ND
Benzyl Alcohol	4	0	4	346	2791	ND	ND	ND
1,2-Dichlorobenzene	4	0	4	346	2791	ND	ND	ND
2-Methylphenol	4	0	4	346	2791	ND	ND	ND
bis(2-Chloroisopropyl)ether	4	0	4	346	2791	ND	ND	ND
4-Methylphenol	4	0	4	346	2791	ND	ND	ND
N-Nitroso-di-n-propylamine	4	0	4	346	2791	ND	ND	ND
Hexachloroethane	4	0	4	346	2791	ND	ND	ND
Nitrobenzene	4	0	4	346	2791	ND	ND	ND
Isophorone	4	0	4	346	2791	ND	ND	ND
2-Nitrophenol	4	0	4	346	2791	ND	ND	ND
2,4-Dimethylphenol	4	0	4	1730	13953	ND	ND	ND
Benzoic Acid	4	0	4	346	2791	ND	ND	ND
bis(2-Chloroethoxy)methane	4	0	4	346	2791	ND	ND	ND
2,4-Dichlorophenol	4	0	4	346	2791	ND	ND	ND
1,2,4-Trichlorobenzene	4	0	4	346	2791	ND	ND	ND
Naphthalene	4	0	4	346	2791	ND	ND	ND
4-Chloroaniline	4	0	4	346	2791	ND	ND	ND
Hexachlorobutadiene	4	0	4	346	2791	ND	ND	ND
4-Chloro-3-methylphenol	4	0	4	346	2791	ND	ND	ND
2-Methylnaphthalene	4	0	4	346	2791	ND	ND	ND
Hexachlorocylopentadiene	4	0	4	346	2791	ND	ND	ND
2,4,6-Trichlorophenol	4	0	4	346	2791	ND	ND	ND
2,4,5-Trichlorophenol	4	0	4	1730	13953	ND	ND	ND
2,Chloronaphthalene	4	0	4	346	2791	ND	ND	ND
2-Nitroaniline	4	0	4	1730	13953	ND	ND	ND
Dimethyl phthalate	4	0	4	346	2791	ND	ND	ND
Acenaphthylene	4	0	4	346	2791	ND	ND	ND
2,6-Dinitrotoluene	4	0	4	1730	13953	ND	ND	ND
3-Nitroaniline	4	0	4	1730	13953	ND	ND	ND
2-Methyl-4,6-dinitrophenol	4	0	4	1730	13953	ND	ND	ND
N-nitrosodimethylamine	4	0	4	346	2791	ND	ND	ND
Azobenzene	4	0	4	1730	13953	ND	ND	ND
Acenaphthene	4	0	4	346	2791	ND	ND	ND
2,4-Dinitrophenol	4	0	4	1730	13953	ND	ND	ND

TABLE 11-2 (Continued)
SUMMARY OF DATA
NORTH SITE SOIL
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

RETEC

Compounds	Number of Samples	Number of Detects	Number BDL	Minimum Quantitation Limit	Maximum Quantitation Limit	Minimum Detected Concentration	Maximum Detected Concentration	Location Of Maximum Detected Concentration
4-Nitrophenol	4	0	4	1730	13953	ND	ND	ND
Dibenzofuran	4	0	4	346	2791	ND	ND	ND
2,4-Dinitrotoluene	4	0	4	346	2791	ND	ND	ND
Diethylphthalate	4	0	4	346	2791	ND	ND	ND
4,Chlorophenyl-phenylether	4	0	4	346	2791	ND	ND	ND
Fluorene	4	0	4	346	2791	ND	ND	ND
4-Nitroaniline	4	0	4	1730	13953	ND	ND	ND
N-Nitrosodiphenylamine(1)	4	0	4	346	2791	ND	ND	ND
4-Bromophenyl-phenylether	4	0	4	346	2791	ND	ND	ND
Hexachlorobenzene	4	0	4	346	2791	ND	ND	ND
Pentachlorophenol	4	0	4	1730	13953	ND	ND	ND
Phenanthrene	4	0	4	346	2791	ND	ND	ND
Anthracene	4	0	4	346	2791	ND	ND	ND
Di-n-butylphthalate	4	0	4	346	2791	ND	ND	ND
Fluoranthene	4	0	4	346	2791	ND	ND	ND
Pyrene	4	0	4	346	2791	ND	ND	ND
Butylbenzylphthalate	4	0	4	346	2791	ND	ND	ND
3,3'-Dichlorobenzidine	4	0	4	692	5581	ND	ND	ND
Benzo(a)anthracene	4	0	4	346	2791	ND	ND	ND
Bis(2-ethylhexyl)phthalate	4	0	4	346	2791	ND	ND	ND
Chrysene	4	0	4	346	2791	ND	ND	ND
Di-n-octyl phthalate	4	0	4	346	2791	ND	ND	ND
Benzo(b)fluoranthene	4	0	4	346	2791	ND	ND	ND
Benzo(k)fluoranthene	4	0	4	346	2791	ND	ND	ND
Benzo(a)pyrene	4	0	4	346	2791	ND	ND	ND
Indeno(1,2,3-cd)pyrene	4	0	4	346	2791	ND	ND	ND
Dibenz(a,h)anthracene	4	0	4	346	2791	ND	ND	ND
Benzo(g,h,i)perylene	4	0	4	346	2791	ND	ND	ND
TPHs (mg/kg)								
WTPH by 418.1	12	5	7	101	119	90 J	27,000	DW4-7.5
WTPH as Diesel	13	10	3	5	26	17	12,172	DW4-7.5
VOLATILES (μg/kg)								
Chloromethane	6	0	6	10	53	ND	ND	ND
Bromomethane	6	0	6	10	53	ND	ND	ND
Vinyl Chloride	6	0	6	10	53	ND	ND	ND
Chloroethane	6	0	6	10	53	ND	ND	ND
Methylene Chloride	6	6	0	NA	NA	3 BJ	56 B	MW36-6
Acrolein	6	0	6	10	53	ND	ND	ND
Acrylonitrile	6	0	6	10	53	ND	ND	ND
Acetone	6	3	3	5	6	10 B	88 B	MW36-6
Carbon Disulfide	6	0	6	5	26	ND	ND	ND
1,1-Dichloroethene	6	0	6	5	26	ND	ND	ND
1,1-Dichloroethane	6	0	6	5	26	ND	ND	ND
Total-1,2-Dichloroethene	6	0	6	5	26	ND	ND	ND
Chloroform	6	0	6	5	26	ND	ND	ND
1,2-Dichloroethane	6	0	6	5	26	ND	ND	ND
2-Butanone	6	0	6	10	53	ND	ND	ND
1,1,1-Trichloroethane	6	0	6	5	26	ND	ND	ND
Carbon Tetrachloride	6	0	6	5	26	ND	ND	ND
Vinyl Acetate	6	0	6	10	53	ND	ND	ND
Bromodichloromethane	6	0	6	5	26	ND	ND	ND
1,2-Dichloropropane	6	0	6	5	26	ND	ND	ND
cis-1,3-Dichloropropene	6	0	6	5	26	ND	ND	ND
Trichloroethene	6	0	6	5	26	ND	ND	ND

TABLE 11-2 (Continued)
SUMMARY OF DATA
NORTH SITE SOIL
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

RETEC

Compounds	Number of Samples	Number of Detects	Number BDL	Minimum Quantitation Limit	Maximum Quantitation Limit	Minimum Detected Concentration	Maximum Detected Concentration	Location Of Maximum Detected Concentration
Dibromochloromethane	6	0	6	5	26	ND	ND	ND
1,1,2-Trichloroethane	6	0	6	5	26	ND	ND	ND
Benzene	9	1	8	5	26	51	51	MW25-4
trans-1,3-dichloropropene	6	0	6	5	26	ND	ND	ND
2-chloroethylvinylether	6	0	6	5	26	ND	ND	ND
Bromoform	6	0	6	5	26	ND	ND	ND
4-Methyl-2-Pentanone	6	0	6	10	53	ND	ND	ND
2-Hexanone	6	0	6	10	53	ND	ND	ND
Tetrachloroethene	6	0	6	5	26	ND	ND	ND
1,1,2,2-Tetrachloroethane	6	0	6	5	26	ND	ND	ND
Toluene	9	0	9	5	26	ND	ND	ND
Chlorobenzene	6	0	6	5	26	ND	ND	ND
Ethylbenzene	9	0	9	5	26	ND	ND	ND
Styrene	6	0	6	5	26	ND	ND	ND
Xylene (total)	9	1	8	5	26	35	35	MW25-4

NOTES:

ND - Not detected
NA - Analytes were detected; see data for quantitation limits
One half the detection limit used in statistics.

TABLE 11-3
SUMMARY OF DATA
SOUTH SITE SOIL
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

RETEC

Compounds	Number of Samples	Number of Detects	Number BDL	Minimum Quantitation Limit	Maximum Quantitation Limit	Minimum Detected Concentration	Maximum Detected Concentration	Location Of Maximum Detected Concentration
TOTAL METALS (mg/kg)								
Antimony	49	15	34	0.1	5	0.14	18	MW31-4
Arsenic	49	49	0	NA	NA	2.5	64	SS19-0
Beryllium	49	8	41	0.15	5.2	0.16	0.71	MW31-4
Cadmium	49	12	37	0.13	5.2	0.3	3.7	MW31-4
Chromium	49	49	0	NA	NA	10.3	56	B3-4
Copper	49	49	0	NA	NA	15.5	323	SS29-0
Lead	51	51	0	NA	NA	3.8	3,600	B9-0
Mercury	49	33	16	0.02	0.15	0.02	0.3	B2-4
Nickel	49	49	0	NA	NA	13.7	71.9	SS29-0
Selenium	49	10	39	0.1	0.6	0.1	0.3	SS28-0
Silver	49	0	49	0.27	10	ND	ND	ND
Thallium	49	5	44	0.2	0.5	0.2	0.3	SS19-0
Zinc	49	49	0	NA	NA	28.6	460	B6-0
PCBs (µg/kg)								
Aroclor 1016	35	0	35	80	100	ND	ND	ND
Aroclor 1221	35	0	35	80	100	ND	ND	ND
Aroclor 1232	35	0	35	80	100	ND	ND	ND
Aroclor 1242	35	0	35	80	100	ND	ND	ND
Aroclor 1248	35	0	35	80	100	ND	ND	ND
Aroclor 1254	36	9	27	160	200	14 J	1,200	SS27-0
Aroclor 1260	37	4	33	160	200	36	137 J	SS16-0
SEMIVOLATILES (µg/kg)								
Phenol	11	0	11	330	6600	ND	ND	ND
bis-(2-Chloroethyl)ether	11	0	11	330	6600	ND	ND	ND
2-Chlorophenol	11	0	11	330	6600	ND	ND	ND
1,3-Dichlorobenzene	11	0	11	330	6600	ND	ND	ND
1,4-Dichlorobenzene	11	0	11	330	6600	ND	ND	ND
Benzyl Alcohol	11	0	11	330	6600	ND	ND	ND
1,2-Dichlorobenzene	11	0	11	330	6600	ND	ND	ND
2-Methylphenol	11	0	11	330	6600	ND	ND	ND
bis(2-Chloroisopropyl)ether	11	0	11	330	6600	ND	ND	ND
4-Methylphenol	11	0	11	330	6600	ND	ND	ND
N-Nitroso-di-n-propylamine	11	0	11	330	6600	ND	ND	ND
Hexachloroethane	11	0	11	330	6600	ND	ND	ND
Nitrobenzene	11	0	11	330	6600	ND	ND	ND
Isophorone	11	0	11	330	6600	ND	ND	ND
2-Nitrophenol	11	0	11	330	6600	ND	ND	ND
2,4-Dimethylphenol	11	0	11	1650	33000	ND	ND	ND
Benzoic Acid	11	0	11	330	6600	ND	ND	ND
bis(2-Chloroethoxy)methane	11	0	11	330	6600	ND	ND	ND
2,4-Dichlorophenol	11	0	11	330	6600	ND	ND	ND
1,2,4-Trichlorobenzene	11	0	11	330	6600	ND	ND	ND
Naphthalene	11	0	11	330	6600	ND	ND	ND
4-Chloroaniline	11	0	11	330	6600	ND	ND	ND
Hexachlorobutadiene	11	0	11	330	6600	ND	ND	ND
4-Chloro-3-methylphenol	11	0	11	330	6600	ND	ND	ND
2-Methylnaphthalene	11	5	6	337	402	100 J	8,300	B4-10
Hexachlorocylopentadiene	11	0	11	330	6600	ND	ND	ND
2,4,6-Trichlorophenol	11	0	11	330	6600	ND	ND	ND
2,4,5-Trichlorophenol	11	0	11	1650	33000	ND	ND	ND
2,Chloronaphthalene	11	0	11	330	6600	ND	ND	ND
2-Nitroaniline	11	0	11	1650	33000	ND	ND	ND
Dimethyl phthalate	11	0	11	330	6600	ND	ND	ND
Acenaphthylene	11	0	11	330	6600	ND	ND	ND
2,6-Dinitrotoluene	11	0	11	1650	33000	ND	ND	ND
3-Nitroaniline	11	0	11	1650	33000	ND	ND	ND
2-Methyl-4,6-dinitrophenol	11	0	11	1650	33000	ND	ND	ND

TABLE 11-3 (Continued)
SUMMARY OF DATA
SOUTH SITE SOIL
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

RETEC

Compounds	Number of Samples	Number of Detects	Number BDL	Minimum Quantitation Limit	Maximum Quantitation Limit	Minimum Detected Concentration	Maximum Detected Concentration	Location Of Maximum Detected Concentration
N-nitrosodimethylamine	11	0	11	330	6600	ND	ND	ND
Azobenzene	11	0	11	1650	33000	ND	ND	ND
Acenaphthene	11	0	11	330	6600	ND	ND	ND
2,4-Dinitrophenol	11	0	11	1650	33000	ND	ND	ND
4-Nitrophenol	11	0	11	1650	33000	ND	ND	ND
Dibenzofuran	11	0	11	330	6600	ND	ND	ND
2,4-Dinitrotoluene	11	0	11	330	6600	ND	ND	ND
Diethylphthalate	11	0	11	330	6600	ND	ND	ND
4,Chlorophenyl-phenylether	11	0	11	330	6600	ND	ND	ND
Fluorene	11	1	10	330	6600	110 J	110 J	B6-8
4-Nitroaniline	11	0	11	1650	33000	ND	ND	ND
N-Nitrosodiphenylamine	11	0	11	330	6600	ND	ND	ND
4-Bromophenyl-phenylether	11	0	11	330	6600	ND	ND	ND
Hexachlorobenzene	11	0	11	330	6600	ND	ND	ND
Pentachlorophenol	11	0	11	1650	33000	ND	ND	ND
Phenanthrene	11	3	8	330	473	144 J	7,500	B4-10
Anthracene	11	0	11	330	6600	ND	ND	ND
Di-n-butylphthalate	11	5	6	345	6600	70 J	115 J	B9-7.5
Fluoranthene	11	2	9	330	6600	144 J	200 J	MW39-6
Pyrene	11	2	9	330	6600	190 J	300 J	MW39-6
Butylbenzylphthalate	11	2	9	330	6600	136 J	300 J	DW2-5
3,3'-Dichlorobenzidine	11	0	11	660	13200	ND	ND	ND
Benzo(a)anthracene	11	1	10	330	6600	110 J	110 J	MW39-6
Bis(2-ethylhexyl)phthalate	11	2	9	330	6600	102 J	136 J	B5-7
Chrysene	11	2	9	330	6600	180 J	189 J	DW-2
Di-n-octyl phthalate	11	1	10	330	6600	112 J	112 J	B5-7
Benzo(b)fluoranthene	11	1	10	330	6600	260 J	260 J	MW39-6
Benzo(k)fluoranthene	11	1	10	330	6600	80 J	80 J	MW39-6
Benzo(a)pyrene	11	1	10	330	6600	130 J	130 J	MW39-6
Indeno(1,2,3-cd)pyrene	11	1	10	330	6600	130 J	130 J	MW39-6
Dibenz(a,h)anthracene	11	0	11	330	6600	ND	ND	ND
Benzo(g,h,i)perylene	11	1	10	330	6600	170 J	170 J	MW39-6
TPHs (mg/kg)								
WTPH by 418.1	53	25	28	5	133	110	14,000	B10-10
WTPH as Diesel	49	30	19	5	30	13 J	12,000	B1-12.5
WTPH as Gasoline	5	1	4	5	6	6	6	MW39-6
VOLATILES (μg/kg)								
Chloromethane	12	0	12	10	53	ND	ND	ND
Bromomethane	12	0	12	10	53	ND	ND	ND
Vinyl Chloride	12	0	12	10	53	ND	ND	ND
Chloroethane	12	0	12	10	53	ND	ND	ND
Methylene Chloride	12	12	0	NA	NA	4 BJ	38 B	B4-10
Acrolein	12	0	12	10	53	ND	ND	ND
Acrylonitrile	12	0	12	10	53	ND	ND	ND
Acetone	12	10	2	5	5	7 B	109 B	B4-10
Carbon Disulfide	12	0	12	5	27	ND	ND	ND
1,1-Dichloroethene	12	0	12	5	27	ND	ND	ND
1,1-Dichloroethane	12	0	12	5	27	ND	ND	ND
Total-1,2-Dichloroethene	12	0	12	5	27	ND	ND	ND
Chloroform	12	0	12	5	27	ND	ND	ND
1,2-Dichloroethane	12	1	11	5	27	9	9	MW33-5
2-Butanone	12	1	11	10	53	24	24	B9-7.5
1,1,1-Trichloroethane	12	0	12	5	27	ND	ND	ND
Carbon Tetrachloride	12	0	12	5	27	ND	ND	ND
Vinyl Acetate	12	0	12	10	53	ND	ND	ND
Bromodichloromethane	12	0	12	5	27	ND	ND	ND

TABLE 11-3 (Continued)
SUMMARY OF DATA
SOUTH SITE SOIL
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

RETEC

Compounds	Number of Samples	Number of Detects	Number BDL	Minimum Quantitation Limit	Maximum Quantitation Limit	Minimum Detected Concentration	Maximum Detected Concentration	Location Of Maximum Detected Concentration
1,2-Dichloropropane	12	0	12	5	27	ND	ND	ND
cis-1,3-Dichloropropene	12	0	12	5	27	ND	ND	ND
Trichloroethene	12	0	12	5	27	ND	ND	ND
Dibromochloromethane	12	0	12	5	27	ND	ND	ND
1,1,2-Trichloroethane	12	0	12	5	27	ND	ND	ND
Benzene	29	1	28	5	500	93	93	MW8-2
trans-1,3-dichloropropene	12	0	12	5	27	ND	ND	ND
2-chloroethylvinylether	12	0	12	5	27	ND	ND	ND
Bromoform	12	0	12	5	27	ND	ND	ND
4-Methyl-2-Pentanone	12	0	12	10	53	ND	ND	ND
2-Hexanone	12	0	12	10	53	ND	ND	ND
Tetrachloroethene	12	0	12	5	27	ND	ND	ND
1,1,2,2-Tetrachloroethane	12	1	11	5	27	23	23	MW37-7.5
Toluene	29	2	27	5	500	540	2,000	MW6-14
Chlorobenzene	12	0	12	5	27	ND	ND	ND
Ethylbenzene	29	3	26	5	500	98	7,800	MW6-14
Styrene	12	5	7	5	27	16	176	B5-7
Xylene (total)	29	3	26	5	500	360	9,600	MW6-14

NOTES:

ND - Not detected
NA - Analytes were detected; see data for quantitation limits
One-half the detection limit used in statistics

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TABLE 11-4
SUMMARY OF DATA
BACKGROUND SOIL
BNRR MAINTENANCE AND FUELING FACILITY SITE
SKYKOMISH, WASHINGTON

Compounds	Number of Samples	Number of Detects	Number BDL	Minimum Quantitation Limit	Maximum Quantitation Limit	Minimum Detected Concentration	Maximum Detected Concentration	Location Of Maximum Detected Concentration
TOTAL METALS (mg/kg)								
Silver	2	0	2	1.2	1.5	ND	ND	ND
Antimony	2	0	2	0.3	0.3	ND	ND	ND
Arsenic	2	2	0	NA	NA	7	31	BG2-0
Beryllium	2	0	2	0.6	0.7	ND	ND	ND
Cadmium	2	0	2	0.6	0.7	ND	ND	ND
Chromium	2	2	0	NA	NA	30.9	41.7	BG2-0
Copper	2	2	0	NA	NA	18.5	26.2	BG2-0
Lead	2	2	0	NA	NA	15.7	28.2	BG2-0
Mercury	2	2	0	NA	NA	0.03	0.06	BG2-0
Nickel	2	2	0	NA	NA	22.8	33.7	BG2-0
Selenium	2	1	1	0.6	0.6	0.1	0.1	BG2-0
Silver	2	0	2	1.2	1.5	ND	ND	ND
Thallium	2	1	1	0.2	0.2	0.3	0.3	BG2-0
Zinc	2	2	0	NA	NA	62.4	75.3	BG2-0
PCBs (μg/kg)								
Aroclor 1016	2	0	2	97	119	ND	ND	ND
Aroclor 1221	2	0	2	97	119	ND	ND	ND
Aroclor 1232	2	0	2	97	119	ND	ND	ND
Aroclor 1242	2	0	2	97	119	ND	ND	ND
Aroclor 1248	2	0	2	97	119	ND	ND	ND
Aroclor 1254	2	0	2	193	238	ND	ND	ND
Aroclor 1260	2	0	2	193	238	ND	ND	ND
TPH by 418.1(mg/kg)	2	0	2	121	149	ND	ND	ND

NOTES:

ND - Not detected

NA - Analytes were detected; see data for quantitation limits

TABLE 11-5
COMPARISON OF SOIL DATA TO BACKGROUND CONCENTRATIONS
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Compounds	Background Normal Source Concentration	North Site Maximum Detected Concentrations	South Site Maximum Detected Concentrations
TOTAL METALS (mg/kg)			
Arsenic	31.0	12*	64
Chromium	41.7	58.3	56
Copper	26.2	41.6	323
Lead	28.2	1897	3600
Mercury	0.060	0.16	0.3
Nickel	33.7	37.8	71.9
Selenium	0.100	0.3	0.3
Thallium	0.300	ND	0.3*
Zinc	75.3	222	460

NOTES:

Background normal source concentration is the 95th % upper confidence limit on the arithmetic mean or the maximum detected concentration, whichever is lower.

* - indicates the maximum detected concentration is less than or equal to the background concentratio

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TABLE 11-6

CHEMICALS OF INTEREST
NORTH SITE AND SOUTH SITE SOIL
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Compounds	SOUTH SITE SOIL	NORTH SITE SOIL
TOTAL METALS		
Antimony	X	X
Arsenic	X	X
Beryllium	X	
Cadmium	X	
Chromium	X	X
Copper	X	X
Lead	X	X
Mercury	X	X
Nickel	X	X
Selenium	X	X
Zinc	X	X
PCBs		
Aroclor 1254	X	
Aroclor 1260	X	
SEMIVOLATILES		
2-Methylnaphthalene	X	
Phenanthrene	X	
Di-n-butylphthalate	X	
Butylbenzylphthalate	X	
Di-n-octyl phthalate	X	
TPH	X	X
VOLATILES		
Toluene	X	
Ethylbenzene	X	
Xylene (total)	X	

TABLE 11-7
SUMMARY OF SEDIMENT SAMPLES AND PARAMETERS ANALYZED
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

	Date Sampled	TPH EPA 418.1	Total Metals EPA 6010/7000	PCBs EPA 8080	Semivolatiles EPA 8270	Volatiles EPA 8240
SOUTH SITE						
SED-6	10/7/93	X	X	X	X	X
SED-7	10/7/93	X	X	X	X	X
NORTH SITE						
SED-1	10/7/93	X	X	X	X	X
SED-2	10/7/93	X	X	X	X	X
SED-3	10/7/93	X	X	X	X	X
SED-10 (SED-3DUP)	10/7/93	X	X	X	X	X
SED-4	10/7/93	X	X	X	X	X
SED-5	10/7/93	X	X	X	X	X

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TABLE 11-8
SUMMARY OF DATA
NORTH SITE SEDIMENT
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Compounds	Number of Samples	Number of Detects	Number BDL	Minimum Quantitation Limit	Maximum Quantitation Limit	Minimum Detected Concentration	Maximum Detected Concentration	Location of Maximum Detected Concentration
METALS (mg/kg)								
Antimony	6	0	6	0.2	0.2	ND	ND	ND
Arsenic	6	6	0	NA	NA	2	50	SED-2
Beryllium	6	0	6	0.1	0.6	ND	ND	ND
Cadmium	6	0	6	0.6	0.6	ND	ND	ND
Chromium	6	6	0	NA	NA	19.7	34	SED-1
Copper	6	6	0	NA	NA	10.9	15.7	SED-10
Lead	6	6	0	NA	NA	2.7	8.3	SED-1
Mercury	6	0	6	0.02	0.02	ND	ND	ND
Nickel	6	6	0	NA	NA	17.6	33.5	SED-1
Selenium	6	0	6	0.1	0.1	ND	ND	ND
Silver	6	0	6	1	1.2	ND	ND	ND
Thallium	6	2	4	0.2	0.2	0.2	0.3	SED-4
Zinc	6	6	0	NA	NA	30.2	42.1	SED-2
PCBs (μg/kg)								
Aroclor 1016	6	0	6	85	93	ND	ND	ND
Aroclor 1221	6	0	6	85	93	ND	ND	ND
Aroclor 1232	6	0	6	85	93	ND	ND	ND
Aroclor 1242	6	0	6	85	93	ND	ND	ND
Aroclor 1248	6	0	6	85	93	ND	ND	ND
Aroclor 1254	6	0	6	170	187	ND	ND	ND
Aroclor 1260	6	0	6	170	187	ND	ND	ND
SVOC (μg/kg)								
Phenol	6	0	6	365	3855	ND	ND	ND
bis-(2-Chloroethyl)ether	6	0	6	365	3855	ND	ND	ND
2-Chlorophenol	6	0	6	365	3855	ND	ND	ND
1,3-Dichlorobenzene	6	0	6	365	3855	ND	ND	ND
1,4-Dichlorobenzene	6	0	6	365	3855	ND	ND	ND
Benzyl Alcohol	6	0	6	365	3855	ND	ND	ND
1,2-Dichlorobenzene	6	0	6	365	3855	ND	ND	ND
2-Methylphenol	6	0	6	365	3855	ND	ND	ND
bis(2-Chloroisopropyl)ether	6	0	6	365	3855	ND	ND	ND
4-Methylphenol	6	0	6	365	3855	ND	ND	ND
N-Nitroso-di-n-propylamine	6	0	6	365	3855	ND	ND	ND
Hexachloroethane	6	0	6	365	3855	ND	ND	ND
Nitrobenzene	6	0	6	365	3855	ND	ND	ND
Isophorone	6	0	6	365	3855	ND	ND	ND
2-Nitrophenol	6	0	6	365	3855	ND	ND	ND
2,4-Dimethylphenol	6	0	6	1827	19276	ND	ND	ND
Benzoic Acid	6	0	6	365	3855	ND	ND	ND
bis(2-Chloroethoxy)methane	6	0	6	365	3855	ND	ND	ND
2,4-Dichlorophenol	6	0	6	365	3855	ND	ND	ND
1,2,4-Trichlorobenzene	6	0	6	365	3855	ND	ND	ND
Naphthalene	6	0	6	365	3855	ND	ND	ND
4-Chloroaniline	6	0	6	365	3855	ND	ND	ND
Hexachlorobutadiene	6	0	6	365	3855	ND	ND	ND
4-Chloro-3-methylphenol	6	0	6	365	3855	ND	ND	ND
2-Methylnaphthalene	6	0	6	365	3855	ND	ND	ND
Hexachlorocylopentadiene	6	0	6	365	3855	ND	ND	ND
2,4,6-Trichlorophenol	6	0	6	365	3855	ND	ND	ND
2,4,5-Trichlorophenol	6	0	6	1827	19276	ND	ND	ND
2,Chloronaphthalene	6	0	6	365	3855	ND	ND	ND
2-Nitroaniline	6	0	6	1827	19276	ND	ND	ND
Dimethyl phthalate	6	0	6	365	3855	ND	ND	ND
Acenaphthylene	6	0	6	365	3855	ND	ND	ND

TABLE 11-8 (Continued)
SUMMARY OF DATA
NORTH SITE SEDIMENT
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

REIEC

Compounds	Number of Samples	Number of Detects	Number BDL	Minimum Quantitation Limit	Maximum Quantitation Limit	Minimum Detected Concentration	Maximum Detected Concentration	Location Of Maximum Detected Concentration
2,6-Dinitrotoluene	6	0	6	1827	19276	ND	ND	ND
3-Nitroaniline	6	0	6	1827	19276	ND	ND	ND
2-Methyl-4,6-dinitrophenol	6	0	6	1827	19276	ND	ND	ND
N-nitrosodimethylamine	6	0	6	365	3855	ND	ND	ND
Azobenzene	6	0	6	1827	19276	ND	ND	ND
Acenaphthene	6	0	6	365	3855	ND	ND	ND
2,4-Dinitrophenol	6	0	6	1827	19276	ND	ND	ND
4-Nitrophenol	6	0	6	1827	19276	ND	ND	ND
Dibenzofuran	6	0	6	365	3855	ND	ND	ND
2,4-Dinitrotoluene	6	0	6	365	3855	ND	ND	ND
Diethylphthalate	6	0	6	365	3855	ND	ND	ND
4,Chlorophenyl-phenylether	6	0	6	365	3855	ND	ND	ND
Fluorene	6	0	6	365	3855	ND	ND	ND
4-Nitroaniline	6	0	6	1827	19276	ND	ND	ND
N-Nitrosodiphenylamine(1)	6	0	6	365	3855	ND	ND	ND
4-Bromophenyl-phenylether	6	0	6	365	3855	ND	ND	ND
Hexachlorobenzene	6	0	6	365	3855	ND	ND	ND
Pentachlorophenol	6	0	6	1827	19276	ND	ND	ND
Phenanthrene	6	0	6	365	3855	ND	ND	ND
Anthracene	6	0	6	365	3855	ND	ND	ND
Di-n-butylphthalate	6	0	6	365	3855	ND	ND	ND
Fluoranthene	6	0	6	365	3855	ND	ND	ND
Pyrene	6	0	6	365	3855	ND	ND	ND
Butylbenzylphthalate	6	0	6	365	3855	ND	ND	ND
3,3'-Dichlorobenzidine	6	0	6	731	7710	ND	ND	ND
Benzo(a)anthracene	6	0	6	365	3855	ND	ND	ND
Bis(2-ethylhexyl)phthalate	6	0	6	365	3855	ND	ND	ND
Chrysene	6	0	6	365	3855	ND	ND	ND
Di-n-octyl phthalate	6	0	6	365	3855	ND	ND	ND
Benzo(b)fluoranthene	6	0	6	365	3855	ND	ND	ND
Benzo(k)fluoranthene	6	0	6	365	3855	ND	ND	ND
Benzo(a)pyrene	6	0	6	365	3855	ND	ND	ND
Indeno(1,2,3-cd)pyrene	6	0	6	365	3855	ND	ND	ND
Dibenz(a,h)anthracene	6	0	6	365	3855	ND	ND	ND
Benzo(g,h,i)perylene	6	0	6	365	3855	ND	ND	ND
WTPH by 418.1 (mg/kg)	6	2	4	106	116	990	6,900	SED-4
VOCs (µg/kg)								
Chloromethane	6	0	6	11	58	ND	ND	ND
Bromomethane	6	0	6	11	58	ND	ND	ND
Vinyl Chloride	6	0	6	11	58	ND	ND	ND
Chloroethane	6	0	6	11	58	ND	ND	ND
Methylene Chloride	6	6	0	NA	NA	3 BJ	28 BJ	SED-4
Acrolein	6	0	6	11	58	ND	ND	ND
Acrylonitrile	6	0	6	11	58	ND	ND	ND
Acetone	6	5	1	6	6	5 J	44 B	SED-4
Carbon Disulfide	6	0	6	5	29	ND	ND	ND
1,1-Dichloroethene	6	0	6	5	29	ND	ND	ND
1,1-Dichloroethane	6	0	6	5	29	ND	ND	ND
Total-1,2-Dichloroethene	6	0	6	5	29	ND	ND	ND
Chloroform	6	0	6	5	29	ND	ND	ND
1,2-Dichloroethane	6	0	6	5	29	ND	ND	ND
2-Butanone	6	0	6	11	58	ND	ND	ND
1,1,1-Trichloroethane	6	0	6	5	29	ND	ND	ND
Carbon Tetrachloride	6	0	6	5	29	ND	ND	ND
Vinyl Acetate	6	0	6	11	58	ND	ND	ND

TABLE 11-8 (Continued)
SUMMARY OF DATA
NORTH SITE SEDIMENT
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

RETEC

Compounds	Number of Samples	Number of Detects	Number BDL	Minimum Quantitation Limit	Maximum Quantitation Limit	Minimum Detected Concentration	Maximum Detected Concentration	Location Of Maximum Detected Concentration
Bromodichloromethane	6	0	6	5	29	ND	ND	ND
1,2-Dichloropropane	6	0	6	5	29	ND	ND	ND
cis-1,3-Dichloropropene	6	0	6	5	29	ND	ND	ND
Trichloroethene	6	0	6	5	29	ND	ND	ND
Dibromochloromethane	6	0	6	5	29	ND	ND	ND
1,1,2-Trichloroethane	6	0	6	5	29	ND	ND	ND
Benzene	6	0	6	5	29	ND	ND	ND
trans-1,3-dichloropropene	6	0	6	5	29	ND	ND	ND
2-chloroethylvinylether	6	0	6	5	29	ND	ND	ND
Bromoform	6	0	6	5	29	ND	ND	ND
4-Methyl-2-Pentanone	6	0	6	11	58	ND	ND	ND
2-Hexanone	6	2	4	11	12	20	320	SED-4
Tetrachloroethene	6	0	6	5	29	ND	ND	ND
1,1,2,2-Tetrachloroethane	6	0	6	5	29	ND	ND	ND
Toluene	6	0	6	5	29	ND	ND	ND
Chlorobenzene	6	0	6	5	29	ND	ND	ND
Ethylbenzene	6	0	6	5	29	ND	ND	ND
Styrene	6	0	6	5	29	ND	ND	ND
Xylene (total)	6	0	6	5	29	ND	ND	ND

NOTES:

ND - Not detected

NA - Analytes were detected; see data for quantitation limits

TABLE 11-9
SUMMARY OF DATA
SOUTH SITE SEDIMENT
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

RETEC

Compounds	Number of Samples	Number of Detects	Number BDL	Minimum Quantitation Limit	Maximum Quantitation Limit	Minimum Detected Concentration	Maximum Detected Concentration	Location Of Maximum Detected Concentration
METALS (mg/kg)								
Antimony	2	0	2	0.2	0.2	ND	ND	ND
Arsenic	2	2	0	NA	NA	8	20	SED-7
Beryllium	2	0	2	0.7	1.5	ND	ND	ND
Cadmium	2	0	2	0.7	1.5	ND	ND	ND
Chromium	2	2	0	NA	NA	24.3	30.1	SED-6
Copper	2	2	0	NA	NA	34.6	36.4	SED-6
Lead	2	2	0	NA	NA	26.8	64.1	SED-7
Mercury	2	2	0	NA	NA	0.04	0.05	SED-6
Nickel	2	2	0	NA	NA	24	39.9	SED-6
Selenium	2	1	1	0.1	0.1	0.1	0.1	SED-7
Silver	2	0	2	1.4	3	ND	ND	ND
Thallium	2	0	2	0.3	0.3	ND	ND	ND
Zinc	2	2	0	NA	NA	105	150	SED-7
PCBs (μg/kg)								
Aroclor 1016	2	0	2	114	116	ND	ND	ND
Aroclor 1221	2	0	2	114	116	ND	ND	ND
Aroclor 1232	2	0	2	114	116	ND	ND	ND
Aroclor 1242	2	0	2	114	116	ND	ND	ND
Aroclor 1248	2	0	2	114	116	ND	ND	ND
Aroclor 1254	2	0	2	229	232	ND	ND	ND
Aroclor 1260	2	0	2	229	232	ND	ND	ND
SVOC (μg/kg)								
Phenol	2	0	2	1910	9442	ND	ND	ND
bis-(2-Chloroethyl)ether	2	0	2	1910	9442	ND	ND	ND
2-Chlorophenol	2	0	2	1910	9442	ND	ND	ND
1,3-Dichlorobenzene	2	0	2	1910	9442	ND	ND	ND
1,4-Dichlorobenzene	2	0	2	1910	9442	ND	ND	ND
Benzyl Alcohol	2	0	2	1910	9442	ND	ND	ND
1,2-Dichlorobenzene	2	0	2	1910	9442	ND	ND	ND
2-Methylphenol	2	0	2	1910	9442	ND	ND	ND
bis(2-Chloroisopropyl)ether	2	0	2	1910	9442	ND	ND	ND
4-Methylphenol	2	0	2	1910	9442	ND	ND	ND
N-Nitroso-di-n-propylamine	2	0	2	1910	9442	ND	ND	ND
Hexachloroethane	2	0	2	1910	9442	ND	ND	ND
Nitrobenzene	2	0	2	1910	9442	ND	ND	ND
Isophorone	2	0	2	1910	9442	ND	ND	ND
2-Nitrophenol	2	0	2	1910	9442	ND	ND	ND
2,4-Dimethylphenol	2	0	2	9551	47210	ND	ND	ND
Benzoic Acid	2	0	2	1910	9442	ND	ND	ND
bis(2-Chloroethoxy)methane	2	0	2	1910	9442	ND	ND	ND
2,4-Dichlorophenol	2	0	2	1910	9442	ND	ND	ND
1,2,4-Trichlorobenzene	2	0	2	1910	9442	ND	ND	ND
Naphthalene	2	0	2	1910	9442	ND	ND	ND
4-Chloroaniline	2	0	2	1910	9442	ND	ND	ND
Hexachlorobutadiene	2	0	2	1910	9442	ND	ND	ND
4-Chloro-3-methylphenol	2	0	2	1910	9442	ND	ND	ND
2-Methylnaphthalene	2	0	2	1910	9442	ND	ND	ND
Hexachlorocylopentadiene	2	0	2	1910	9442	ND	ND	ND
2,4,6-Trichlorophenol	2	0	2	1910	9442	ND	ND	ND
2,4,5-Trichlorophenol	2	0	2	9551	47210	ND	ND	ND
2,Chloronaphthalene	2	0	2	1910	9442	ND	ND	ND
2-Nitroaniline	2	0	2	9551	47210	ND	ND	ND
Dimethyl phthalate	2	0	2	1910	9442	ND	ND	ND
Acenaphthylene	2	0	2	1910	9442	ND	ND	ND
2,6-Dinitrotoluene	2	0	2	9551	47210	ND	ND	ND
3-Nitroaniline	2	0	2	9551	47210	ND	ND	ND
2-Methyl-4,6-dinitrophenol	2	0	2	9551	47210	ND	ND	ND

TABLE 11-9 (Continued)
SUMMARY OF DATA
SOUTH SITE SEDIMENT
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

RETEC

Compounds	Number of Samples	Number of Detects	Number BDL	Minimum Quantitation Limit	Maximum Quantitation Limit	Minimum Detected Concentration	Maximum Detected Concentration	Location Of Maximum Detected Concentration
N-nitrosodimethylamine	2	0	2	1910	9442	ND	ND	ND
Azobenzene	2	0	2	9551	47210	ND	ND	ND
Acenaphthene	2	0	2	1910	9442	ND	ND	ND
2,4-Dinitrophenol	2	0	2	9551	47210	ND	ND	ND
4-Nitrophenol	2	0	2	9551	47210	ND	ND	ND
Dibenzofuran	2	0	2	1910	9442	ND	ND	ND
2,4-Dinitrotoluene	2	0	2	1910	9442	ND	ND	ND
Diethylphthalate	2	0	2	1910	9442	ND	ND	ND
4,Chlorophenyl-phenylether	2	0	2	1910	9442	ND	ND	ND
Fluorene	2	0	2	1910	9442	ND	ND	ND
4-Nitroaniline	2	0	2	9551	47210	ND	ND	ND
N-Nitrosodiphenylamine(1)	2	0	2	1910	9442	ND	ND	ND
4-Bromophenyl-phenylether	2	0	2	1910	9442	ND	ND	ND
Hexachlorobenzene	2	0	2	1910	9442	ND	ND	ND
Pentachlorophenol	2	0	2	9551	47210	ND	ND	ND
Phenanthrene	2	0	2	1910	9442	ND	ND	ND
Anthracene	2	0	2	1910	9442	ND	ND	ND
Di-n-butylphthalate	2	0	2	1910	9442	ND	ND	ND
Fluoranthene	2	0	2	1910	9442	ND	ND	ND
Pyrene	2	0	2	1910	9442	ND	ND	ND
Butylbenzylphthalate	2	0	2	1910	9442	ND	ND	ND
3,3'-Dichlorobenzidine	2	0	2	3821	18884	ND	ND	ND
Benzo(a)anthracene	2	0	2	1910	9442	ND	ND	ND
Bis(2-ethylhexyl)phthalate	2	0	2	1910	9442	ND	ND	ND
Chrysene	2	0	2	1910	9442	ND	ND	ND
Di-n-octyl phthalate	2	0	2	1910	9442	ND	ND	ND
Benzo(b)fluoranthene	2	0	2	1910	9442	ND	ND	ND
Benzo(k)fluoranthene	2	0	2	1910	9442	ND	ND	ND
Benzo(a)pyrene	2	0	2	1910	9442	ND	ND	ND
Indeno(1,2,3-cd)pyrene	2	0	2	1910	9442	ND	ND	ND
Dibenz(a,h)anthracene	2	0	2	1910	9442	ND	ND	ND
Benzo(g,h,i)perylene	2	0	2	1910	9442	ND	ND	ND
WTPH by 418.1 (mg/kg)	2	2	0	NA	NA	97 J	99 J	SED-7
VOCs (μg/kg)								
Chloromethane	2	0	2	14	14	ND	ND	ND
Bromomethane	2	0	2	14	14	ND	ND	ND
Vinyl Chloride	2	0	2	14	14	ND	ND	ND
Chloroethane	2	0	2	14	14	ND	ND	ND
Methylene Chloride	2	2	0	NA	NA	6 BJ	6 BJ	SED-6
Acrolein	2	0	2	14	14	ND	ND	ND
Acrylonitrile	2	0	2	14	14	ND	ND	ND
Acetone	2	1	1	7	7	9 B	9 B	SED-6
Carbon Disulfide	2	0	2	7	7	ND	ND	ND
1,1-Dichloroethene	2	0	2	7	7	ND	ND	ND
1,1-Dichloroethane	2	0	2	7	7	ND	ND	ND
Total-1,2-Dichloroethene	2	0	2	7	7	ND	ND	ND
Chloroform	2	0	2	7	7	ND	ND	ND
1,2-Dichloroethane	2	0	2	7	7	ND	ND	ND
2-Butanone	2	0	2	14	14	ND	ND	ND
1,1,1-Trichloroethane	2	0	2	7	7	ND	ND	ND
Carbon Tetrachloride	2	0	2	7	7	ND	ND	ND
Vinyl Acetate	2	0	2	14	14	ND	ND	ND
Bromodichloromethane	2	0	2	7	7	ND	ND	ND
1,2-Dichloropropane	2	0	2	7	7	ND	ND	ND
cis-1,3-Dichloropropene	2	0	2	7	7	ND	ND	ND
Trichloroethene	2	0	2	7	7	ND	ND	ND
Dibromochloromethane	2	0	2	7	7	ND	ND	ND
1,1,2-Trichloroethane	2	0	2	7	7	ND	ND	ND

TABLE 11-9 (Continued)
SUMMARY OF DATA
SOUTH SITE SEDIMENT
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Compounds	Number of Samples	Number of Detects	Number BDL	Minimum Quantitation Limit	Maximum Quantitation Limit	Minimum Detected Concentration	Maximum Detected Concentration	Location Of Maximum Detected Concentration
Benzene	2	0	2	7	7	ND	ND	ND
trans-1,3-dichloropropene	2	0	2	7	7	ND	ND	ND
2-chloroethylvinylether	2	0	2	7	7	ND	ND	ND
Bromoform	2	0	2	7	7	ND	ND	ND
4-Methyl-2-Pentanone	2	0	2	14	14	ND	ND	ND
2-Hexanone	2	0	2	14	14	ND	ND	ND
Tetrachloroethene	2	0	2	7	7	ND	ND	ND
1,1,2,2-Tetrachloroethane	2	0	2	7	7	ND	ND	ND
Toluene	2	0	2	7	7	ND	ND	ND
Chlorobenzene	2	0	2	7	7	ND	ND	ND
Ethylbenzene	2	0	2	7	7	ND	ND	ND
Styrene	2	0	2	7	7	ND	ND	ND
Xylene (total)	2	0	2	7	7	ND	ND	ND

NOTES:

ND - Not detected
NA - Analytes were detected; see data for quantitation limits

TABLE 11-10

CHEMICALS OF INTEREST
NORTH SITE AND SOUTH SITE SEDIMENT
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Compounds	SOUTH SITE SEDIMENT	NORTH SITE SEDIMENT
TOTAL METALS		
Arsenic	X	X
Chromium	X	X
Copper	X	X
Lead	X	X
Mercury	X	
Nickel	X	X
Selenium	X	
Thallium		X
Zinc	X	X
TPH	X	X

* PAHs addressed per request of Ecology although not detected in sediment samples.

TABLE 11-11
SUMMARY OF GROUNDWATER SAMPLES AND PARAMETERS ANALYZED
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Monitoring Well	Date Sampled	TPH as Diesel EPA 8015 mod.	TPH EPA 418.1	Dissolved Metals EPA 6010/7000	Total Metals EPA 6010/7000	PCBs EPA 8080	Volatiles EPA 8240 EPA 8020*	Semivolatiles EPA 8270 EPA 8310**
MW-01	11/8/93	X						
MW-01	4/6/94	X						
MW-01	8/2/94	X						
MW-01	11/9/94	X						
MW-02	11/3/93	X		X	X			X
MW-02	4/6/94							
MW-02	8/3/94			X				
MW-02	11/9/94			X				
MW-03	11/05/93	X			X		X	X
MW-03	8/3/94	X						
MW-03	11/9/94	X						
MW-04	11/05/93	X			X	X	X	X
MW-04	4/6/94	X			X	X	X	X
MW-04	8/3/94	X						
MW-04	11/9/94	X						
MW-05	11/05/93	X						
MW-05	4/7/94	X		X	X			X
MW-05	8/2/94	X		X				
MW-05	11/8/94	X		X				
MW-07	11/02/93	X			X	X		X
MW-07	4/5/94						BTEX	
MW-9	11/05/93	X				X	X	X
MW-9	4/5/94			X	X	X		PAH
MW-9	8/2/94			X		X		PAH
MW-9	11/8/94	X		X				
MW-10	11/08/93	X			X			X
MW-10	4/5/94						BTEX	
MW-11	11/09/93	X			X		X	
MW-11	4/6/94						BTEX	X
MW-11	8/2/94							PAH
MW-11	11/8/94	X						
MW-12	11/02/93	X			X	X	X	X - PAH
MW-12	4/6/94							PAH
MW-12	8/2/94							PAH
MW-13	11/04/93	X						
MW-13	4/5/94	X						
MW-13	8/3/94	X						
MW-13	11/9/94	X						
MW-14	11/08/93	X			X	X	X	X
MW-14	4/6/94	X						
MW-15	11/08/93	X			X			
MW-16	11/08/93	X		X		X		
MW-16	4/6/94			X	X			
MW-16	8/3/94			X				
MW-18	11/08/93	X						
MW-19	11/04/93	X			X	X	X	X
MW-19	4/5/94	X				X		
MW-19	8/2/94	X				X		

TABLE 11-11 (Continued)
SUMMARY OF GROUNDWATER SAMPLES AND PARAMETERS ANALYZED
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Monitoring Well	Date Sampled	TPH as Diesel EPA 8015 mod.	TPH EPA 418.1	Dissolved Metals EPA 6010/7000	Total Metals EPA 6010/7000	PCBs EPA 8080	Volatiles EPA 8240 EPA 8020*	Semivolatiles EPA 8270 EPA 8310**
MW-23	11/04/93	X			X		X	X
MW-23	4/5/94	X		X	X		BTEX	PAH
MW-23	8/2/94	X		X				PAH
MW-23	11/8/94			X				
MW-24	11/09/93	X						
MW-28	11/03/93	X			X			X
MW-28	4/5/94	X						X
MW-28	8/2/94	X						PAH
MW-29	11/03/93	X						
MW-30	11/04/93	X						
MW-31	11/04/93	X			X	X	X	X
MW-31	4/6/94			X	X			
MW-31	8/3/94			X				
MW-31	11/9/94			X				
MW-32	11/04/93	X				X		
MW-32	4/5/94					X		
MW-33	11/03/93	X						
MW-34	11/03/93	X						
MW-34	4/6/94	X					X	
MW-34	8/3/94	X						
MW-35	11/03/93	X		X	X		X	X
MW-35	4/6/94	X						
MW-35	8/3/94	X		X				
MW-35	11/8/94	X		X				
MW-36	11/09/93	X					X	
MW-36	4/5/94	X		X	X		BTEX	PAH
MW-36	8/2/94	X		X				PAH
MW-37	11/09/93	X					X	
MW-37	4/5/94	X		X	X		BTEX	PAH
MW-37	8/2/94	X		X				PAH
MW-37	11/8/94	X		X				
MW-38	11/04/93	X						X
MW-38	4/6/94	X		X	X			
MW-38	8/3/94	X		X				
MW-38	11/8/94	X		X				
MW-40	11/09/93	X				X		X
MW-40	4/7/94	X		X	X			
MW-40	8/4/94	X		X				
MW-40	11/9/94	X		X				
DW-1	11/08/93	X						X
DW-1	4/6/94	X						
DW-1	8/4/94	X						
DW-2	11/02/93	X			X	X		X
DW-2	4/7/94	X		X	X			
DW-2	8/4/94	X		X				
DW-2	11/9/94			X				
DW-3	11/08/93	X				X		X
DW-3	4/7/94			X	X			
DW-3	8/4/94			X				
DW-3	11/9/94			X				

TABLE 11-11 (Continued)
SUMMARY OF GROUNDWATER SAMPLES AND PARAMETERS ANALYZED
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Monitoring Well	Date Sampled	TPH as Diesel EPA 8015 mod.	TPH EPA 418.1	Dissolved Metals EPA 6010/7000	Total Metals EPA 6010/7000	PCBs EPA 8080	Volatiles EPA 8240 EPA 8020*	Semivolatiles EPA 8270 EPA 8310**
DW-4	11/9/93	X			X			X
DW-4	4/7/94	X						
DW-4	8/4/94	X						
DW-5	11/9/93	X						X
DW-5	4/7/94	X						
DW-5	8/4/94	X						

NOTES:

* - EPA 8020 is the analytical method for BTEX (Benzene/Toluene/Ethylbenzene/Xylene)
* - EPA 8310 is the analytical method for PAH compounds (Polycyclic Aromatic Hydrocarbons)

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TABLE 11-12
SUMMARY OF DATA
GROUNDWATER
BNRR MAINTENANCE AND FUELING FACILITY SITE
SKYKOMISH, WASHINGTON

Compounds	Number of Samples	Number of Detects	Number BDL	Minimum Quantitation Limit	Maximum Quantitation Limit	Minimum Detected Concentration	Maximum Detected Concentration	Location Of Maximum Detected Concentration
DISSOLVED METALS (mg/L)								
Arsenic	38	15	23	0.001	0.01	0.001	0.011	MW-36
Chromium	38	1	37	0.001	0.01	0.01 B	0.01 B	MW-16
Lead	37	2	35	0.001	0.001	0.002	0.003	MW-40
TOTAL METALS (mg/L)								
Antimony	16	5	11	0.001	0.01	0.001	0.02	MW-28
Arsenic	29	27	2	0.001	0.001	0.001	0.54	MW-02
Beryllium	16	0	16	0.005	0.1	ND	ND	ND
Cadmium	16	3	13	0.0001	0.002	0.0002	0.0003	MW-35
Chromium	29	17	12	0.01	0.2	0.02	0.4	DW-2
Copper	16	10	6	0.01	0.05	0.01	0.32	DW-2
Lead	29	23	6	0.001	0.02	0.001	0.15	MW-40
Mercury	16	4	12	0.0002	0.0002	0.0002	0.0007	DW-2
Nickel	16	5	11	0.02	0.4	0.02	0.37	DW-2
Selenium	16	1	15	0.001	0.02	0.002	0.002	MW-02
Silver	16	0	16	0.01	0.2	ND	ND	ND
Thallium	16	0	16	0.002	0.04	ND	ND	ND
Zinc	16	9	7	0.01	0.2	0.01	0.52	DW-2
PCBs (μg/L)								
Aroclor 1016	16	0	16	0.05	0.5	ND	ND	ND
Aroclor 1221	16	0	16	0.05	0.5	ND	ND	ND
Aroclor 1232	16	0	16	0.05	0.5	ND	ND	ND
Aroclor 1242	16	0	16	0.05	0.5	ND	ND	ND
Aroclor 1248	16	0	16	0.05	0.5	ND	ND	ND
Aroclor 1254	16	0	16	0.05	1	ND	ND	ND
Aroclor 1260	16	0	16	0.05	1	ND	ND	ND
SEMIVOLATILES (μg/L)								
Phenol	23	0	23	5	50	ND	ND	ND
bis-(2-Chloroethyl)ether	23	0	23	5	50	ND	ND	ND
2-Chlorophenol	23	0	23	5	50	ND	ND	ND
1,3-Dichlorobenzene	23	0	23	5	50	ND	ND	ND
1,4-Dichlorobenzene	23	0	23	5	50	ND	ND	ND
Benzyl Alcohol	23	0	23	5	50	ND	ND	ND
1,2-Dichlorobenzene	23	0	23	5	50	ND	ND	ND
2-Methylphenol	23	0	23	5	50	ND	ND	ND
bis(2-Chloroisopropyl) ether	23	0	23	5	50	ND	ND	ND
4-Methylphenol	23	0	23	5	50	ND	ND	ND
N-Nitroso-di-n-propylamine	23	0	23	5	50	ND	ND	ND
Hexachloroethane	23	0	23	5	50	ND	ND	ND
Nitrobenzene	23	0	23	5	50	ND	ND	ND
Isophorone	23	0	23	5	50	ND	ND	ND
2-Nitrophenol	23	0	23	5	50	ND	ND	ND
2,4-Dimethylphenol	23	0	23	25	250	ND	ND	ND
Benzoic Acid	23	0	23	5	50	ND	ND	ND
bis(2-Chloroethoxy)methane	23	0	23	5	50	ND	ND	ND
2,4-Dichlorophenol	23	0	23	5	50	ND	ND	ND
1,2,4-Trichlorobenzene	23	0	23	5	50	ND	ND	ND
Naphthalene	37	1	36	1.8	50	32	32	MW-11
4-Chloroaniline	23	0	23	5	50	ND	ND	ND
Hexachlorobutadiene	23	0	23	5	50	ND	ND	ND
4-Chloro-3-methylphenol	23	0	23	5	50	ND	ND	ND
2-Methylnaphthalene	24	1	23	5	50	200	200	MW-11
Hexachlorocylopentadiene	23	0	23	5	50	ND	ND	ND
2,4,6-Trichlorophenol	23	0	23	5	50	ND	ND	ND
2,4,5-Trichlorophenol	23	0	23	25	250	ND	ND	ND

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TABLE 11-12 (Continued)
SUMMARY OF DATA
GROUNDWATER
BNRR MAINTENANCE AND FUELING FACILITY SITE
SKYKOMISH, WASHINGTON

Compounds	Number of Samples	Number of Detects	Number BDL	Minimum Quantitation Limit	Maximum Quantitation Limit	Minimum Detected Concentration	Maximum Detected Concentration	Location Of Maximum Detected Concentration
2-Chloronaphthalene	23	0	23	5	50	ND	ND	ND
2-Nitroaniline	23	0	23	25	250	ND	ND	ND
Dimethyl phthalate	23	0	23	5	50	ND	ND	ND
Acenaphthylene	37	0	37	2.3	50	ND	ND	ND
2,6-Dinitrotoluene	23	0	23	25	250	ND	ND	ND
3-Nitroaniline	23	0	23	25	250	ND	ND	ND
N-nitrosodimethylamine	23	0	23	5	50	ND	ND	ND
Acenaphthene	37	2	35	1.8	50	1.3 J	28	MW-11
2,4-Dinitrophenol	23	0	23	25	250	ND	ND	ND
4-Nitrophenol	23	0	23	25	250	ND	ND	ND
Dibenzofuran	24	1	23	5	50	19	19	MW-11
2,4-Dinitrotoluene	23	0	23	5	50	ND	ND	ND
Diethylphthalate	23	0	23	5	50	ND	ND	ND
4-Chlorophenyl-phenylether	23	0	23	5	50	ND	ND	ND
Fluorene	36	5	31	0.21	50	0.2 J	48	MW-11
4-Nitroaniline	23	0	23	25	250	ND	ND	ND
4,6-Dinitro-2-methylphenol	23	0	23	25	250	ND	ND	ND
N-Nitrosodiphenylamine(1)	23	0	23	5	50	ND	ND	ND
4-Bromophenyl-phenylether	23	0	23	5	50	ND	ND	ND
Hexachlorobenzene	23	0	23	5	50	ND	ND	ND
Pentachlorophenol	23	0	23	25	250	ND	ND	ND
Phenanthrene	37	2	35	0.64	50	0.4 J	110	MW-11
Anthracene	37	6	31	0.66	50	0.5 J	9.2	MW-11
Di-n-butylphthalate	23	0	23	5	50	ND	ND	ND
Fluoranthene	37	6	31	0.21	50	0.15 J	52 J	MW-11
Pyrene	37	1	36	0.27	50	3.9	3.9	MW-11
Butylbenzylphthalate	23	0	23	5	50	ND	ND	ND
3,3'-Dichlorobenzidine	23	0	23	20	100	ND	ND	ND
Benzo(a)anthracene	37	7	30	0.02	50	0.1	3	MW-9
Bis(2-ethylhexyl)phthalate	23	1	22	5	50	3 J	3 J	MW-07
Chrysene	37	1	36	0.15	50	2	2	MW-9
Di-n-octyl phthalate	23	1	22	5	50	3 J	3 J	MW-07
Benzo(b)fluoranthene	37	0	37	0.02	50	ND	ND	ND
Benzo(k)fluoranthene	37	0	37	0.02	50	ND	ND	ND
Benzo(a)pyrene	37	0	37	0.03	50	ND	ND	ND
Indeno(1,2,3-cd)pyrene	37	1	36	0.05	50	0.2	0.2	MW-12
Dibenz(a,h)anthracene	37	1	36	0.03	50	0.08	0.08	MW-12
Benzo(g,h,i)perylene	37	0	37	0.08	50	ND	ND	ND
Azobenzene	22	0	22	25	250	ND	ND	ND
WTPH as Diesel (mg/L)	83	37	46	0.02	0.3	0.09 J	37	MW-11
VOLATILES (μg/L)								
Chloromethane	13	1	12	10	10	2 J	2 J	MW-37
Bromomethane	13	0	13	10	10	ND	ND	ND
Vinyl Chloride	13	0	13	10	10	ND	ND	ND
Chloroethane	13	0	13	10	10	ND	ND	ND
Methylene Chloride	13	13	0	NA	NA	1 BJ	12 B	MW-11
Acrolein	13	0	13	10	10	ND	ND	ND
Acrylonitrile	13	0	13	10	10	ND	ND	ND
Acetone	13	9	4	5	5	4 BJ	10	MW-03
Carbon Disulfide	13	0	13	5	5	ND	ND	ND
1,1-Dichloroethene	13	1	12	5	5	1 J	1 J	MW-11
1,1-Dichloroethane	13	0	13	5	5	ND	ND	ND
Total-1,2-Dichloroethene	13	0	13	5	5	ND	ND	ND
Chloroform	13	1	12	5	5	6 B	6 B	MW-34
1,2-Dichloroethane	13	0	13	5	5	ND	ND	ND

TABLE 11-12 (Continued)
SUMMARY OF DATA
GROUNDWATER
BNRR MAINTENANCE AND FUELING FACILITY SITE
SKYKOMISH, WASHINGTON

RETEC

Compounds	Number of Samples	Number of Detects	Number BDL	Minimum Quantitation Limit	Maximum Quantitation Limit	Minimum Detected Concentration	Maximum Detected Concentration	Location Of Maximum Detected Concentration
2-Butanone	13	0	13	10	10	ND	ND	ND
1,1,1-Trichloroethane	13	0	13	5	5	ND	ND	ND
Carbon Tetrachloride	13	0	13	5	5	ND	ND	ND
Vinyl Acetate	13	0	13	10	10	ND	ND	ND
Bromodichloromethane	13	0	13	5	5	ND	ND	ND
1,2-Dichloropropane	13	0	13	5	5	ND	ND	ND
cis-1,3-Dichloropropene	13	0	13	5	5	ND	ND	ND
Trichloroethene	13	0	13	5	5	ND	ND	ND
Dibromochloromethane	13	0	13	5	5	ND	ND	ND
1,1,2-Trichloroethane	13	0	13	5	5	ND	ND	ND
Benzene	20	2	18	0.5	5	0.4 J	1 J	MW-11
trans-1,3-dichloropropene	13	0	13	5	5	ND	ND	ND
2-chloroethylvinylether	13	0	13	5	5	ND	ND	ND
Bromoform	13	0	13	5	5	ND	ND	ND
4-Methyl-2-Pentanone	13	0	13	10	10	ND	ND	ND
2-Hexanone	13	0	13	10	10	ND	ND	ND
Tetrachloroethene	13	0	13	5	5	ND	ND	ND
1,1,2,2-Tetrachloroethane	13	0	13	5	5	ND	ND	ND
Toluene	20	4	16	1	5	1 J	2	MW-37
Chlorobenzene	13	0	13	5	5	ND	ND	ND
Ethylbenzene	20	2	18	1	5	1 J	5	MW-11
Styrene	13	0	13	5	5	ND	ND	ND
Xylene (total)	20	4	16	1	5	1 J	22	MW-11

NOTES:

ND - Not detected
NA - analytes were detected; see data for quantitation limits

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TABLE 11-13

CHEMICALS OF INTEREST
GROUNDWATER
BNRR MAINTENANCE AND FUELING FACILITY SITE
SKYKOMISH, WASHINGTON

Compounds	GROUNDWATER
DISSOLVED METALS	
Arsenic	X
Chromium	X
Lead	X
VOLATILES	
1, 1-Dichloroethene	X
SEMIVOLATILES	
Fluorene	X
Anthracene	X
Fluoranthene	X
Benz(a)anthracene	X
Chrysene	X
TOTAL METALS	
Antimony	X
Arsenic	X
Cadmium	X
Chromium	X
Copper	X
Lead	X
Mercury	X
Nickel	X
Selenium	X
Zinc	X
TPH	X

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TABLE 11-14
SUMMARY OF SURFACE WATER SAMPLES AND PARAMETERS ANALYZED
BNRR FORMER MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

	Date Sampled	TPH EPA 418.1	TPH as Diesel EPA 8015 mod.	Dissolved Metals EPA 6010/7000	Total Metals EPA 6010/7000	Semivolatiles EPA 8270/8310
SW-1	11/5/93	X			X	X
SW-2	11/5/93	X			X	X
SW-3	11/5/93	X			X	X
SW-3	4/7/94			X	X	
SW-3	8/3/94		X		X	
SW-4	11/5/93	X			X	X
SW-5	11/5/93	X			X	X
SW-5	4/6/94			X	X	PAH
SW-5	8/2/94		X		X	PAH
SW-5	11/8/94		X			
SW-6	11/5/93	X			X	PAH
SW-6	4/7/94			X	X	
SW-6	8/2/94		X		X	
SW-6	11/9/94	X			X	
SW-7	4/7/94			X	X	
SW-7	11/9/94	X				

NOTES:

* - EPA 8310 is the analytical method for PAH compounds (Polycyclic Aromatic Hydrocarbons).

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TABLE 11-15
SUMMARY OF DATA
SURFACE WATER
BNRR FORMER MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Compounds	Number of Samples	Number of Detects	Number BDL	Minimum Quantitation Limit	Maximum Quantitation Limit	Minimum Detected Concentration	Maximum Detected Concentration	Location Of Maximum Detected Concentration
DISSOLVED METALS (mg/L)								
Arsenic	4	0	4	0.001	0.001	ND	ND	ND
Chromium	4	0	4	0.01	0.01	ND	ND	ND
Lead	4	0	4	0.001	0.001	ND	ND	ND
TOTAL METALS (mg/L)								
Antimony	6	0	6	0.001	0.001	ND	ND	ND
Arsenic	13	0	13	0.001	0.001	ND	ND	ND
Beryllium	6	0	6	0.005	0.005	ND	ND	ND
Cadmium	6	0	6	0.0001	0.0001	ND	ND	ND
Chromium	13	0	13	0.01	0.01	ND	ND	ND
Copper	6	0	6	0.01	0.01	ND	ND	ND
Lead	13	0	13	0.001	0.001	ND	ND	ND
Mercury	6	0	6	0.0002	0.0002	ND	ND	ND
Nickel	6	0	6	0.02	0.02	ND	ND	ND
Selenium	6	0	6	0.001	0.001	ND	ND	ND
Silver	6	0	6	0.01	0.01	ND	ND	ND
Thallium	6	0	6	0.002	0.002	ND	ND	ND
Zinc	6	0	6	0.01	0.01	ND	ND	ND
SEMIVOLATILES (μg/L)								
Phenol	6	0	6	10	10	ND	ND	ND
bis-(2-Chloroethyl)ether	6	0	6	10	10	ND	ND	ND
2-Chlorophenol	6	0	6	10	10	ND	ND	ND
1,3-Dichlorobenzene	6	0	6	10	10	ND	ND	ND
1,4-Dichlorobenzene	6	0	6	10	10	ND	ND	ND
Benzyl Alcohol	6	0	6	10	10	ND	ND	ND
1,2-Dichlorobenzene	6	0	6	10	10	ND	ND	ND
2-Methylphenol	6	0	6	10	10	ND	ND	ND
bis(2-Chloroisopropyl) ether	6	0	6	10	10	ND	ND	ND
4-Methylphenol	6	0	6	10	10	ND	ND	ND
N-Nitroso-di-n-propylamine	6	0	6	10	10	ND	ND	ND
Hexachloroethane	6	0	6	10	10	ND	ND	ND
Nitrobenzene	6	0	6	10	10	ND	ND	ND
Isophorone	6	0	6	10	10	ND	ND	ND
2-Nitrophenol	6	0	6	10	10	ND	ND	ND
2,4-Dimethylphenol	6	0	6	50	50	ND	ND	ND
Benzoic Acid	6	0	6	10	10	ND	ND	ND
bis(2-Chloroethoxy)methane	6	0	6	10	10	ND	ND	ND
2,4-Dichlorophenol	6	0	6	10	10	ND	ND	ND
1,2,4-Trichlorobenzene	6	0	6	10	10	ND	ND	ND
Naphthalene	8	0	8	1.8	10	ND	ND	ND
4-Chloroaniline	6	0	6	10	10	ND	ND	ND
Hexachlorobutadiene	6	0	6	10	10	ND	ND	ND
4-Chloro-3-methylphenol	6	0	6	10	10	ND	ND	ND
2-Methylnaphthalene	6	0	6	10	10	ND	ND	ND
Hexachlorocylopentadiene	6	0	6	10	10	ND	ND	ND
2,4,6-Trichlorophenol	6	0	6	10	10	ND	ND	ND
2,4,5-Trichlorophenol	6	0	6	50	50	ND	ND	ND
2-Chloronaphthalene	6	0	6	10	10	ND	ND	ND
2-Nitroaniline	6	0	6	50	50	ND	ND	ND
Dimethyl phthalate	6	0	6	10	10	ND	ND	ND
Acenaphthylene	8	0	8	2.3	10	ND	ND	ND
2,6-Dinitrotoluene	6	0	6	50	50	ND	ND	ND
3-Nitroaniline	6	0	6	50	50	ND	ND	ND

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TABLE 11-15 (Continued)
SUMMARY OF DATA
SURFACE WATER
BNRR FORMER MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Compounds	Number of Samples	Number of Detects	Number BDL	Minimum Quantitation Limit	Maximum Quantitation Limit	Minimum Detected Concentration	Maximum Detected Concentration	Location Of Maximum Detected Concentration
N-nitrosodimethylamine	6	0	6	10	10	ND	ND	ND
Acenaphthene	6	0	6	10	10	ND	ND	ND
2,4-Dinitrophenol	6	0	6	50	50	ND	ND	ND
4-Nitrophenol	6	0	6	50	50	ND	ND	ND
Dibenzofuran	6	0	6	10	10	ND	ND	ND
2,4-Dinitrotoluene	6	0	6	10	10	ND	ND	ND
Diethylphthalate	6	0	6	10	10	ND	ND	ND
4-Chlorophenyl-phenylether	6	0	6	10	10	ND	ND	ND
Fluorene	8	0	8	0.21	10	ND	ND	ND
4-Nitroaniline	6	0	6	50	50	ND	ND	ND
4,6-Dinitro-2-methylphenol	6	0	6	50	50	ND	ND	ND
N-Nitrosodiphenylamine(1)	6	0	6	10	10	ND	ND	ND
4-Bromophenyl-phenylether	6	0	6	10	10	ND	ND	ND
Hexachlorobenzene	6	0	6	10	10	ND	ND	ND
Pentachlorophenol	6	0	6	50	50	ND	ND	ND
Phenanthrene	8	0	8	0.64	10	ND	ND	ND
Anthracene	8	0	8	0.66	10	ND	ND	ND
Di-n-butylphthalate	6	0	6	10	10	ND	ND	ND
Fluoranthene	8	1	7	0.21	10	0.4	0.4	SW-5
Pyrene	8	0	8	0.27	10	ND	ND	ND
Butylbenzylphthalate	6	0	6	10	10	ND	ND	ND
3,3'-Dichlorobenzidine	6	0	6	20	20	ND	ND	ND
Benzo(a)anthracene	8	0	8	0.02	10	ND	ND	ND
Bis(2-ethylhexyl)phthalate	6	1	5	10	10	23	23	SW-6
Chrysene	8	0	8	0.15	10	ND	ND	ND
Di-n-octyl phthalate	6	0	6	10	10	ND	ND	ND
Benzo(b)fluoranthene	8	0	8	0.02	10	ND	ND	ND
Benzo(k)fluoranthene	8	0	8	0.02	10	ND	ND	ND
Benzo(a)pyrene	8	0	8	0.03	10	ND	ND	ND
Indeno(1,2,3-cd)pyrene	8	0	8	0.05	10	ND	ND	ND
Dibenz(a,h)anthracene	8	0	8	0.03	10	ND	ND	ND
Benzo(g,h,i)perylene	8	0	8	0.08	10	ND	ND	ND
Azobenzene	6	0	6	50	50	ND	ND	ND
Acenaphthene	2	0	2	1.8	1.8	ND	ND	ND
TPHs (mg/L)								
WTPH by 418.1	8	0	8	0.2	1	ND	ND	ND
WTPH as Diesel	5	2	3	0.2	0.2	0.1 J	0.1 J	SW-5

NOTES:

ND - Not detected
NA - Analytes were detected; see data for quantitation limits

TABLE 11-16
FINAL CHEMICALS OF INTEREST
BNRR FORMER MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Compounds	Soil		Sediment		Groundwater	Surface Water
	South Site	North Site	South Site	North Site		
DISSOLVED METALS						
Arsenic					X	
Chromium					X	
Lead					X	
TOTAL METALS						
Antimony	X	X			X	
Arsenic	X		X	X	X	
Beryllium	X					
Cadmium	X				X	
Chromium	X	X	X	X	X	
Copper	X	X	X	X	X	
Lead	X	X	X	X	X	
Mercury	X	X	X		X	
Nickel	X	X	X	X	X	
Selenium	X	X	X		X	
Thallium				X		
Zinc	X	X	X	X	X	
PCBs						
Aroclor 1254	X					
Aroclor 1260	X					
SEMIVOLATILES						
2-Methylnaphthalene	X					
Fluorene					X	
Anthracene					X	
Fluoranthene					X	
Benzo(a)anthracene					X	
Phenanthrene	X					
Di-n-butylphthalate	X					
Butylbenzylphthalate	X					
Di-n-octyl phthalate	X					
TPHs						
WTPH by 418.1	X	X	X	X		
WTPH as Diesel	X	X			X	X
WTPH as Gasoline	X					
VOLATILES						
Toluene	X				X	
Ethylbenzene	X					
Xylene (total)	X				X	

TABLE 11-17

TOXICITY DATA FOR CHEMICALS OF INTEREST
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Compounds	SOIL South Site	SOIL North Site	SEDIMENT South Site	SEDIMENT North Site	Ground Water	Surface Water	Reference Dose Oral (mg/kg-day)	Reference Dose Inhalation (mg/kg-day)	Cancer Potency Factor Oral (kg-day/mg)	Cancer Potency Factor Inhalation (kg-day/mg)	Cancer Weight-of-Evidence	BCF
TOTAL METALS												
Antimony	X	X			X		0.0004	ND	ND	ND	ND	1
Arsenic	X	X	X	X	X (T&D)		0.0003	ND	1.75	50	A	44
Beryllium	X						0.005	ND	4.3	8.4	B2	19
Cadmium	X				X		0.001	ND	6.1*	6.1*	B1	64
Chromium	X	X	X	X	X (T&D)		0.005	ND	ND	41	A	16
Copper	X	X	X	X	X		0.37	ND	ND	ND	D	36
Lead	X	X	X	X	X (T&D)		ND	ND	ND	ND	B2	ND
Mercury	X	X	X		X		0.0003	0.0000857	ND	ND	D	ND
Nickel	X	X	X	X	X		0.02	ND	ND	ND	ND	47
Selenium	X	X	X		X		0.005	ND	ND	ND	D	ND
Thallium				X			0.0001	ND	ND	ND	D	116
Zinc	X	X	X	X	X		0.3	ND	ND	ND	D	47
PCBs												
Aroclor 1254	X						ND	ND	7.7	ND	B2	31200
Aroclor 1260	X						ND	ND	7.7	ND	B2	31200
SEMIVOLATILES												
2-Methylnaphthalene	X						ND	ND	ND	ND	ND	ND
Fluorene					X		0.04	ND	ND	ND	D	30
Anthracene					X		0.3	ND	ND	ND	D	30
Fluoranthene					X		0.04	ND	ND	ND	D	1150
Benzo(a)anthracene					X		ND	ND	7.3	ND	B2	30
Phenanthrene	X						ND	ND	ND	ND	ND	ND
Di-n-butylphthalate	X						0.1	ND	ND	ND	D	89
Butylbenzylphthalate	X						0.2	ND	ND	ND	C	414
Di-n-octyl phthalate	X						0.02	ND	ND	ND	ND	ND
Chrysene					X		ND	ND	7.3	ND	B2	30
TPH	X	X	X	X	X	X	ND	ND	ND	ND	ND	ND
VOLATILES												
1,1-Dichloroethene					X		0.009	ND	0.6	1.2	C	5.6
Toluene	X						0.2	0.1143	ND	ND	D	10.7
Ethylbenzene	X						0.1	0.2857	ND	ND	D	37.5
Xylene (total)	X						2	ND	ND	ND	ND	ND

NOTES:
T - Total Metals
D - Dissolved Metals
* PAHs addressed per request of Ecology although not detected in sediment samples.

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TABLE 11-18
INTAKE ASSUMPTIONS
METHOD B - SOIL
BNRR FORMER MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Carcinogenic Soil Cleanup Level (mg/kg) $= \dfrac{RISK * ABW * LIFE * UCF1}{CPF * SIR * AB1 * DUR * FOC}$

Intake Parameter		units	
RISK =	Acceptable cancer risk level	1.00E-06	
ABW =	Lifetime average body weight:	16	kg
LIFE =	Lifetime	75	years
UCF1 =	Unit conversion factor	1.00E+06	mg/kg
CPF =	Cancer Potency Factor	chemical-specific	kg-day/mg
SIR =	Soil ingestion rate	200	mg/day
AB1=	Gastrointestinal absorption rate	1	
DUR =	Exposure duration	6	years
FOC =	Frequency of contact	1	

Noncarcinogenic Soil Cleanup Level (mg/kg) $= \dfrac{RfD * ABW * UCF2 * HQ}{SIR * AB1 * FOC}$

Intake Parameter		units	
RfD =	Reference Dose	chemical-specific	mg/kg/day
ABW =	Lifetime average body weight:	16	kg
UCF2 =	Unit conversion factor	1E+06	mg/kg
HQ =	Hazard Quotient	1	
SIR =	Soil ingestion rate	200	mg/day
AB1=	Gastrointestinal absorption rate	1	
FOC =	Frequency of contact	1	

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TABLE 11-19
INTAKE ASSUMPTIONS
METHOD C - SOIL
BNRR FORMER MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Carcinogenic Soil Cleanup Level (mg/kg) = $\frac{RISK * ABW * LIFE * UCF1}{CPF * SIR * AB1 * DUR * FOC}$

Intake Parameter		units	
RISK =	Acceptable cancer risk level	**1.00E-05**	
ABW =	Lifetime average body weight:	16	kg
LIFE =	Lifetime	75	years
UCF1 =	Unit conversion factor	1000000	mg/kg
CPF =	Cancer Potency Factor	chemical-specific	kg-day/mg
SIR =	Soil ingestion rate	**100**	mg/day
AB1 =	Gastrointestinal absorption rate	1	
DUR =	Exposure duration	6	years
FOC =	Frequency of contact	**0.5**	

Noncarcinogenic Soil Cleanup Level (mg/kg) = $\frac{RfD * ABW * UCF2 * HQ}{SIR * AB1 * FOC}$

Intake Parameter		units	
RfD =	Reference Dose	chemical-specific	mg/kg/day
ABW =	Lifetime average body weight:	16	kg
UCF2 =	Unit conversion factor	1E+06	mg/kg
HQ =	Hazard Quotient	1	
SIR =	Soil ingestion rate	**100**	mg/day
AB1 =	Gastrointestinal absorption rate	1	
FOC =	Frequency of contact	**0.5**	

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TABLE 11-20
INTAKE ASSUMPTIONS
METHOD B - GROUNDWATER
BNRR FORMER MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Carcinogenic Groundwater Cleanup Level (μg/L) =

$$\frac{RISK * ABW * LIFE * UCF}{CPF * DWIR * DUR * INH}$$

Intake Parameter		units	
RISK =	Acceptable cancer risk level	1.00E-06	
ABW =	Lifetime average body weight:	70	kg
LIFE =	Lifetime	75	years
UCF =	Unit conversion factor	1000	μg/mg
CPF =	Cancer Potency Factor	chemical-specific	kg-day/mg
DWIR =	Drinking water ingestion rate	2	L/day
DUR =	Exposure duration	30	years
INH =	Inhalation correction factor	chemical-specific	

Noncarcinogenic Groundwater Cleanup Level (μg/L) =

$$\frac{RfD * ABW * UCF * HQ}{DWIR * INH}$$

Intake Parameter		units	
RfD =	Reference Dose	chemical-specific	mg/kg/day
ABW =	Lifetime average body weight:	16	kg
UCF2 =	Unit conversion factor	1000	μg/mg
HQ =	Hazard Quotient	1	
DWIR =	Drinking water ingestion rate	1	L/day
INH =	Inhalation correction factor	chemical-specific	

TABLE 11-21
INTAKE ASSUMPTIONS
METHOD C - GROUNDWATER
BNRR FORMER MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Carcinogenic Groundwater Cleanup Level (μg/L) =

$$\frac{RISK * ABW * LIFE * UCF}{CPF * DWIR * DUR * INH}$$

Intake Parameter		units	
RISK =	Acceptable cancer risk level	1.00E-05	
ABW =	Lifetime average body weight:	70	kg
LIFE =	Lifetime	75	years
UCF =	Unit conversion factor	1000	μg/mg
CPF =	Cancer Potency Factor	chemical-specific	kg-day/mg
DWIR =	Drinking water ingestion rate	2	L/day
DUR =	Exposure duration	30	years
INH =	Inhalation correction factor	chemical-specific	

Noncarcinogenic Groundwater Cleanup Level (μg/L) =

$$\frac{RfD * ABW * UCF * HQ}{DWIR * INH}$$

Intake Parameter		units	
RfD =	Reference Dose	chemical-specific	mg/kg/day
ABW =	Lifetime average body weight:	70	kg
UCF =	Unit conversion factor	1000	μg/mg
HQ =	Hazard Quotient	1	
DWIR =	Drinking water ingestion rate	2	L/day
INH =	Inhalation correction factor	chemical-specific	

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TABLE 11-22
INTAKE ASSUMPTIONS
METHOD B - SURFACE WATER
BNRR FORMER MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Carcinogenic Surface Water Cleanup Level (mg/kg) =

$$\frac{RISK * ABW * LIFE * UCF1 * UCF2}{CPF * BCF * FCR * FDF * DUR}$$

Intake Parameter		units	
RISK =	Acceptable cancer risk level	1.00E-06	
ABW =	Lifetime average body weight:	70	kg
LIFE =	Lifetime	75	years
UCF1 =	Unit conversion factor	1000	µg/mg
UCF2 =	Unit conversion factor	1000	g/L
CPF =	Cancer potency factor	chemical-specific	kg-day/mg
BCF =	Bioconcentration factor (fish)	chemical-specific	
FCR =	Fish consumption rate	54	g/day
FDF=	Fish diet fraction	0.5	
DUR =	Exposure duration	30	years

Noncarcinogenic Surface Water Cleanup Level (mg/kg) =

$$\frac{RfD * ABW * UCF1 * UCF2 * HQ}{BCF * FCR * FDF}$$

Intake Parameter		units	
RfD =	Reference Dose	chemical-specific	mg/kg-day
ABW =	Lifetime average body weight:	70	kg
UCF1 =	Unit conversion factor	1000	µg/mg
UCF2 =	Unit conversion factor	1000	g/L
HQ =	Hazard Quotient	1	
BCF =	Bioconcentration factor (fish)	chemical-specific	
FCR =	Fish consumption rate	54	g/day
FDF=	Fish diet fraction	0.5	

TABLE 11-23
INTAKE ASSUMPTIONS
METHOD C - SURFACE WATER
BNRR FORMER MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Carcinogenic Surface Water Cleanup Level (mg/kg) =

$$\frac{RISK * ABW * LIFE * UCF1 * UCF2}{CPF * BCF * FCR * FDF * DUR}$$

Intake Parameter		units	
RISK =	Acceptable cancer risk level	1.00E-05	
ABW =	Lifetime average body weight:	70	kg
LIFE =	Lifetime	75	years
UCF1 =	Unit conversion factor	1000	µg/mg
UCF2 =	Unit conversion factor	1000	g/L
CPF =	Cancer potency factor	chemical-specific	kg-day/mg
BCF =	Bioconcentration factor (fish)	chemical-specific	
FCR =	Fish consumption rate	54	g/day
FDF=	Fish diet fraction	0.2	
DUR =	Exposure duration	30	years

Noncarcinogenic Surface Water Cleanup Level (mg/kg) =

$$\frac{RfD * ABW * UCF1 * UCF2 * HQ}{BCF * FCR * FDF}$$

Intake Parameter		units	
RfD =	Reference Dose	chemical-specific	mg/kg-day
ABW =	Lifetime average body weight:	70	kg
UCF1 =	Unit conversion factor	1000	µg/mg
UCF2 =	Unit conversion factor	1000	g/L
HQ =	Hazard Quotient	1	
BCF =	Bioconcentration factor (fish)	chemical-specific	
FCR =	Fish consumption rate	54	g/day
FDF=	Fish diet fraction	0.2	

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TABLE 11-24
INTAKE ASSUMPTIONS
METHOD B - AIR
BNRR FORMER MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Carcinogenic Air Cleanup Level ($\mu g/m^3$)

$$\frac{RISK * BW * LIFE * UCF}{CPF * BR * ABS * DUR}$$

Intake Parameter		units	
RISK =	Acceptable cancer risk level	1.00E-06	
BW =	Lifetime average body weight:	70	kg
LIFE =	Lifetime	75	years
UCF =	Unit conversion factor	1000	$\mu g/mg$
CPF =	Cancer Potency Factor	chemical-specific	kg-day/mg
BR =	Breathing Rate	20	m^3/day
DUR =	Exposure duration	30	years
ABS =	Absorption percentage	1	

Noncarcinogenic Air Cleanup Level ($\mu g/m^3$) =

$$\frac{RfD * ABW * UCF * HQ}{BR * ABS}$$

Intake Parameter		units	
RfD =	Reference Dose	chemical-specific	mg/kg/day
ABW =	Lifetime average body weight:	16	kg
UCF =	Unit conversion factor	1000	$\mu g/mg$
HQ =	Hazard Quotient	1	
BR =	Breathing Rate	10	m^3/day
ABS =	Absorption percentage	1	

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TABLE 11-25
INTAKE ASSUMPTIONS
METHOD C - AIR
BNRR FORMER MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Carcinogenic Air Cleanup Level ($\mu g/m^3$) =

$$\frac{RISK * BW * LIFE * UCF}{CPF * BR * ABS * DUR}$$

Intake Parameter		units	
RISK =	Acceptable cancer risk level	1.00E-05	
BW =	Lifetime average body weight:	70	kg
LIFE =	Lifetime	75	years
UCF =	Unit conversion factor	1000	μg/mg
CPF =	Cancer Potency Factor	chemical-specific	kg-day/mg
BR =	Breathing Rate	20	m^3/day
DUR =	Exposure duration	30	years
ABS =	Absorption percentage	1	

Noncarcinogenic Air Cleanup Level ($\mu g/m^3$) =

$$\frac{RfD * ABW * UCF * HQ}{BR * ABS}$$

Intake Parameter		units	
RfD =	Reference Dose	chemical-specific	mg/kg/day
ABW =	Lifetime average body weight:	70	kg
UCF =	Unit conversion factor	1000	μg/mg
HQ =	Hazard Quotient	1	
BR =	Breathing Rate	20	m^3/day
ABS =	Absorption percentage	1	

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TABLE 11-26

SUMMARY OF DATA
NORTH SITE SOIL
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Compounds	Maximum Detected Concentration	Arithmetic Mean	Standard Deviation	One Tail t-Statistic at 95%	Normal Upper 95% Confidence Limit	Normal Source Concentration	Geometric Mean	Geometric Standard Deviation	One Tail H-Statistic at 95%	Lognormal Upper 95% Confidence Limit	Lognormal Source Concentration
TOTAL METALS (mg/kg)											
Antimony	0.2	0.119	0.046	1.895	0.149	0.149	0.111	1.51	2.218	0.171	0.171
Arsenic	12	7.09	4.64	1.895	10.2	10.2	2.98	8.19	6.909	6,595	12.0
Chromium	58.3	34.8	11.8	1.895	42.6	42.6	33.3	1.36	2.076	44.4	44.4
Copper	41.6	29.6	9.80	1.895	36.2	36.2	28.1	1.43	2.076	39.6	39.6
Lead	1,897	293	651	1.895	730	730	50.8	7.51	6.297	47,174	1,897
Mercury	0.16	0.053	0.055	1.895	0.090	0.090	0.031	3.11	3.982	0.320	0.160
Nickel	37.8	29.4	6.02	1.895	33.5	33.5	28.9	1.23	1.955	34.3	34.3
Selenium	0.3	0.119	0.088	1.895	0.178	0.178	0.096	1.95	2.571	0.231	0.231
Zinc	222	109	81.3	1.895	164	164	84.0	2.19	2.78	261	222
TPHs (mg/kg)											
WTPH by 418.1	27,000	2,699	7,753	1.796	6,719	6,719	171	7.87	4.962	31,595	27,000
WTPH as Diesel	12,172	1,287	3,413	1.782	2,974	2,974	88.9	10.5	5.791	71,667	12,172

Notes:

ND - Not detected.

One half the detection limit used in statistics.

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TABLE 11-27
SUMMARY OF DATA
SOUTH SITE SOIL
BNRR FORMER MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Compounds	Maximum Detected Concentration	Arithmetic Mean	Standard Deviation	One Tail t-Statistic at 95%	Normal Upper 95% Confidence Limit	Normal Source Concentration	Geometric Mean	Geometric Standard Deviation	One Tail H-Statistic at 95%	Lognormal Upper 95% Confidence Limit	Lognormal Source Concentration
TOTAL METALS (mg/kg)											
Antimony	18	1.12	2.84	1.677	1.80	1.80	0.320	4.12	3.151	1.66	1.66
Arsenic	64	12.8	11.3	1.677	15.5	15.5	9.67	2.08	2.087	15.8	15.8
Beryllium	0.71	0.518	0.517	1.677	0.642	0.642	0.374	2.11	2.087	0.618	0.618
Cadmium	3.7	0.681	0.684	1.677	0.845	0.845	0.476	2.29	2.187	0.870	0.870
Chromium	56	28.3	10.5	1.677	30.8	30.8	26.6	1.44	1.778	31.1	31.1
Copper	323	77.7	72.6	1.677	95.1	95.1	56.3	2.17	2.087	95.9	95.9
Lead	3,600	344	611	1.676	488	488	103	5.62	3.401	1,055	1,055
Mercury	0.3	0.062	0.055	1.677	0.075	0.075	0.044	2.36	2.187	0.084	0.084
Nickel	71.9	29.8	10.7	1.677	32.4	32.4	28.2	1.39	1.778	32.5	32.5
Selenium	0.3	0.140	0.079	1.677	0.159	0.159	0.120	1.79	1.913	0.166	0.166
Thallium	0.3	0.135	0.060	1.677	0.149	0.149	0.125	1.44	1.778	0.147	0.147
Zinc	460	138	106	1.677	164	164	108	1.99	1.995	168	168
PCBs (μg/kg)											
Aroclor 1254	1,200	117	191	1.69	171	171	83.3	1.96	2.006	131	131
Aroclor 1260	137 J	87.1	13.0	1.688	90.7	90.7	85.9	1.19	1.696	91.7	91.7
SEMIVOLATILES (μg/kg)											
2-Methylnaphthalene	8,300	961	2,437	1.812	2,292	2,292	289	3.29	3.403	2,113	2,113
Phenanthrene	7,500	844	2,208	1.812	2,050	2,050	248	3.12	3.403	1,612	1,612
TPH (mg/kg)											
WTPH by 418.1	14,000	915	2,195	1.675	1,420	1,420	133	8.37	3.97	4,083	4,083
WTPH as Diesel	12,000	1,164	2,487	1.677	1,760	1,760	69.0	17.7	5.364	39,798	12,000
WTPH as Gasoline	6	3.30	1.52	2.132	4.75	4.75	3.09	1.46	2.402	5.24	5.24
VOLATILES (μg/kg)											
Toluene	2,000	112	380	1.701	233	233	12.3	5.58	3.635	176	176
Ethylbenzene	7,800	311	1,446	1.701	768	768	12.6	6.32	3.792	257	257
Xylene (total)	9,600	400	1,779	1.701	962	962	14.8	7.66	3.803	509	509

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TABLE 11-28

STATISTICAL SUMMARY
NORTH SITE SEDIMENT
BNRR MAINTENANCE AND FUELING FACILITY SITE
SKYKOMISH, WASHINGTON

Compounds	Maximum Detected Concentration	Arithmetic Mean	Standard Deviation	One Tail t-Statistic at 95%	Normal Upper 95% Confidence Limit	Normal Source Concentration	Geometric Mean	Geometric Standard Deviation	One Tail H-Statistic at 95%	Lognormal Upper 95% Confidence Limit	Lognormal Source Concentration
METALS (mg/kg)											
Arsenic	50	12.7	18.5	2.015	27.9	27.9	6.69	3.10	4.905	152	50.0
Chromium	34	24.6	5.27	2.015	29.0	29.0	24.2	1.22	2.095	29.8	29.8
Copper	15.7	13.9	1.77	2.015	15.4	15.4	13.8	1.14	1.961	15.7	15.7
Lead	8.3	4.80	2.13	2.015	6.55	6.55	4.43	1.55	2.467	7.89	7.89
Nickel	33.5	22.8	6.03	2.015	27.7	27.7	22.2	1.28	2.095	28.7	28.7
Thallium	0.3	0.150	0.084	2.015	0.219	0.219	0.135	1.62	2.467	0.257	0.257
Zinc	42.1	35.5	4.71	2.015	39.3	39.3	35.2	1.14	1.961	39.8	39.8
WTPH by 418.1 (mg/kg)	6,900	1,352	2,744	2.015	3,609	3,609	200	8.02	8.067	3,204,141	6,900

Notes:

One half the detection limit used in statistics.

TABLE 11-29

STATISTICAL SUMMARY
SOUTH SITE SEDIMENT
BNRR MAINTENANCE AND FUELING FACILITY SITE
SKYKOMISH, WASHINGTON

Compounds	Maximum Detected Concentration	Arithmetic Mean	Standard Deviation	One Tail t-Statistic at 95%	Normal Upper 95% Confidence Limit	Normal Source Concentration	Geometric Mean	Geometric Standard Deviation	One Tail H-Statistic at 95%	Lognormal Upper 95% Confidence Limit	Lognormal Source Concentration
METALS (mg/kg)											
Arsenic	20	14.0	8.49	6.314	51.9	20.0	12.6	1.91	NA	NA	NA
Chromium	30.1	27.2	4.10	6.314	45.5	30.1	27.0	1.16	NA	NA	NA
Copper	36.4	35.5	1.27	6.314	41.2	36.4	35.5	1.04	NA	NA	NA
Lead	64.1	45.5	26.4	6.314	163	64.1	41.4	1.85	NA	NA	NA
Mercury	0.05	0.045	0.007	6.314	0.077	0.050	0.045	1.17	NA	NA	NA
Nickel	39.9	32.0	11.2	6.314	82.1	39.9	30.9	1.43	NA	NA	NA
Selenium	0.1	0.075	0.035	6.314	0.233	0.100	0.071	1.63	NA	NA	NA
Zinc	150	128	31.8	6.314	270	150	125	1.29	NA	NA	NA
WTPH by 418.1 (mg/kg)	99 J	98.0	1.41	6.314	104	99.0	98.0	1.01	NA	NA	NA

Notes:
One half the detection limit used in statistics.

TABLE 11-30

STATISTICAL SUMMARY
GROUNDWATER
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Compounds	Maximum Detected Concentration	Arithmetic Mean	Standard Deviation	One Tail t-Statistic at 95%	Normal Upper 95% Confidence Limit	Normal Source Concentration	Geometric Mean	Geometric Standard Deviation	One Tail H-Statistic at 95%	Lognormal Upper 95% Confidence Limit	Lognormal Source Concentration
DISSOLVED METALS (mg/L)											
Arsenic	0.011	0.002	0.003	1.687	0.003	0.003	0.001	3.07	2.685	0.004	0.004
Chromium	0.01 B	0.005	0.001	1.687	0.005	0.005	0.005	1.48	1.787	0.006	0.006
Lead	0.003	0.001	0.000	1.688	0.001	0.001	0.001	1.44	1.788	0.001	0.001
TOTAL METALS (mg/L)											
Antimony	0.02	0.003	0.005	1.753	0.005	0.005	0.001	3.21	3.046	0.007	0.007
Arsenic	0.54	0.061	0.126	1.701	0.100	0.100	0.017	5.68	3.635	0.250	0.250
Cadmium	0.0003	0.000	0.000	1.753	0.000	0.000	0.000	3.07	3.046	0.001	0.000
Chromium	0.4	0.071	0.095	1.701	0.101	0.101	0.029	4.42	3.16	0.210	0.210
Copper	0.32	0.066	0.100	1.753	0.110	0.110	0.025	4.27	3.634	0.284	0.284
Lead	0.15	0.020	0.031	1.701	0.029	0.029	0.007	5.46	3.475	0.085	0.085
Mercury	0.0007	0.000	0.000	1.753	0.000	0.000	0.000	1.86	2.165	0.000	0.000
Nickel	0.37	0.066	0.097	1.753	0.108	0.108	0.030	3.42	3.243	0.181	0.181
Selenium	0.002	0.002	0.003	1.753	0.003	0.002	0.001	2.93	2.714	0.004	0.002
Zinc	0.52	0.078	0.132	1.753	0.136	0.136	0.030	4.21	3.634	0.323	0.323
SEMIVOLATILES (ug/L)											
Fluorene	48	5.32	8.47	1.69	7.71	7.71	2.31	4.77	3.073	17.6	17.6
Anthracene	9.2	4.39	4.19	1.688	5.55	5.55	2.86	2.95	2.418	7.94	7.94
Fluoranthene	52 J	6.50	9.12	1.688	9.03	9.03	3.15	4.38	3.161	20.5	20.5
Benzo(a)anthracene	3.00	3.92	4.30	1.688	5.11	3.00	1.48	7.56	3.807	41.3	3.00
Chrysene	2.00	3.81	4.35	1.688	5.02	2.00	1.50	6.10	3.793	24.1	2.00
WTPH as Diesel (mg/L)	37	1.03	4.16	1.664	1.79	1.79	0.196	5.34	3.25	1.45	1.45
VOLATILES (ug/L)											
1,1-Dichloroethene	1 J	2.38	0.416	1.782	2.59	1.00	2.33	1.29	1.832	2.75	1.00
Toluene	2	1.85	0.875	1.729	2.19	2.00	1.56	1.95	2.101	2.70	2.00
Xylene (total)	22	3.25	4.59	1.729	5.02	5.02	2.07	2.52	2.458	5.33	5.33

ND - Not detected.

One half the detection limit used in statistics.

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TABLE 11-31
STATISTICAL SUMMARY
SURFACE WATER
BNRR FORMER MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Compounds	Maximum Detected Concentration	Arithmetic Mean	Standard Deviation	One Tail t-Statistic at 95%	Normal Upper 95% Confidence Limit	Normal Source Concentration	Geometric Mean	Geometric Standard Deviation	One Tail H-Statistic at 95%	Lognormal Upper 95% Confidence Limit	Lognormal Source Concentration
TPH (mg/L)											
WTPH as Diesel	0.1 J	0.100	0.000	2.132	0.100	0.100	0.100	1.00	ERR	0.100	0.100

NOTE:

One-half the detection limit used in statistics.

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TABLE 11-32

AIR MODEL EXPOSURE POINT CONCENTRATIONS
BNRR MAINTENANCE AND FUELING FACILITY SITE
SKYKOMISH, WASHINGTON

Compound	South Site Soil 95% UCL ug/kg	South Site Exposure Concentration Volatiles mg/m³	South Site Exposure Concentration Dust mg/m³	South Site Exposure Concentration Total mg/m³	North Site Soil 95% UCL ug/kg	North Site Exposure Concentration Volatiles mg/m³	North Site Exposure Concentration Dust mg/m³	North Site Exposure Concentration Total mg/m³
Antimony	1800	0.00E+00	1.49E-09	1.49E-09	149	0.00E+00	1.23E-10	1.23E-10
Arsenic	15500	2.42E-09	1.28E-08	1.52E-08	10200	1.59E-09	8.42E-09	1.00E-08
Beryllium	642	0.00E+00	5.30E-10	5.30E-10	0	0.00E+00	0.00E+00	0.00E+00
Cadmium	845	1.38E-12	6.98E-10	6.99E-10	0	0.00E+00	0.00E+00	0.00E+00
Chromium	30800	4.80E-09	2.54E-08	3.02E-08	42600	6.65E-09	3.52E-08	4.18E-08
Copper	95100	1.48E-08	7.85E-08	9.33E-08	36200	5.65E-09	2.99E-08	3.55E-08
Lead	488000	3.55E-09	4.03E-07	4.07E-07	730000	5.31E-09	6.03E-07	6.08E-07
Mercury	75	1.53E-05	6.19E-11	1.53E-05	90	1.84E-05	7.43E-11	1.84E-05
Nickel	32400	0.00E+00	2.67E-08	2.67E-08	33500	0.00E+00	2.77E-08	2.77E-08
Selenium	159	0.00E+00	1.31E-10	1.31E-10	178	0.00E+00	1.47E-10	1.47E-10
Thallium	149	0.00E+00	1.23E-10	1.23E-10	0	0.00E+00	0.00E+00	0.00E+00
Zinc	164000	2.56E-08	1.35E-07	1.61E-07	164000	2.56E-08	1.35E-07	1.61E-07
Aroclor 1254	171	2.25E-07	1.41E-10	2.25E-07	0	0.00E+00	0.00E+00	0.00E+00
Aroclor 1260	90.7	1.20E-07	7.49E-11	1.20E-07	0	0.00E+00	0.00E+00	0.00E+00
2-Methylnaphthalene	2292	8.26E-05	1.89E-09	8.26E-05	0	0.00E+00	0.00E+00	0.00E+00
Phenanthrene	2050	4.02E-06	6.98E-11	4.02E-06	0	0.00E+00	0.00E+00	0.00E+00
Di-n-butyl phthalate	115	2.81E-09	9.49E-11	2.90E-09	0	0.00E+00	0.00E+00	0.00E+00
Butyl benzyl phthalate	300	5.82E-05	2.48E-10	5.82E-05	0	0.00E+00	0.00E+00	0.00E+00
Di-n-octyl phthalate	337	0.00E+00	2.78E-10	2.78E-10	0	0.00E+00	0.00E+00	0.00E+00
Toluene	223	4.89E-06	7.60E-12	4.89E-06	0	0.00E+00	0.00E+00	0.00E+00
Ethylbenzene	768	8.25E-06	2.62E-11	8.25E-06	0	0.00E+00	0.00E+00	0.00E+00
Xylenes	962	1.29E-05	1.09E-11	1.29E-05	0	0.00E+00	0.00E+00	0.00E+00

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TABLE 11-33

ECOLOGICAL CHEMICALS OF INTEREST
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Compounds	SEDIMENT SOUTH SITE (mg/kg)	SEDIMENT NORTH SITE (mg/kg)	SURFACE WATER (mg/L)
TOTAL METALS			
Arsenic	27.9	20	
Chromium	29	30.1	
Copper	15.4	36.4	
Lead	6.55	64.1	
Mercury	ND	0.05	
Nickel	27.7	39.9	
Selenium	ND	0.1	
Thallium	0.219	ND	
Zinc	39.3	150	
PAHs			
Benzo(a)anthracene		0.11	
Benzo(a)pyrene		0.13	
Benzo(b)fluoranthene		0.26	
Benzo(g,h,i)perylene		0.17	
Benzo(k)fluoranthene		0.8	
Fluoranthene		0.2	
Indeno(1,2,3-cd)pyrene		0.13	
Phenanthrene		0.18	
Pyrene		0.3	
TPHs	3609	99	0.1

* PAHs addressed per request of Ecology although not detected in sediment samples.

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TABLE 11-34

SEDIMENT BENCHMARKS COMPARED TO SITE CONCENTRATIONS
NORTH SITE AND SOUTH SITE SEDIMENT
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

TOTAL METALS AND TPH						
	Sediment Concentrations (mg/kg)		Sediment Qualtiy Criteria (mg/kg)			
Compounds	North Site	South Site	Effects Range Low (ER-L)	Effects Range Median (ER-M)	AET	Lowest Effect Level
Total Metals						
Arsenic	20	27.9	8.2	70	57	6
Chromium	30.1	29	81	370	260	26
Copper	36.4	15.4	34	270	390	16
Lead	64.1	6.55	46.7	218	450	31
Mercury	0.05	ND	0.15	0.71	0.41	0.2
Nickel	39.9	27.7	20.9	51.6	NA	16
Selenium	0.1	ND	NA	NA	NA	NA
Thallium	ND	0.219	NA	NA	NA	NA
Zinc	150	39.3	150	410	410	120
TPH (mg/kg)	99	3609	NA	NA	NA	NA

HYPOTHETICAL PAHS					
	Sediment Concentrations* North Site (mg/kg)	Sediment Qualtiy Criteria (mg/kg)			
Compounds		Effects Range Low (ER-L)	Effects Range Median (ER-M)	AET	Lowest Effect Level
PAHs					
Benzo(a)anthracene	0.11	0.261	1.6	NA	1.3***
Benzo(a)pyrene	0.13	0.43	1.6	NA	NA
Benzo(b)fluoranthene	0.26	NA	NA	NA	NA
Benzo(g,h,i)perylene	0.17	NA	NA	NA	NA
Benzo(k)fluoranthene	0.8	NA	NA	NA	NA
Fluoranthene	0.2	0.6	5.1	NA	1.8***
Indeno(1,2,3-cd)pyrene	0.13	NA	NA	NA	NA
Phenanthrene	0.18	0.24	1.5	NA	0.14***
Pyrene	0.3	0.665	2.6	NA	1.3***

NOTES:

Sediment concentrations are the exposure point concentrations (the upper 95th percentile on the arithmetic mean or the maximum, whichever is lower) for metals and TPH.

* PAHs addressed per request of Ecology although not detected in sediments. PAH concentrations were derived from North Site soil sample with the highest PAH concentrations (MW-39).

** EPA Interim Sediment Criteria for Nonpolar Organics (chronic) - EPA, 1988.

*** EPA Interim Criteria (chronic), 1988.

Effects Range Low (ER-L) and Effects Range Median (ER-M)source: Long 1994.

AET - Apparent Effects Threshold - Washington State Sediment Criteria as cited in Hull 1993.

NA - data not available

ND - not a chemical of interest in that area

TABLE 11-35

EXPOSURE EFFECTS RATIOS FOR TOTAL METALS AND TPH
NORTH SITE SEDIMENT
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Compounds	Sediment Concentrations* North Site (mg/kg)	Sediment Qualtiy Criteria (mg/kg)				Exposure Effects Ratio			
		Effects Range Low (ER-L)	Effects Range Median(ER-M)	AET	Lowest Effect Level	for Effects Range Low (ER-L)	for Effects Range Median(ER-M)	for AET	for Lowest Effect Level
Total Metals									
Arsenic	20	8.2	70	57	6	2.44	0.29	0.35	3.33
Chromium	30.1	81	370	260	26	0.37	0.08	0.12	1.16
Copper	36.4	34	270	390	16	1.07	0.13	0.09	2.28
Lead	64.1	46.7	218	450	31	1.37	0.29	0.14	2.07
Mercury	0.05	0.15	0.71	0.41	0.2	0.33	0.07	0.12	0.25
Nickel	39.9	20.9	51.6	NA	16	1.91	0.77	ND	2.49
Selenium	0.1	NA	NA	NA	NA	ND	ND	ND	ND
Thallium	ND	NA	NA	NA	NA	ND	ND	ND	ND
Zinc	150	150	410	410	120	1.00	0.37	0.37	1.25
TPHs (mg/kg)	99	NA	NA	NA	NA	ND	ND	ND	ND

NOTES:

* Sediment concentrations are the exposure point concentrations (the upper 95th percentile on the arithmetic mean or the maximum, whichever is lower) for metals and TPH.

Effects Range Low (ER-L) and Effects Range Median (ER-M) source: Long 1994.

AET - Apparent Effects Threshold - Washington State Sediment Criteria as cited in Hull 1993.

Lowest Effect Level source is the Ontario Ministry of the Environment (1990).

NA - data not available

ND - not a chemical of interest in that area or EER cannot be calculated due to absence of data.

TABLE 11-36

EXPOSURE EFFECTS RATIOS FOR HYPOTHETICAL PAHS
NORTH SITE SEDIMENT
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Compounds	Sediment Concentrations North Site (mg/kg)	Sediment Qualtiy Criteria (mg/kg)				Exposure Effects Ratio			
		Effects Range Low (ER-L)	Effects Range Median(ER-M)	AET	Lowest Effect Level	for Effects Range Low (ER-L)	for Effects Range Median(ER-M)	for AET	for Lowest Effect Level
PAHs									
Benzo(a)anthracene	0.11	0.261	1.6	NA	1.3	0.42	0.07	ND	0.08
Benzo(a)pyrene	0.13	0.43	1.6	NA	NA	0.30	0.08	ND	ND
Benzo(b)fluoranthene	0.26	NA	NA	NA	NA	ND	ND	ND	ND
Benzo(g,h,i)perylene	0.17	NA	NA	NA	NA	ND	ND	ND	ND
Benzo(k)fluoranthene	0.8	NA	NA	NA	NA	ND	ND	ND	ND
Fluoranthene	0.2	0.6	5.1	NA	1.8	0.33	0.04	ND	0.11
Indeno(1,2,3-cd)pyrene	0.13	NA	NA	NA	NA	ND	ND	ND	ND
Phenanthrene	0.18	0.24	1.5	NA	0.14	0.75	0.12	ND	1.29
Pyrene	0.3	0.665	2.6	NA	1.3	0.45	0.12	ND	0.23

NOTES:

PAHs addressed per request of Ecology although not detected in sediments. PAH concentrations were derived from North Site soil sample with the highest PAH concentrations (MW-39).

Effects Range Low (ER-L) and Effects Range Median (ER-M)source: Long 1994.

AET - Apparent Effects Threshold - Washington State Sediment Criteria as cited in Hull 1993.

NA - data not available

ND - not a chemical of interest in that area or EER cannot be calculated due to absence of data.

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TABLE 11-37

EXPOSURE EFFECTS RATIOS FOR TOTAL METALS AND TPH
SOUTH SITE SEDIMENT
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Compounds	Sediment Concentrations* South Site (mg/kg)	Sediment Qualtiy Criteria (mg/kg)				Exposure Effects Ratio			
		Effects Range Low (ER-L)	Effects Range Median(ER-M)	AET	Lowest Effect Level	for Effects Range Low (ER-L)	for Effects Range Median(ER-M)	for AET	for Lowest Effect Level
Total Metals									
Arsenic	27.9	8.2	70	57	6	3.40	0.40	0.49	4.65
Chromium	29	81	370	260	26	0.36	0.08	0.11	1.12
Copper	15.4	34	270	390	16	0.45	0.06	0.04	0.96
Lead	6.55	46.7	218	450	31	0.14	0.03	0.01	0.21
Mercury	ND	0.15	0.71	0.41	0.2	ND	0.00	ND	ND
Nickel	27.7	20.9	51.6	NA	16	1.33	0.54	ND	1.73
Selenium	ND	NA	NA	NA	NA	ND	ND	ND	ND
Thallium	0.219	NA	NA	NA	NA	ND	ND	ND	ND
Zinc	39.3	150	410	410	120	0.26	0.10	0.10	0.33
TPHs (mg/kg)	3609	NA	NA	NA	NA	ND	ND	ND	ND

NOTES:

* Sediment concentrations are the exposure point concentrations (the upper 95th percentile on the arithmetic mean or the maximum, whichever is lower) for metals and TPH.

Effects Range Low (ER-L) and Effects Range Median (ER-M) source: Long 1994.

AET - Apparent Effects Threshold - Washington State Sediment Criteria as cited in Hull 1993.

Lowest Effect Level source is the Ontario Ministry of the Environment (1990).

NA - data not available

ND - not a COI in this area or EER cannot be determined due to lack of sediment concentration or benchmark data.

TABLE 12-1

SITE GROUNDWATER CONCENTRATIONS AND CLEANUP LEVELS (μg/l)
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Compounds	SITE GROUNDWATER QUALITY		DRINKING WATER STANDARD (MCL) (1)	MTCA- GROUND-WATER - INGESTION		EPA AMBIENT WATER QUALITY CRITERIA (2)		SURFACE WATER QUALITY STD (3)	MTCA- SURFACE WATER - INGESTION		SITE CLEANUP LEVEL
	Total	Dissolved		METHOD B	METHOD C	Aquatic	Humans		METHOD B	METHOD C	
METALS											
Antimony	5.0	--	6.0	6.4	14	NC	4,300	NC	1,040	2,590	6.0
Arsenic	100	3.0	50	0.05	0.5	190	0.14	190	0.084	2.1	**0.05**
Cadmium (a)	0.3	--	5.0	8.0	17.5	1.1	170	1.1	20	51	1.1
Chromium (b)	101	5.0	100	80	175	11	3,400	11	810	2,030	**11**
Copper (a)	110	--	1,300 (T)	592	1300	12	NC	12	2,660	6,660	**12**
Lead (a)	29	1.0	15 (T)	--	--	3.2	NC	3.2	--	--	**3.2**
Mercury	0.25	--	2.0	4.8	10.5	0.012	0.15	0.012	--	--	**0.012**
Nickel (a)	108	--	100	320	700	160	4,600	160	1,100	2,760	100
Selenium	2.0	--	NC	80	175	5.0	6,800	5.0	--	--	5.0
Zinc (a)	136	--	5,000 (S)	4,800	10,500	110	NC	110	16,500	41,400	**110**
SEMIVOLATILES											
Fluorene	7.7	--	NC	640	1,400	NC	14,000	NC	3,460	8,640	640
Anthracene	5.6	--	NC	4,800	10,500	NC	110,000	NC	25,900	64,800	4,800
Fluoranthene	9.0	--	NC	640	1,400	NC	370	NC	90	225	90
Chrysene	2.0		0.2 (P)	0.012	0.12	NC	0.031		0.030	0.74	**0.012**
Benzo(a)anthracene	3.0	--	0.1 (P)	0.012	0.12	NC	0.031	NC	0.030	0.74	**0.012**
TPH	1,790	--	NC	--	--	NC	NC	NC	--	--	**1.0** (A)
VOLATILES											
Toluene	2.0	--	1,000	1,600	3,500	NC	200,000	NC	48,500	121,000	1,000
1,1-Dichloroethene	1.0		7.0	0.073	0.73	NC	3.2	NC	2	48	**0.073**
Xylene (total)	5.0	--	10,000	16,000	35,000	NC	NC	NC	--	--	10,000

NOTES:

(a) EPA aquatic life criteria and Ecology surface water quality criteria based on 100 mg/l CaCO3
(b) Toxicity data provided for Cr (IV)
--Insufficient Data to Calculate
NC - No criteria or standard established

T - EPA Action Level; lead applies at tap
P - Proposed MCL, not finalized
S - Secondary MCL, not health based
A -MTCA Method A gw cleanup value. Value is not health-based but is meant to prevent objectionable taste or odor.

1 - EPA and Ecology (WAC 246-290-310) regulations
2 - EPA Section 304(a) Criteria. Human health criteria based on food (aquatic organisms) ingestion only.
3 - WAC-173-201A-040

[shaded box] Indicates that Site data exceed cleanup level

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TABLE 12-2

SOIL QUALITY DATA AND MTCA CLEANUP LEVELS (mg/kg)
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Compounds	SITE SOIL QUALITY DATA South Site	North Site	Back-ground	STATE BACK-GROUND	RESIDENTIAL SOIL CLEANUP LEVELS METHOD A (1)	METHOD B	METHOD C	100 x GW CLEANUP LEVEL	SITE CLEANUP LEVEL
METALS									
Antimony	1.8	0.15	<0.3	5.0	NA	32	128	0.6	32
Arsenic	15.5	10.2	31	7.0	20	1.4	57	0.005	57
Beryllium	0.64	NA	<0.6	1.4	NA	0.23	9.3	NA	9.3
Cadmium	0.85	NA	<0.6	1.0	2.0	0.16	22	0.11	22
Chromium	30.8	42.6	41.7	41.9	100	400	1,600	1.1	400
Copper	95.1	36.2	26.2	36.0	NA	2,960	11,800	1.2	2,960
Lead	488	730	28.2	17.1	250	--	--	0.32	**250**
Mercury	0.075	0.09	0.06	0.07	1.0	24	96	0.0012	24
Nickel	32.4	33.5	33.7	38.2	NA	1,600	6,400	16	1,600
Selenium	0.16	0.18	0.10	0.78	NA	400	1,600	0.5	400
Thallium	0.15	NA	0.30	<5.0	NA	6	22	NA	5.6
Zinc	164	164	75.3	85.8	NA	24,000	96,000	11	24,000
PCBs									
Aroclor 1254	0.17	NA	NA	NA	1.0	0.13	5.2	NA	**0.13**
Aroclor 1260	0.091	NA	NA	NA	1.0	0.13	5.2	NA	0.13
SEMIVOLATILES									
2-Methylnaphthalene	2.3	NA	NA	NA	NA	--	--	NA	NA
Phenanthrene	2.05	NA	NA	NA	NA	--	--	NA	NA
TPH									
WTPH by 418.1	1,420	6,719	NA	NA	200	--	--	NA	**200**
WTPH as Diesel	1,760	2,974	NA	NA	200	--	--	NA	**200**
WTPH as Gasoline	4.75	NA	NA	NA	100	--	--	NA	100
VOLATILES									
Toluene	0.23	NA	NA	NA	40	16,000	64,000	100	40
Ethylbenzene	0.77	NA	NA	NA	20	8,000	32,000	NA	20
Xylene (total)	0.96	NA	NA	NA	20	160,000	640,000	1,000	20

NOTES:

1 - Method A applies only to routine cleanup action and is not applicable for the Skykomish site. Method A values are presented in this table in response to a specific request from Ecology

NA - Not Applicable; no cleanup level specified in Method A, or compound not analyzed for or not a COI for this media

-- - Insufficient data to calculate

[shaded box] Indicates that site data exceed cleanup value

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TABLE 12-3

CALCULATED AIR CONCENTRATIONS AND CLEANUP LEVELS ($\mu g/m^3$)
BNRR MAINTENANCE AND FUELING FACILITY SITE
SKYKOMISH, WASHINGTON

Compound	CALCULATED AIR CONCENTRATION		AIR CLEANUP LEVEL	
	SOUTH SITE	NORTH SITE	MTCA METHOD B	MTCA METHOD C
METALS				
Antimony	1.49E-09	1.23E-10	--	--
Arsenic	1.52E-08	9.98E-09	1.50E-07	1.50E-06
Beryllium	5.30E-10	NA	8.93E-07	8.93E-06
Cadmium	6.99E-10	NA	--	--
Chromium	3.02E-08	4.18E-08	1.83E-07	1.83E-06
Copper	9.33E-08	3.55E-08	--	--
Lead	4.07E-07	6.08E-07	--	--
Mercury	1.53E-05	1.84E-05	1.37E-04	3.00E-04
Nickel	2.67E-08	2.77E-08	--	--
Selenium	1.31E-10	1.47E-10	--	--
Thallium	1.23E-10	NA	--	--
Zinc	1.61E-07	1.61E-07	--	--
PCBs				
Aroclor 1254	2.25E-07	NA	--	--
Aroclor 1260	1.20E-07	NA	--	--
SEMIVOLATILES				
2-Methylnaphthalene	8.26E-05	NA	--	--
Phenanthrene	4.02E-06	NA	--	--
VOLATILES				
Toluene	4.89E-06	NA	1.83E-01	4.00E-01
Ethylbenzene	8.25E-06	NA	4.57E-01	1.00E+00
Xylenes (total)	1.29E-05	NA	--	--

-- Indicates insufficient data to calculate cleanup level
NA - Not Applicable, compound not a COI for this media

TABLE 12-4

REMEDIAL ACTION OBJECTIVES AND CLEANUP STANDARDS
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

REMEDIAL ACTION OBJECTIVE	CLEANUP STANDARD
Protect humans from exposure to chemicals of interest in soil above protective levels	Prevent exposure of humans to soils within the upper 15 ft that contain concentrations above: 0.13 mg/kg PCBs All other soil COI are below appropriate risk-based cleanup levels
Protect humans from exposure to chemicals of interest in groundwater above protective levels.	Prevent human ingestion of groundwater that contains concentrations above: 0.05 μg/L arsenic 80 μg/L chromium 100 μg/L nickel 0.01 μg/L benzo(a)anthracene 0.01 μg/L chrysene All other groundwater COI are below risk-based cleanup levels or MCLs
Protect humans from exposure to chemicals of interest in aquatic organisms above protective levels.	Prevent discharges of groundwater to surface water that cause surface water concentrations to be exceed: 0.084 μg/L arsenic 0.15 μg/L mercury 0.03 μg/L benzo(a)anthracene 0.03 μg/L chrysene All other groundwater COI are below ambient water quality criteria to protect human health
Protect aquatic life from exposure to chemicals of interest above protective levels	Prevent LNAPL seeps and discharges of groundwater to surface water that cause surface water concentrations to exceed: 11 μg/L chromium (VI) 12 μg/L copper 3.2 μg/L lead 0.012 μg/L mercury 110 μg/L zinc All other groundwater COI are below ambient water quality criteria to protect aquatic life
Comply with applicable laws and standards	Address soil and groundwater that exceed the following Method A cleanup levels: 200 mg/kg TPH in soil 1 mg/L TPH in groundwater 250 mg/kg lead in soil 5 μg/L lead in groundwater All other site soil and groundwater COI are addressed above with risk-based valu

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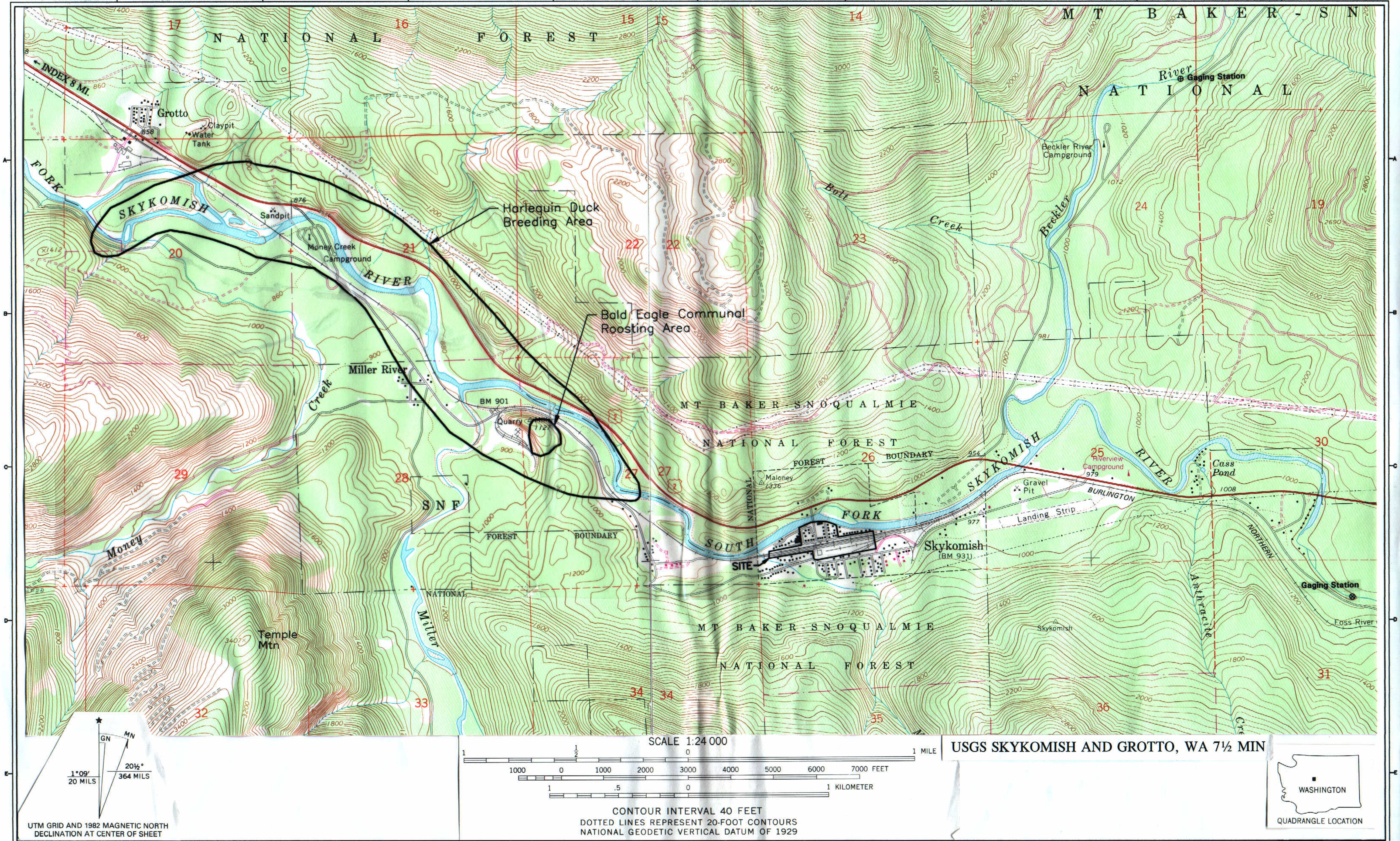
TABLE 12-5
POTENTIAL REQUIREMENTS CONSIDERED FOR DEVELOPMENT OF CLEANUP OBJECTIVES
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

AUTHORIZING STATUTE	IMPLEMENTING REGULATION	POTENTIALLY APPLICABLE?	RATIONALE
Chemical-Specific Requirements			
Clean Water Act 33 USC 1251-1387	Water Quality Standards 40 CFR 131	Yes	Groundwater discharges to surface waters that support aquatic life.
Safe Drinking Water Act 42 USC 300f-300j-11	Drinking Water Standards 40 CFR 141 and 143	Yes	Groundwater is used as a potable supply in the area of the Site.
Model Toxics Control Act RCW 70.105D	MTCA Cleanup Regulations WAC 173-340	Yes	Establishes cleanup standards for soil, groundwater, surface water and air.
Water Pollution Control Act RCW 90.48	Water Quality Standards for Surface Water WAC 173-201A	Yes	Establishes narrative and numeric standards for waters of the state.
Water Pollution Control Act RCW 90.48	Water Quality Standards for Groundwater WAC 173-201A	No	Cleanup actions under MTCA are exempt from the groundwater standards.
Public Water Supplies RCW 43.29	Maximum Contaminant Levels WAC 246-290	Yes	Groundwater used as potable supply in the Site area.
Location-Specific Requirements			
Floodplain Management Executive Order 11988	Procedures on Floodplain Management, 40 CFR 6, Appendix A	Yes	Will apply if cleanup activities occur within the floodplain.
Protection of Wetlands Executive Order 11988	Procedures on Wetlands Protection, 40 CFR 6, Appendix A	No	No adjacent wetlands so cleanup activities will not impact wetlands
Resource Conservation and Recovery Act, (RCRA) Subtitle D, 42 USC, 6931-6949	Solid Waste Disposal Facility Standards 40 CFR 257	Yes	Cleanup may include containment near floodplain, surface water
Solid Waste Management Act RCW 70.95	Minimum Functional Standards for Solid Waste WAC 173-304	No	Location standards do not apply to disposal of problem waste.
Shoreline Management Act RCW 90.58	Permits for Development on Shorelines of the State WAC 173-14	Yes	Will apply if cleanup activities occur within 200 ft of shoreline.

TABLE 12-5 (Continued)
POTENTIAL REQUIREMENTS CONSIDERED FOR DEVELOPMENT OF CLEANUP OBJECTIVES
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

AUTHORIZING STATUTE	IMPLEMENTING REGULATION	POTENTIALLY APPLICABLE?	RATIONALE
Endangered Species Act 16 USC, 1531 et seq.		No	No endangered species identified near the site.
Fish and Wildlife Coordination Act, 16 USC 661 et seq.		Yes	Will apply if cleanup impacts breeding area.
Action-Specific Requirements			
Resource Conservation and Recovery Act, (RCRA), Subtitle C, 42 USC 6921-6939	Identification and Listing of Wastes, 40 CFR 261;	No	No RCRA-regulated wastes identified.
Hazardous Waste Management Act RCW 70.105	Dangerous Waste Regulations; WAC 173-303	Yes	Generator and storage requirements may apply to recovered LNAPL
WA Clean Air Act RCW 70.94	PSAPCA Regulations 1 and 3	Yes	May apply to excavation and/or construction
Model Toxics Control Act RCW 70.105D	MTCA Cleanup Regulations WAC 173-340	Yes	Sets minimum requirements for cleanup actions



BNRR SKYKOMISH, WASHINGTON

3-1161-320

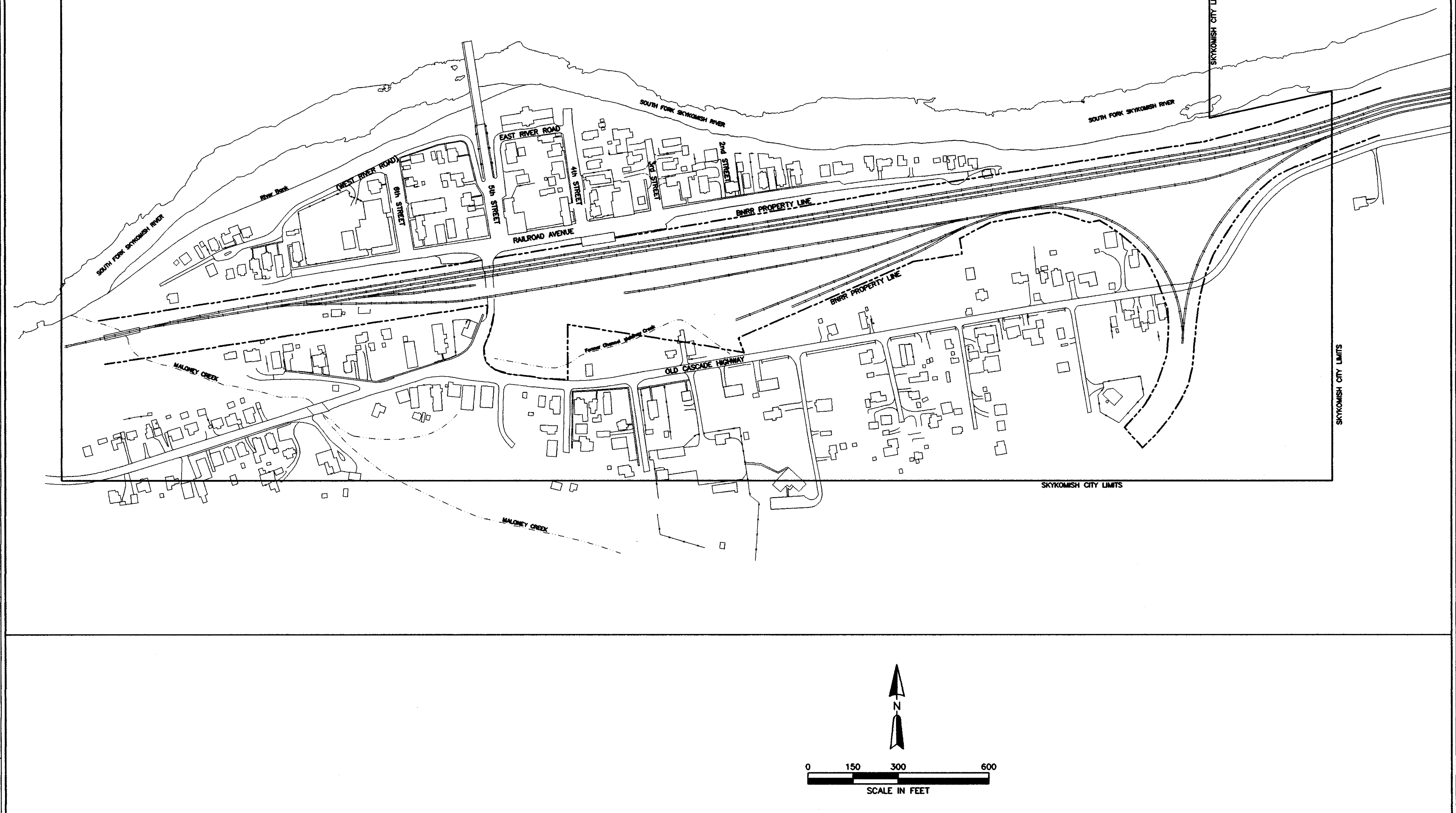
SITE LOCATION MAP

RETEC REMEDIATION TECHNOLOGIES INC

FIGURE 1-1 | REV 0

0 | E.F. | 2/16/95 | INITIAL ISSUE

CURRENT DATE: 2/16/95



REFERENCE DWG	DESCRIPTION	NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
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		0	E.F.	2/15/95	INITIAL ISSUE				

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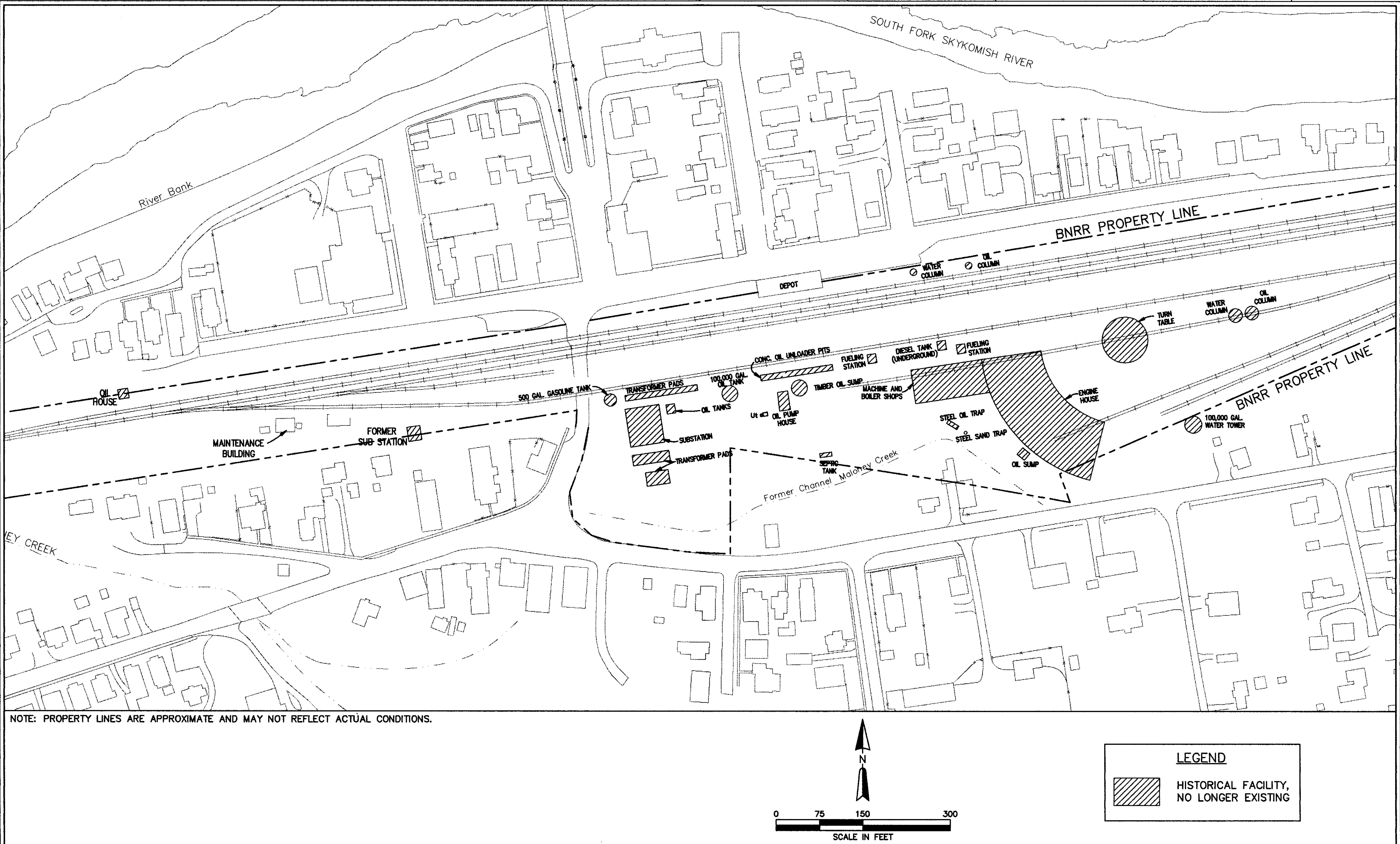
3-1161-350

CURRENT DATE: 2/15/95 CAD FILE 11615695

SITE LOCATION MAP

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 1-2 REV 0



NOTE: PROPERTY LINES ARE APPROXIMATE AND MAY NOT REFLECT ACTUAL CONDITIONS.

REFERENCE DWG	DESCRIPTION	NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
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3-1161-350

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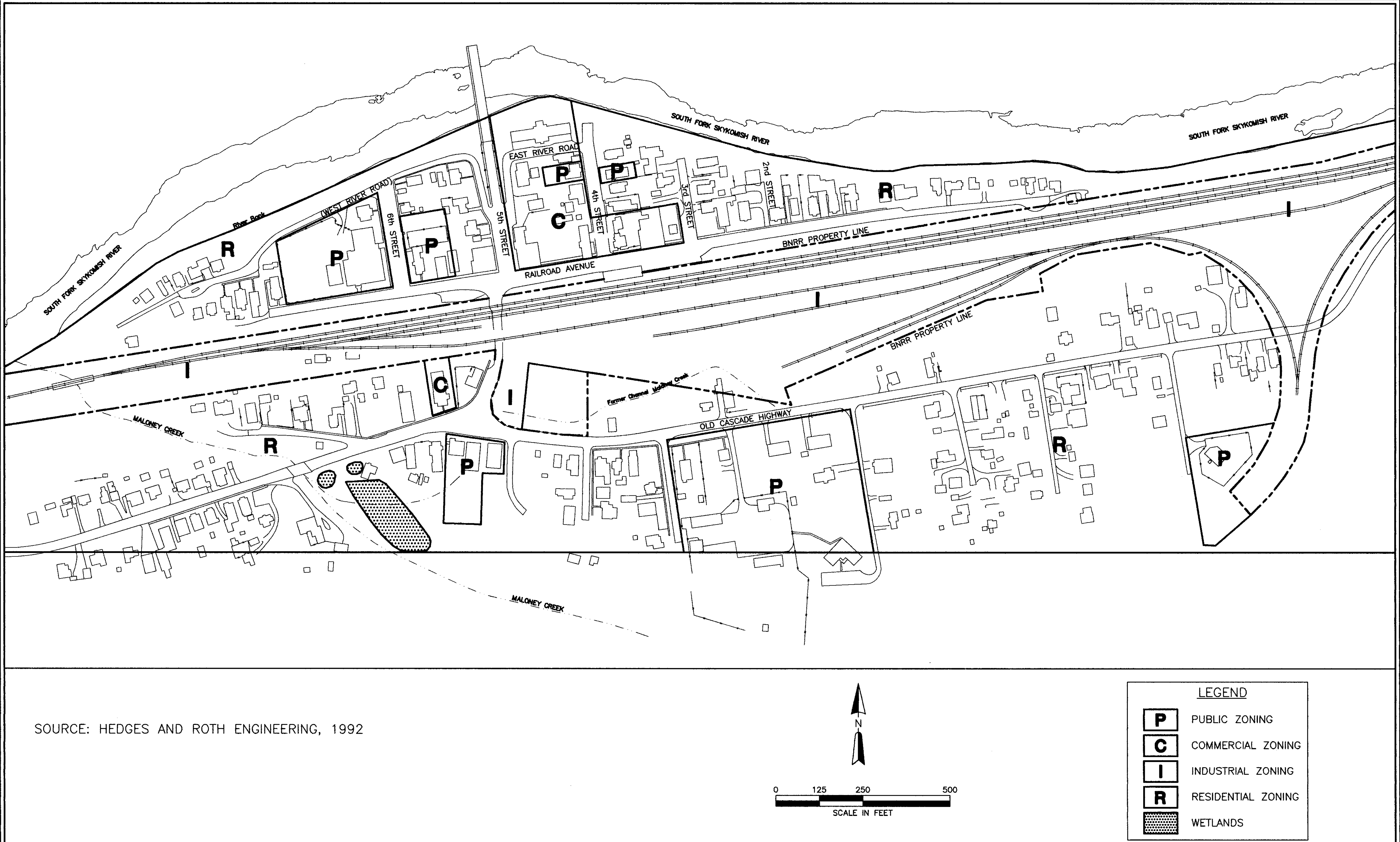
HISTORICAL FACILITIES MAP

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 1-3 REV. 0



SOURCE: HEDGES AND ROTH ENGINEERING, 1992

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
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REFERENCE DWG | DESCRIPTION

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3-1161-350

CURRENT DATE: 2/23/95 | CAD FILE 1161S54S

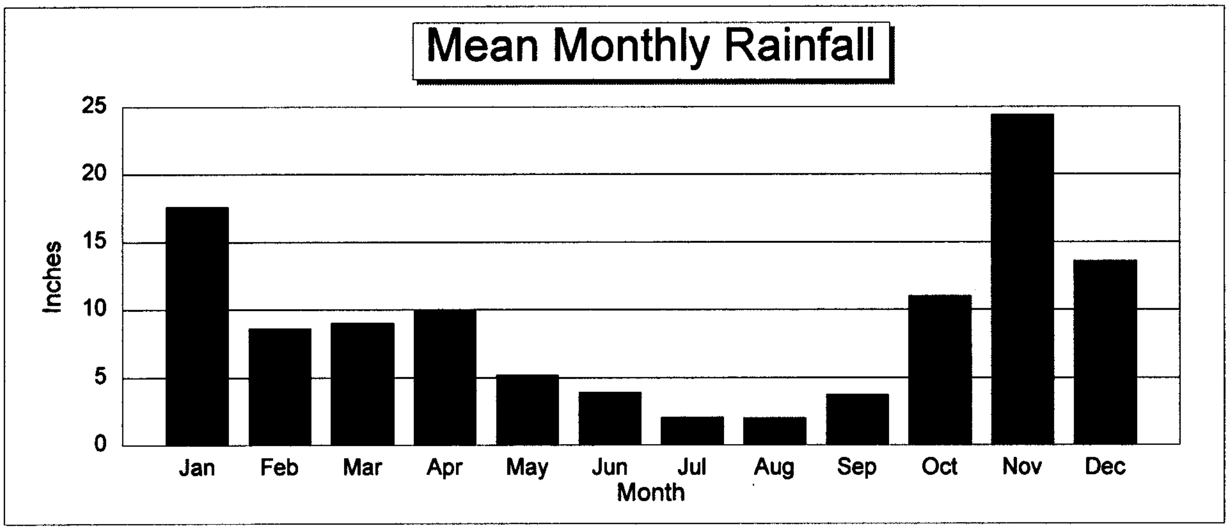
CURRENT LAND USE AND ZONING

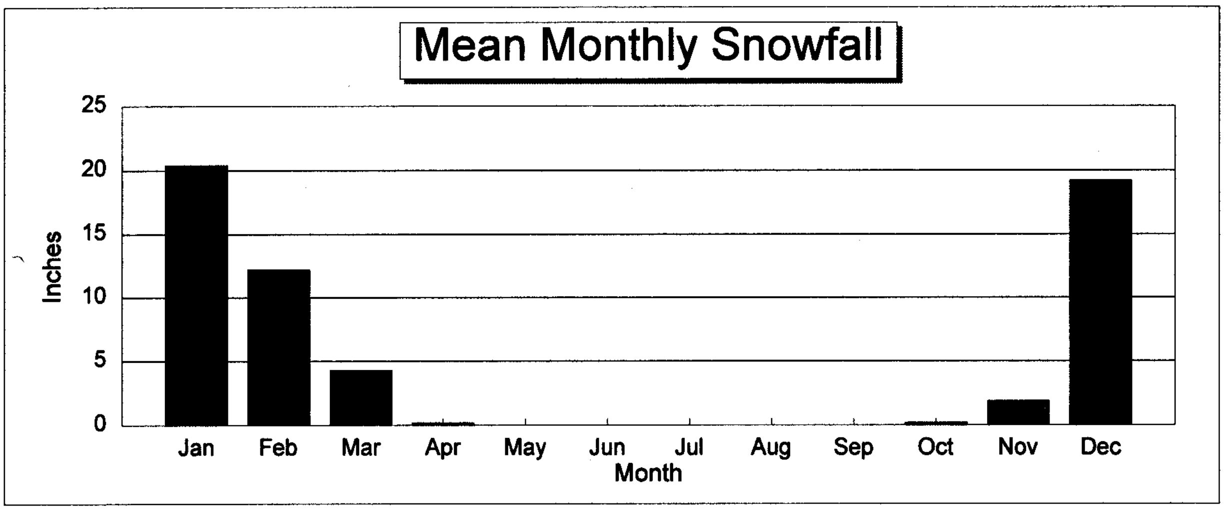
RETEC REMEDIATION TECHNOLOGIES INC

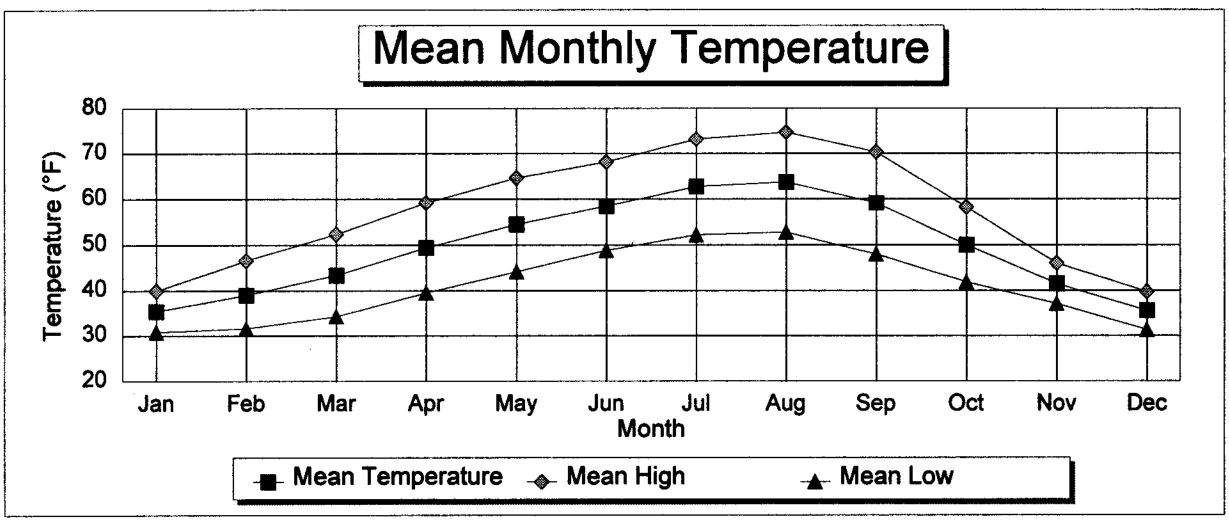
DRAWING NO. FIGURE 2-1 | REV 0

REI EC

FIGURE 2-2
MONTHLY CLIMATE TRENDS

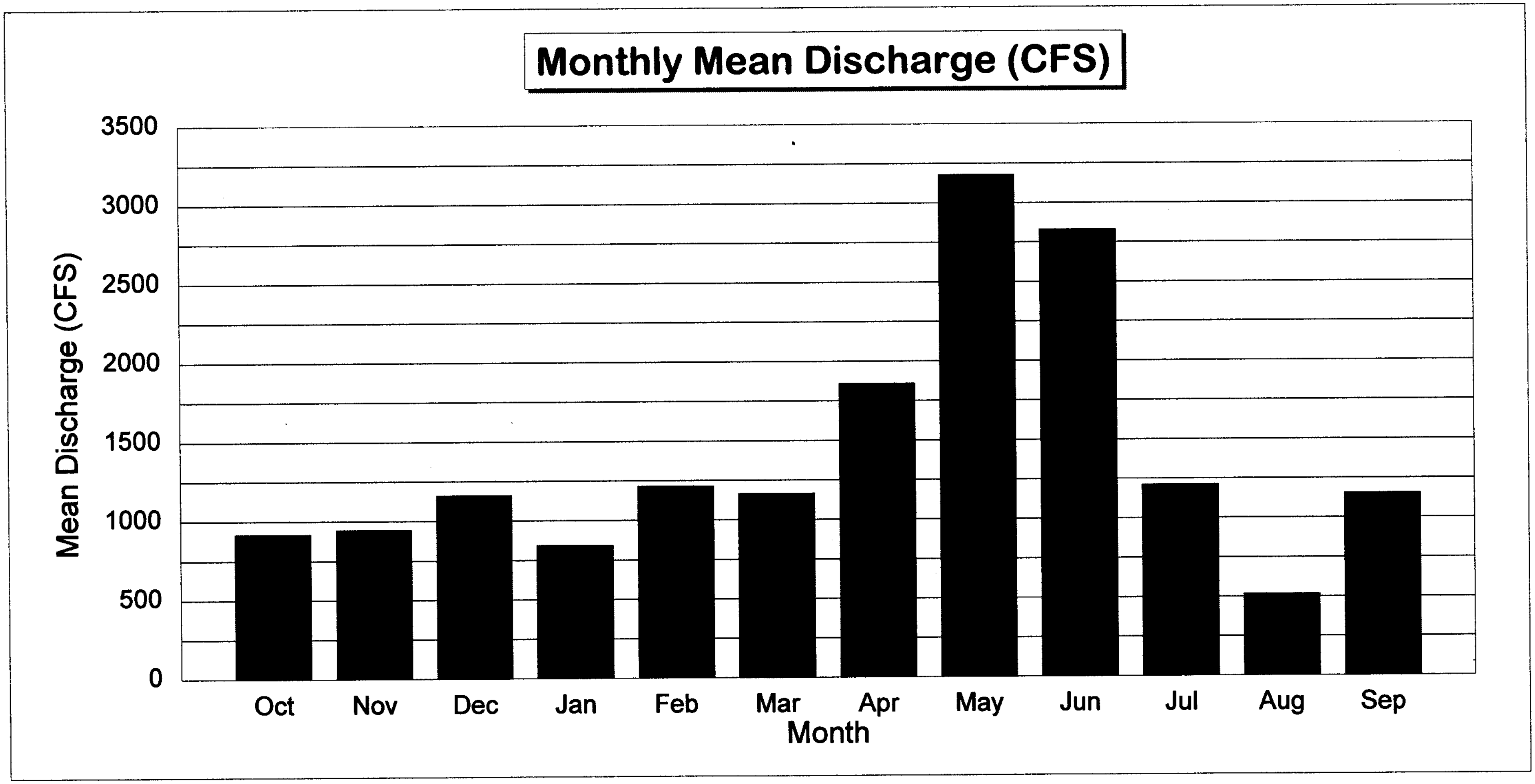






Period: January 1988 to July 1993
Source: Western Regional Climactic Center, Reno, Nevada

FIGURE 2-3
SOUTH FORK OF THE SKYKOMISH RIVER



NOTE: Based on sum of discharges measured on Beckler River and on South Fork upgradient of Beckler River during 1930-1931 and 1947-1949.

SOURCE:
FEMA, 1989 FOR MALONEY CREEK
HARPER RIGHELLIS, 1995 AREA NORTH OF MALONEY CREEK 100 YEAR FLOOD.

LEGEND

- FLOODWAY AREAS
- AREAS OF 100 YEAR FLOOD
- AREAS OF 500 YEAR FLOOD; AREAS OF 100 YEAR FLOOD WITH AVERAGE DEPTHS OF LESS THAN 1 FOOT OR WITH DRAINAGE AREAS LESS THAN 1 SQUARE MILE; AND AREAS AREAS PROTECTED BY LEVEES FROM 100 YEAR FLOOD.
- AREAS OUTSIDE OF 500 YEAR FLOOD
- —925— BASE FLOOD ELEVATION (FT*)

* NATIONAL GEODETIC VERTICAL DATUM OF 1929

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
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3-1161-350

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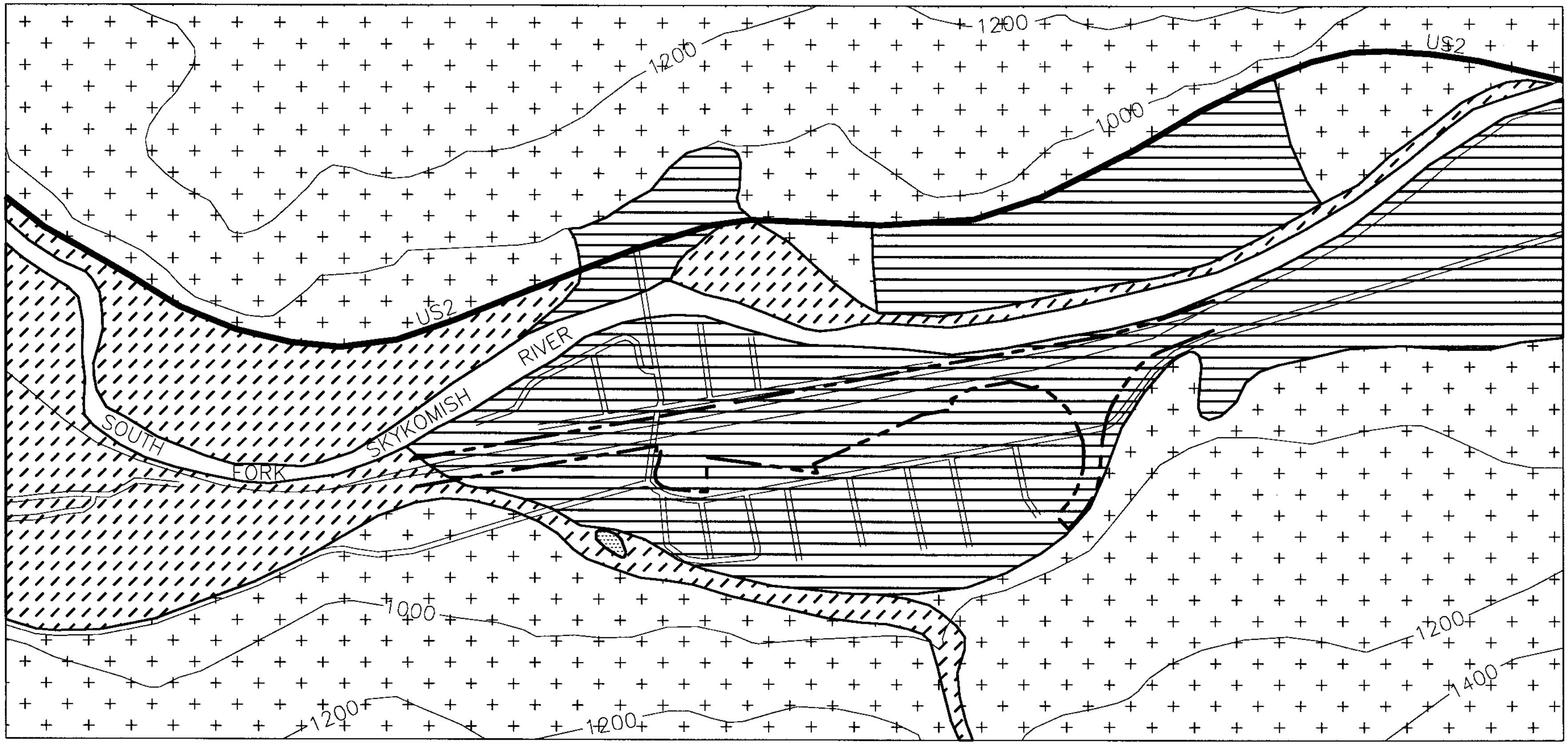
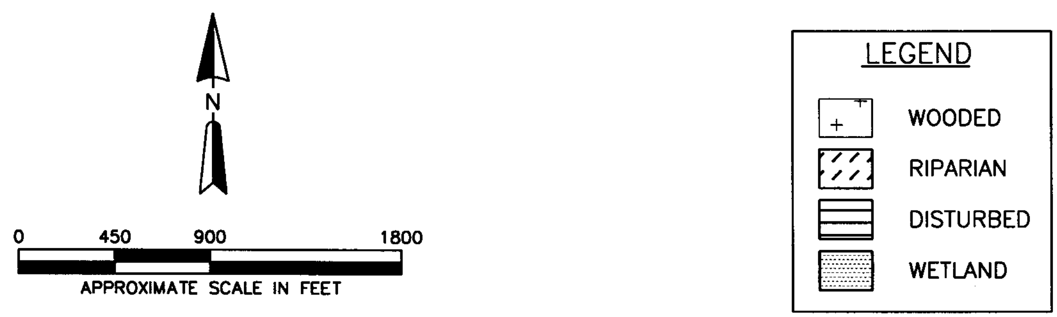
FLOOD PLAIN MAP

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 2-4 REV 0



SOURCE: USGS SKYKOMISH 7.5'



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0							
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NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE

BNRR SKYKOMISH, WASHINGTON

3-1161-350

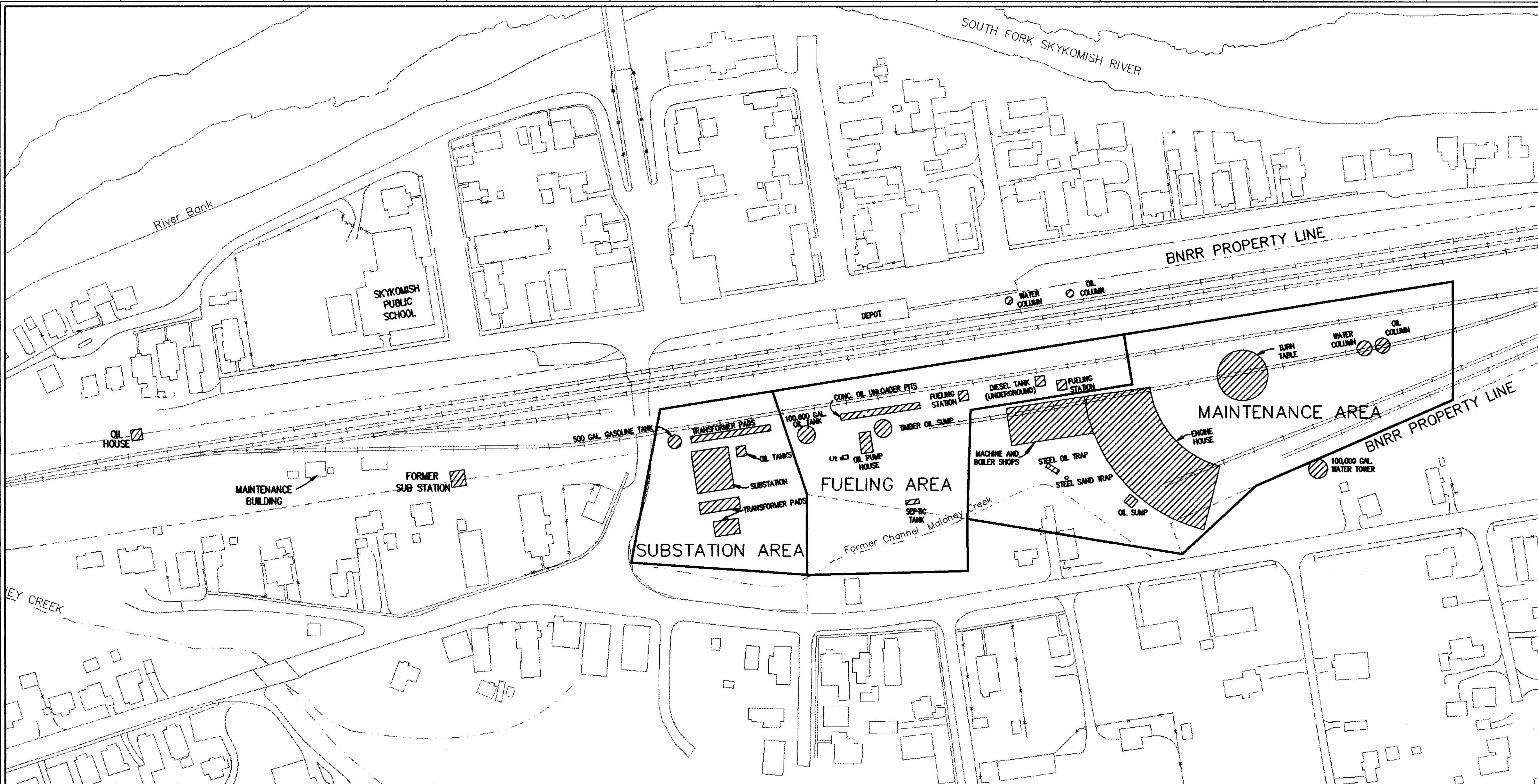
SCALE: NONE

CAD FILE: 1161S75S

DISTRIBUTION OF GENERAL VEGETATION ZONES

RETEC
REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 2-5 REV. 0



NOTE: PROPERTY LINES ARE APPROXIMATE AND MAY NOT REFLECT ACTUAL CONDITIONS.

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REFERENCE DWG | DESCRIPTION

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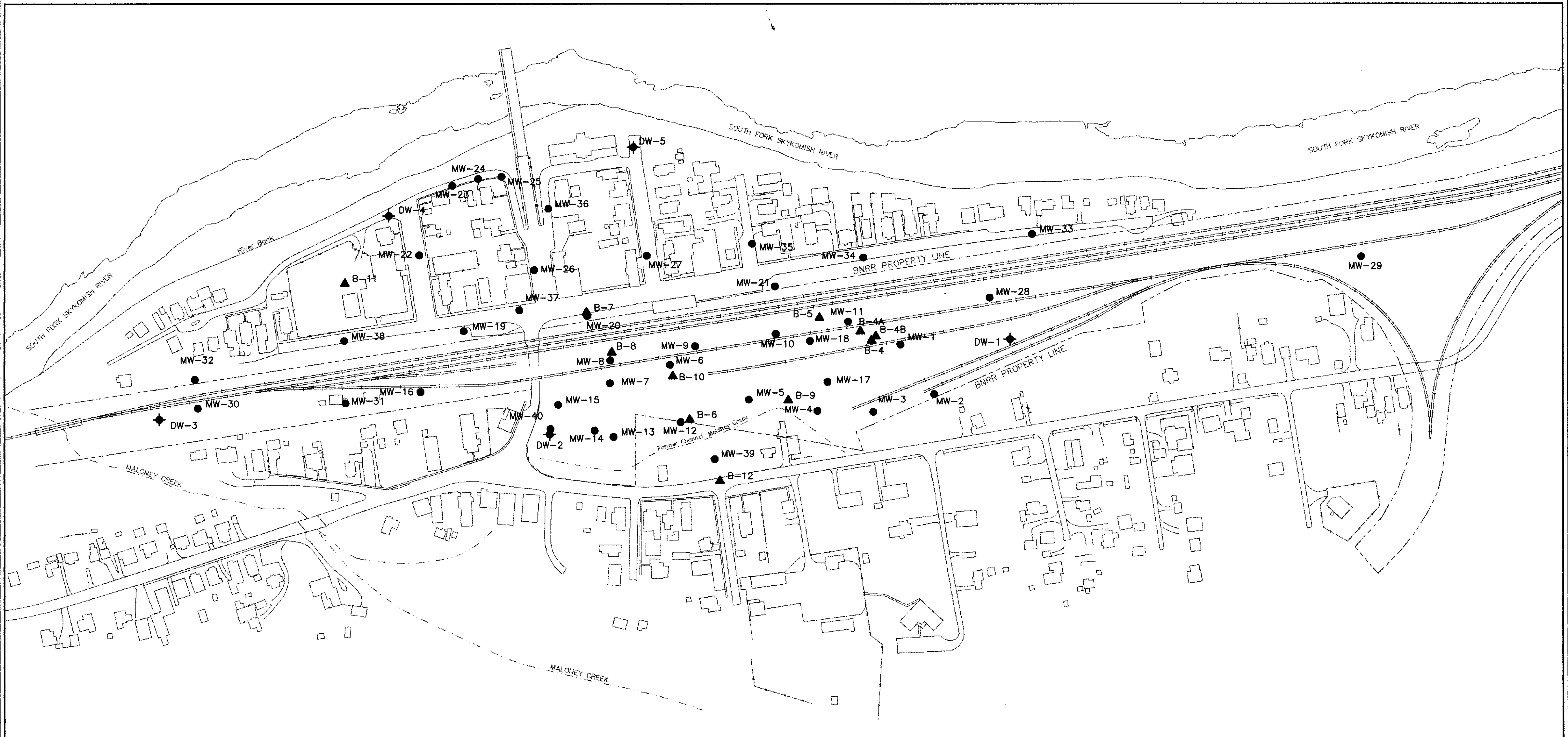
CURRENT DATE: 2/23/95 | CAD FILE 1161S83S

LOCATION OF SOURCE AREAS

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 3-1 | 0



N

0 125 250 500

SCALE IN FEET

LEGEND

- MW-32 MONITORING WELL LOCATION
- DW-1 DEEP MONITORING WELL LOCATION
- B-11 BORING LOCATION

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
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REFERENCE DWG	DESCRIPTION

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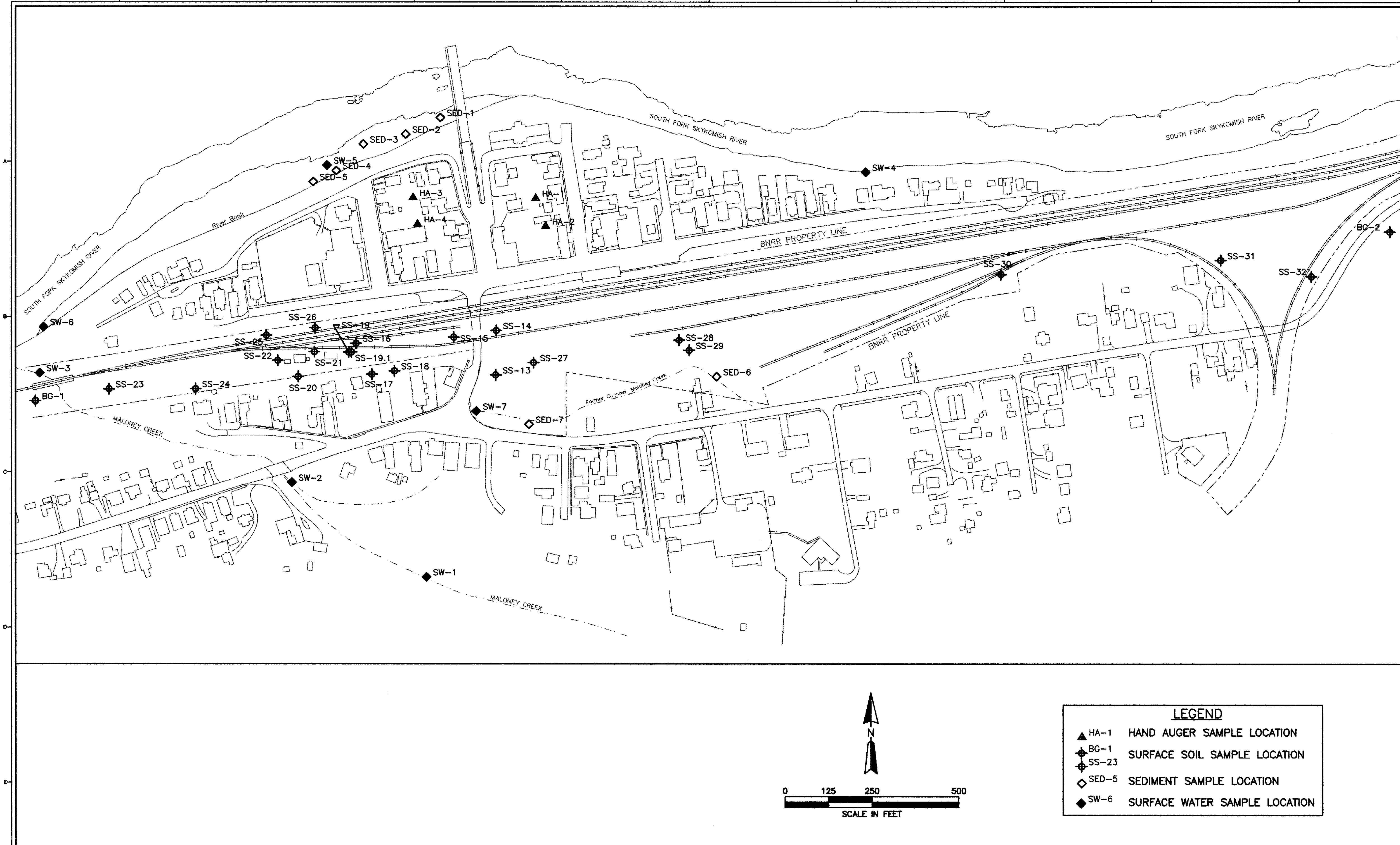
CURRENT DATE: 1/18/95 CAD FILE 1161S50S

BORING AND WELL LOCATION MAP

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 4-1 REV. 0



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REFERENCE DWG | DESCRIPTION

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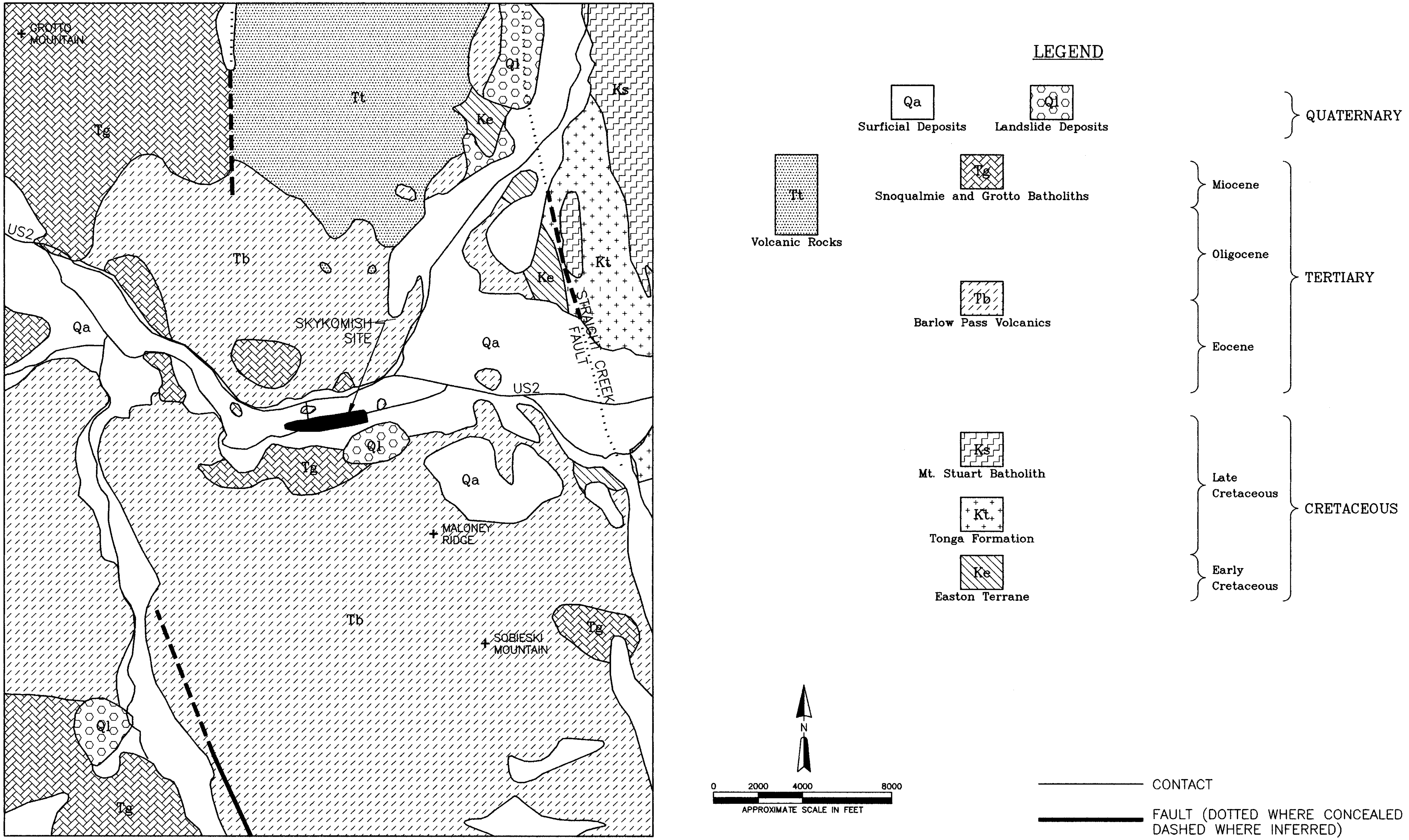
CURRENT DATE: 2/15/95 CAD FILE 1161S51S

REMEDIAL INVESTIGATION
HAND AUGER, SURFACE SOIL,
SEDIMENT, SURFACE WATER SAMPLE
LOCATION MAP

RETEC
REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 4-2 REV. 0



SOURCE: TABOR, et.al, 1994

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
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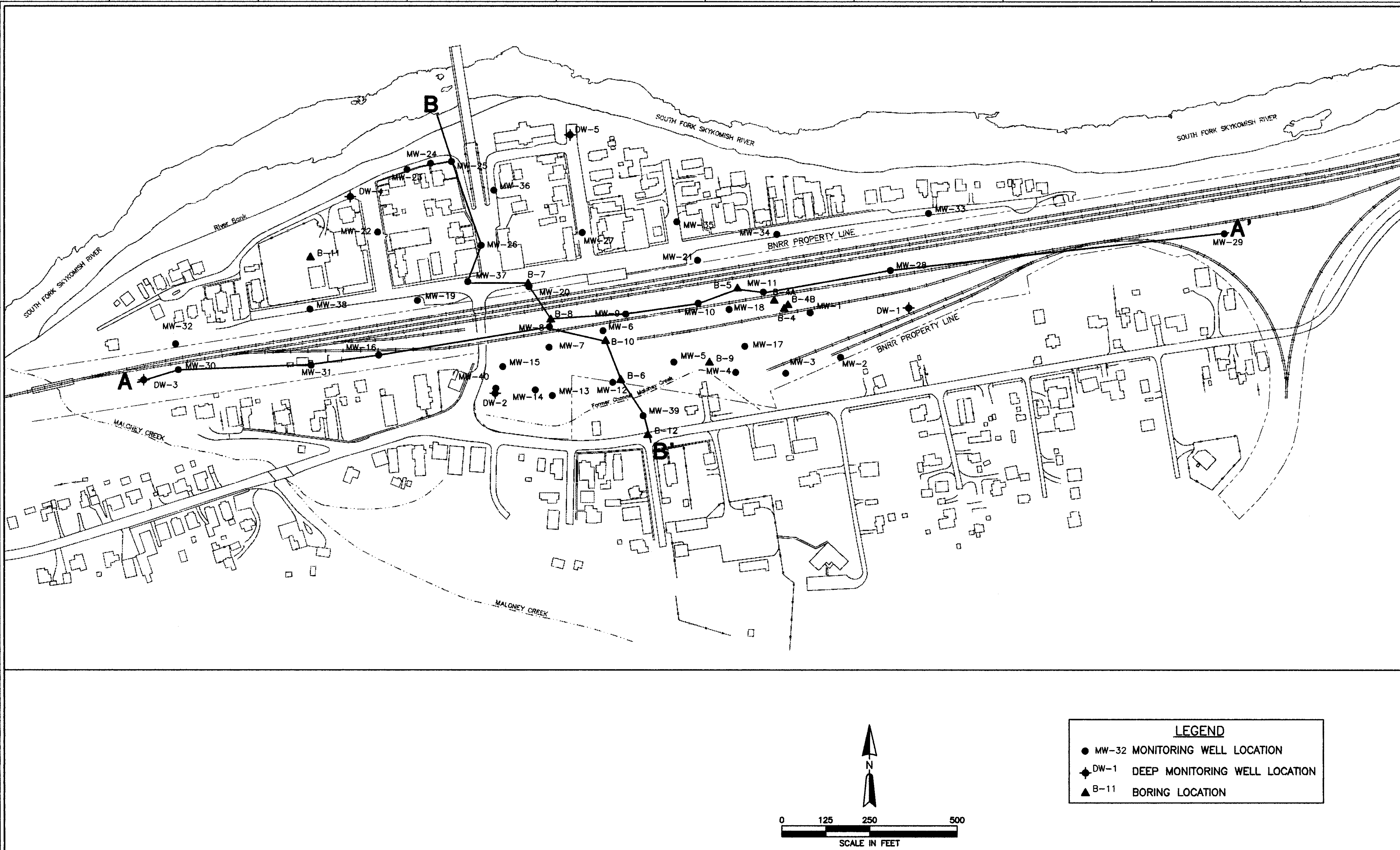
3-1161-350

CURRENT DATE: 2/3/95 CAD FILE 11613S2S

GENERALIZED GEOLOGIC MAP

RETEC REMEDIATION TECHNOLOGIES INC

FIGURE 5-1 REV 0



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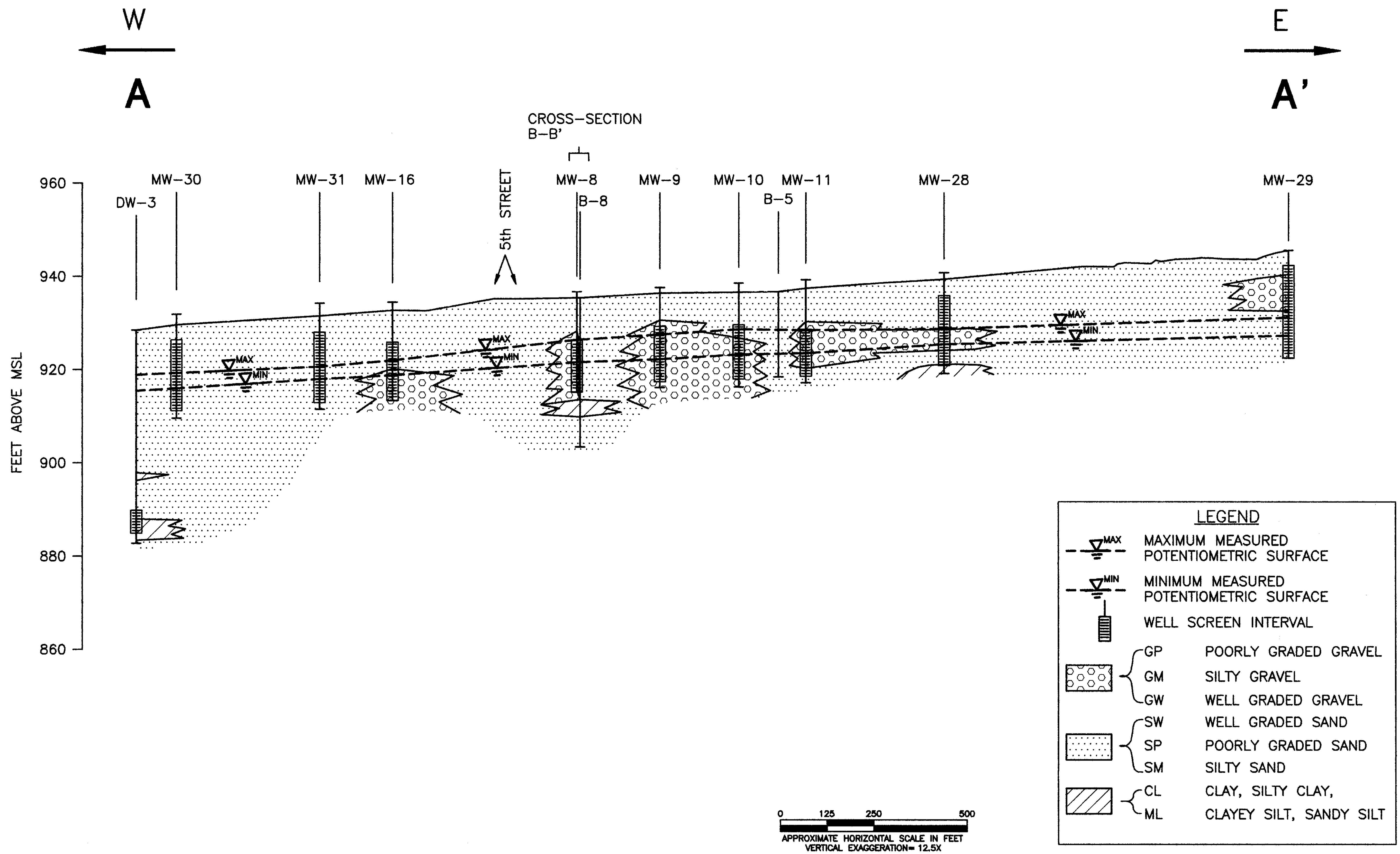
CURRENT DATE: 2/15/95 CAD FILE 1161S77S

CROSS SECTION LOCATION MAP

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 5-2 REV 0



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REFERENCE DWG	DESCRIPTION	NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD DATE

BNRR SKYKOMISH, WASHINGTON

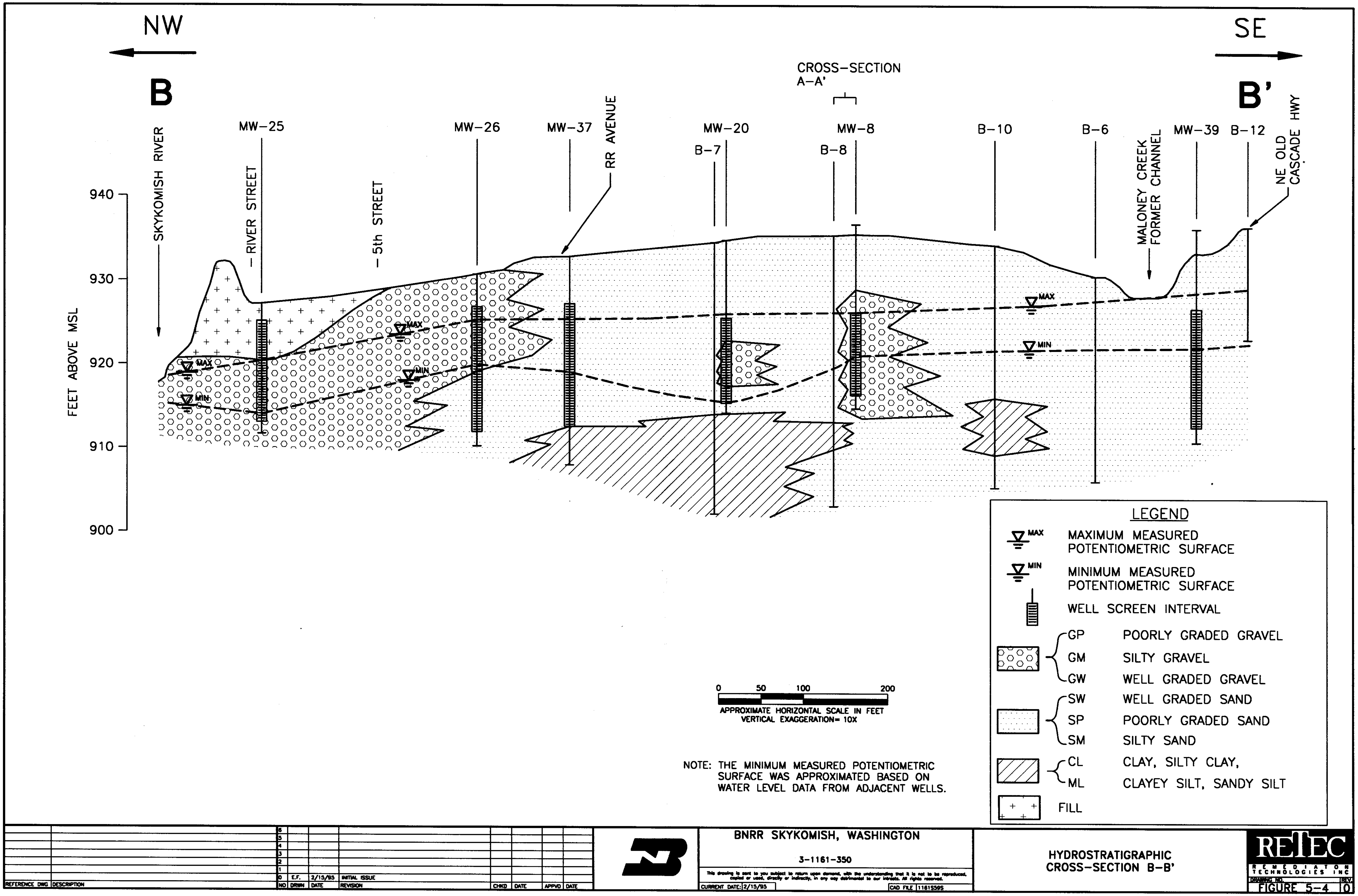
3-1161-350

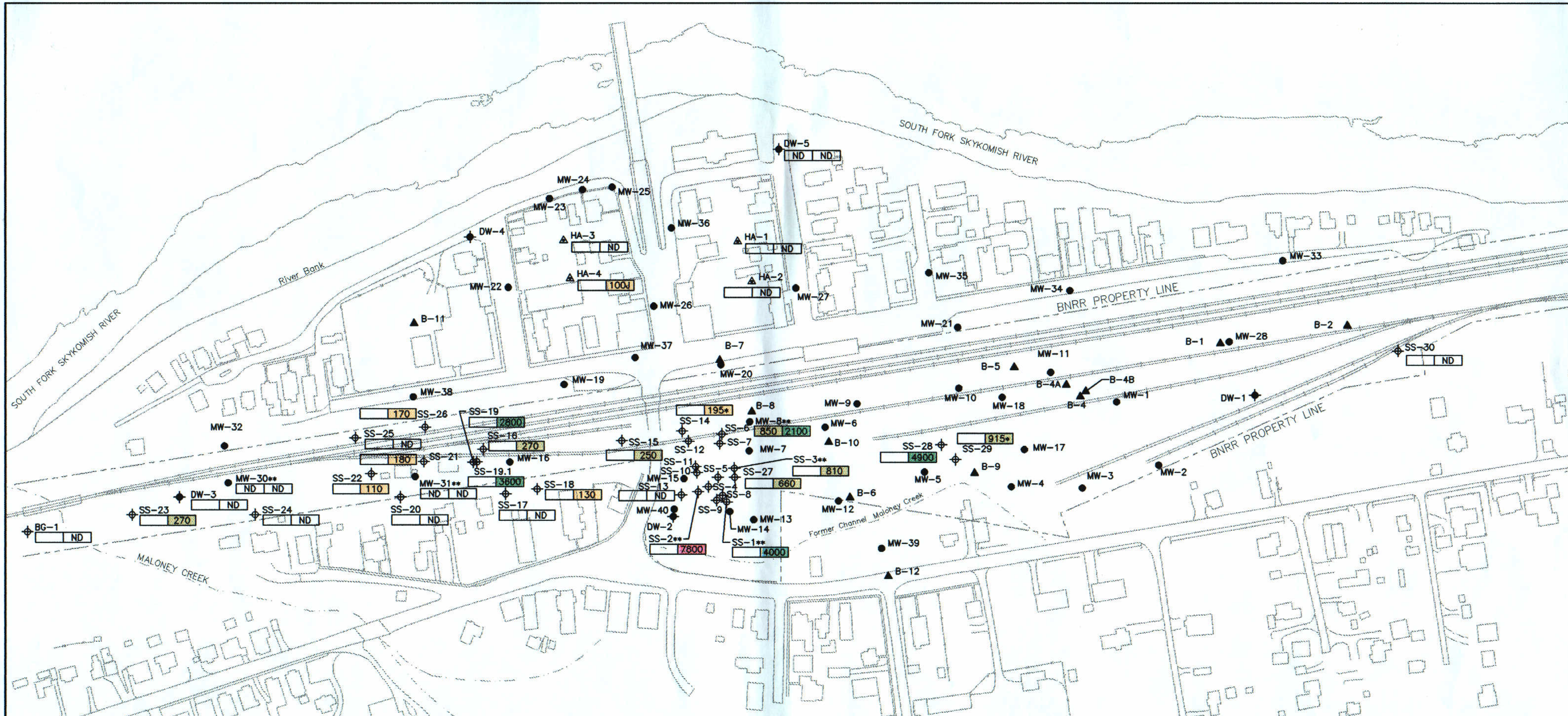
CURRENT DATE: 2/15/95 CAD FILE 1161S608

HYDROSTRATIGRAPHIC CROSS-SECTION A-A'

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 5-3 REV 0


NW
SE
B
B'
CROSS-SECTION A-A'
SKYKOMISH RIVER
MW-25
RIVER STREET
5th STREET
MW-26
MW-37
RR AVENUE
MW-20
B-7
B-8
MW-8
B-10
B-6
MALONEY CREEK FORMER CHANNEL
MW-39
B-12
NE OLD CASCADE HWY
FEET ABOVE MSL
940
930
920
910
900
MAX
MIN
LEGEND
MAXIMUM MEASURED POTENTIOMETRIC SURFACE
MINIMUM MEASURED POTENTIOMETRIC SURFACE
WELL SCREEN INTERVAL
GP POORLY GRADED GRAVEL
GM SILTY GRAVEL
GW WELL GRADED GRAVEL
SW WELL GRADED SAND
SP POORLY GRADED SAND
SM SILTY SAND
CL CLAY, SILTY CLAY,
ML CLAYEY SILT, SANDY SILT
FILL
0 50 100 200
APPROXIMATE HORIZONTAL SCALE IN FEET
VERTICAL EXAGGERATION= 10X
NOTE: THE MINIMUM MEASURED POTENTIOMETRIC SURFACE WAS APPROXIMATED BASED ON WATER LEVEL DATA FROM ADJACENT WELLS.
0 E.F. 2/15/95 INITIAL ISSUE
NO DRWN DATE REVISION CHKD DATE APPVD DATE
REFERENCE DWG DESCRIPTION
BNRR SKYKOMISH, WASHINGTON
3-1161-350
CURRENT DATE: 2/15/95
CAD FILE 1161S59S
HYDROSTRATIGRAPHIC CROSS-SECTION B-B'
RETEC
REMEDIATION TECHNOLOGIES INC
FIGURE 5-4
0



LEGEND

● MW-32	MONITORING WELL LOCATION
DW-1	DEEP MONITORING WELL LOCATION
▲ B-11	BORING LOCATION
BG-1	BACKGROUND SAMPLE LOCATION
SS-23	SURFACE SOIL SAMPLE LOCATION
HA-1	HAND AUGER SAMPLE LOCATION

24 | 480 WTPH-D / WTPH-418.1

CONCENTRATIONS

- >ND-200 mg/kg
- 201-1,000 mg/kg
- 1,001-5,000 mg/kg
- >5,000 mg/kg

ND NOT DETECTED

J INDICATES ESTIMATED VALUE

NOTES:

1. * INDICATES THE AVERAGE CONCENTRATION OF DUPLICATE SAMPLE.
2. ** INDICATES PRE-RI DATA (THE METHOD USED DURING THE PRE-RI INVESTIGATIONS MAY PROVIDE LOWER VALUES THAN CURRENT METHODS)

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
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0	E.F.	2/24/95	INITIAL ISSUE				

REFERENCE DWG | DESCRIPTION

BNRR SKYKOMISH, WASHINGTON

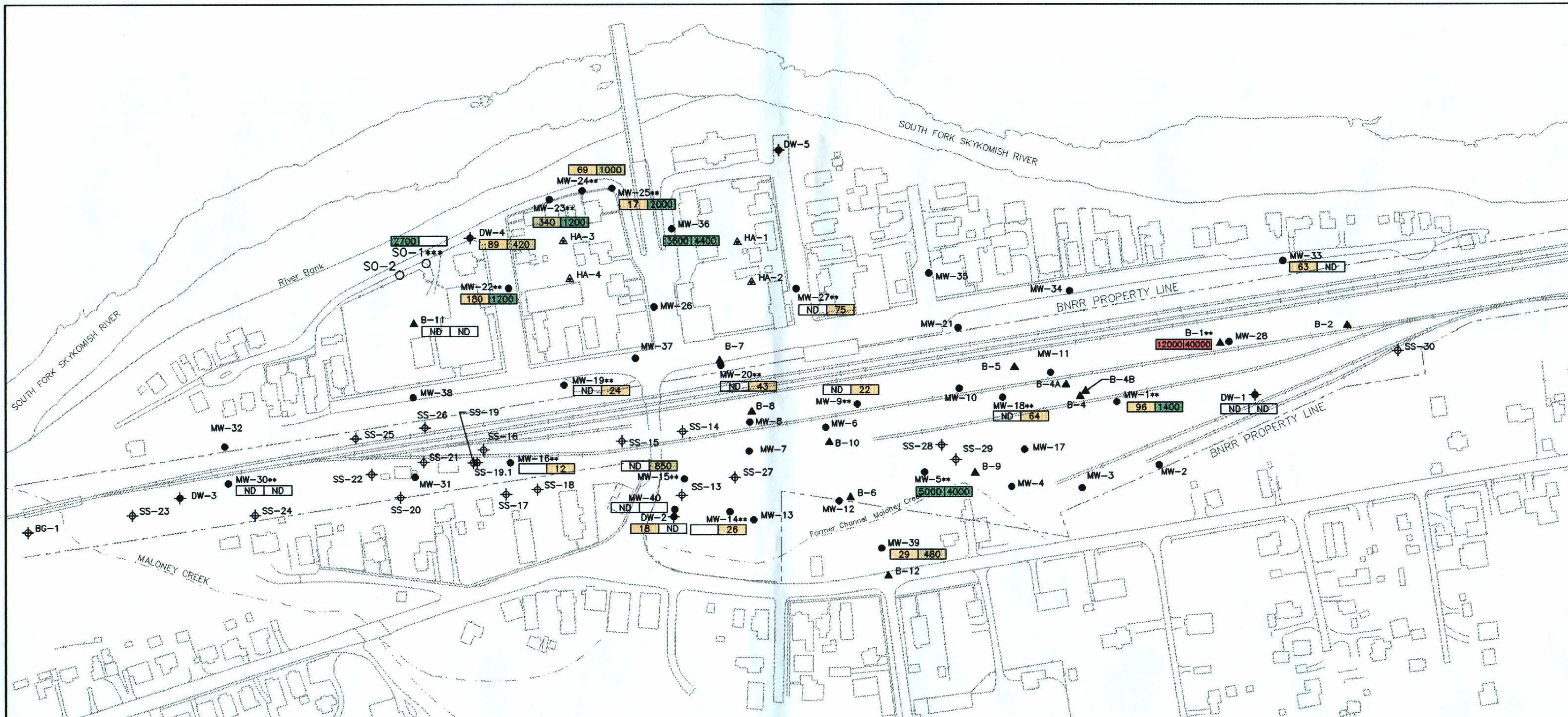
3-1161-350

CURRENT DATE: 2/24/95 | CAD FILE 1161S71S

TPH CONCENTRATIONS IN VADOSE SOIL SAMPLES (0-2 FEET BGS)

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 5-5 REV 0



NOTES:

1. * INDICATES THE AVERAGE CONCENTRATION OF DUPLICATE SAMPLE.
2. ** INDICATES PRE-RI DATA (THE METHOD USED DURING THE PRE-RI INVESTIGATIONS MAY PROVIDE LOWER VALUES THAN CURRENT METHODS)
3. *** INDICATES INTERIM ACTION DATA ANALYTICAL METHOD WAS WTPH-D EXTENDED.

LEGEND

- ● MW-32 MONITORING WELL LOCATION
- DW-1 DEEP MONITORING WELL LOCATION
- ▲ B-11 BORING LOCATION
- BG-1 BACKGROUND SAMPLE LOCATION
- SS-23 SURFACE SOIL SAMPLE LOCATION
- HA-1 HAND AUGER SAMPLE LOCATION

24 | 480 WTPH-D / WTPH-418.1

CONCENTRATIONS

- >ND-200 mg/kg
- 201-1,000 mg/kg
- 1,001-5,000 mg/kg
- >5,000 mg/kg
- ND NOT DETECTED
- J INDICATES ESTIMATED VALUE

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
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0	E.F.	2/24/95	INITIAL ISSUE				

REFERENCE DWG | DESCRIPTION

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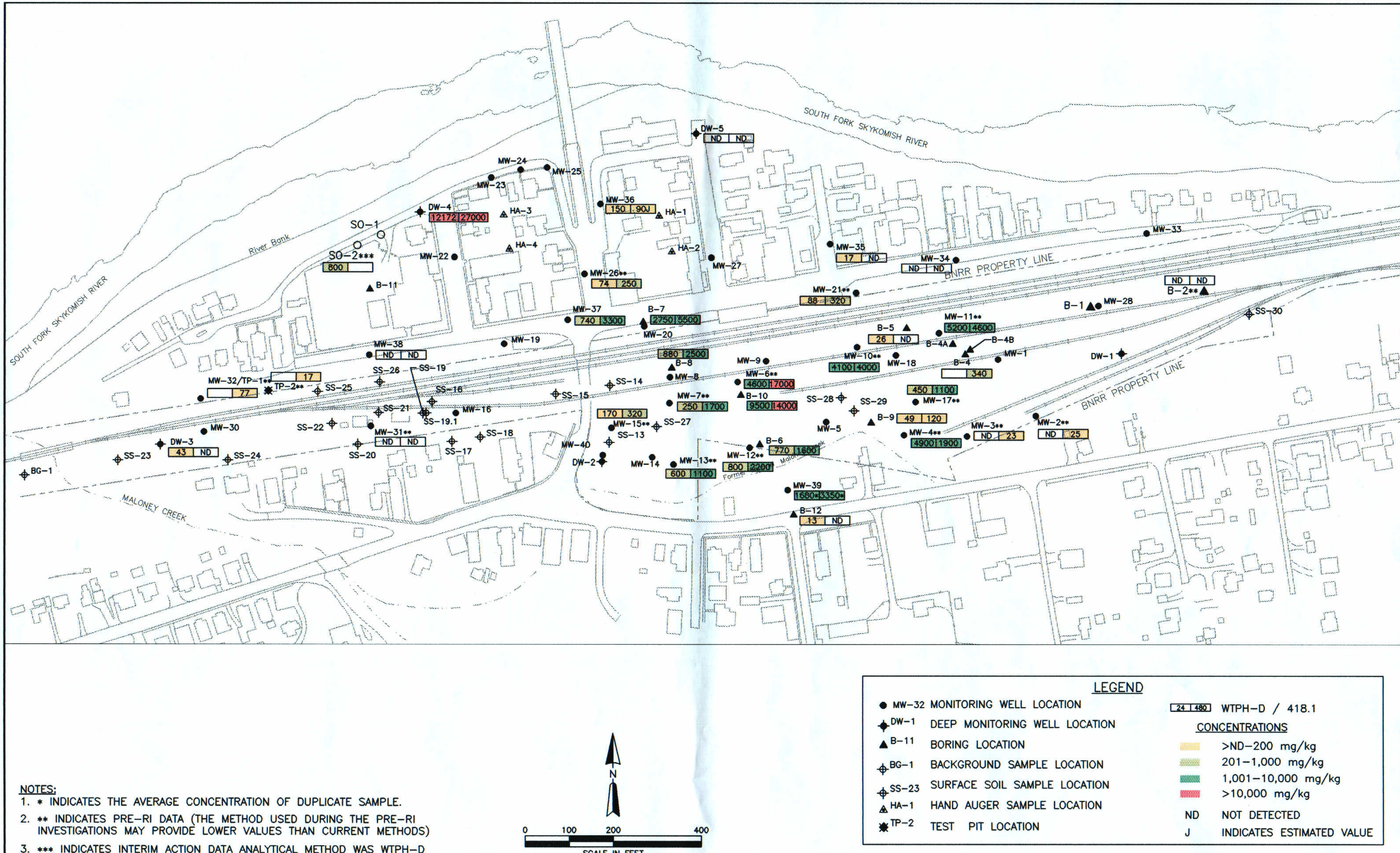
3-1161-350

CURRENT DATE: 2/24/95 CAD FILE 1161S87S

TPH CONCENTRATIONS IN VADOSE SOIL SAMPLES (2-6 FEET BGS)

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 5-6 REV 0



LEGEND

- ● MW-32 MONITORING WELL LOCATION
- DW-1 DEEP MONITORING WELL LOCATION
- ▲ B-11 BORING LOCATION
- BG-1 BACKGROUND SAMPLE LOCATION
- SS-23 SURFACE SOIL SAMPLE LOCATION
- HA-1 HAND AUGER SAMPLE LOCATION
- TP-2 TEST PIT LOCATION

24 | 480 WTPH-D / 418.1

CONCENTRATIONS

- >ND-200 mg/kg
- 201-1,000 mg/kg
- 1,001-10,000 mg/kg
- >10,000 mg/kg
- ND NOT DETECTED
- J INDICATES ESTIMATED VALUE

NOTES:

1. * INDICATES THE AVERAGE CONCENTRATION OF DUPLICATE SAMPLE.
2. ** INDICATES PRE-RI DATA (THE METHOD USED DURING THE PRE-RI INVESTIGATIONS MAY PROVIDE LOWER VALUES THAN CURRENT METHODS)
3. *** INDICATES INTERIM ACTION DATA ANALYTICAL METHOD WAS WTPH-D EXTENDED.

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REFERENCE DWG | DESCRIPTION

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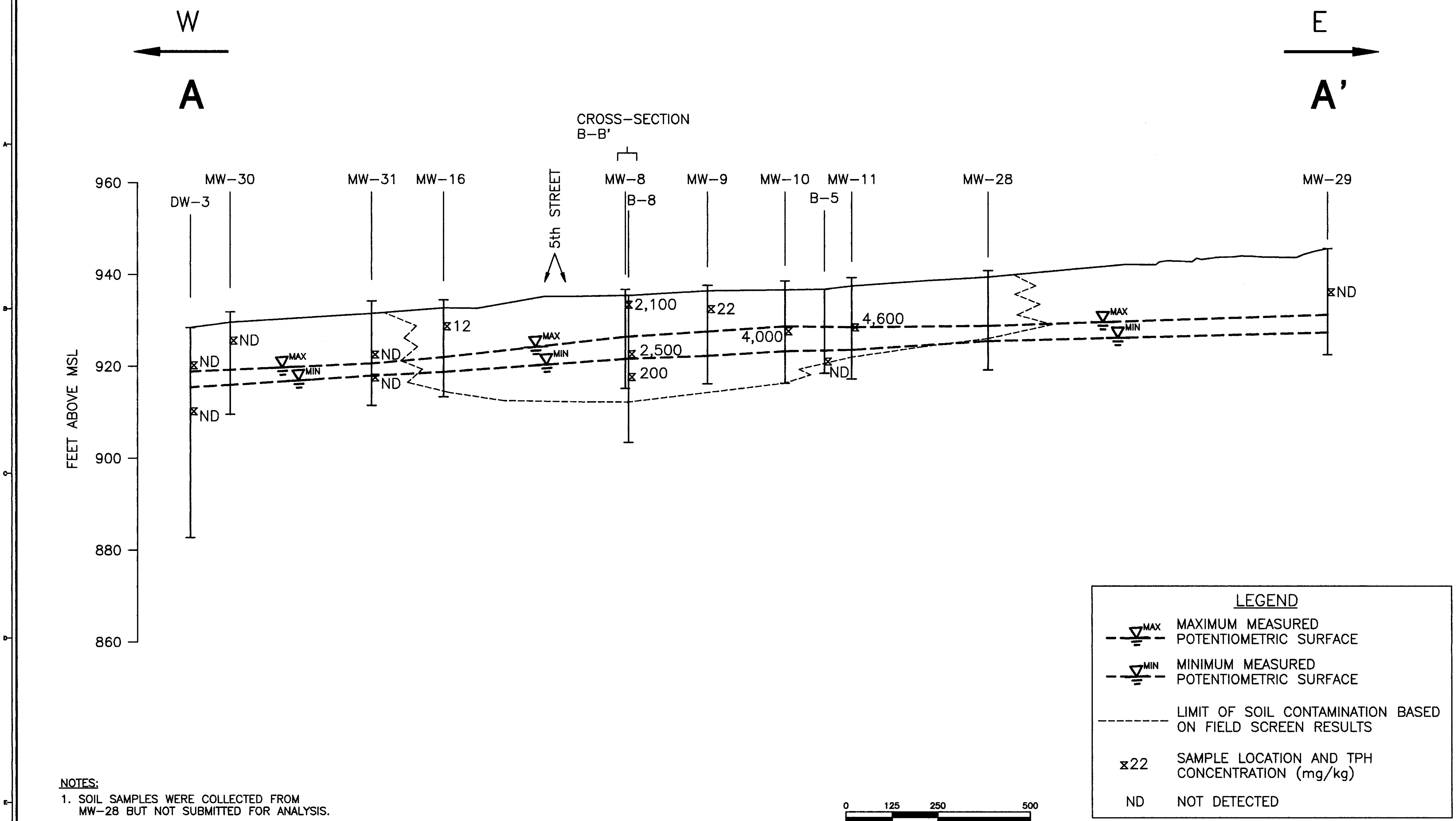
3-1161-350

CURRENT DATE: 2/10/95 | CAD FILE 1161S72S

TPH CONCENTRATIONS IN AQUIFER SOIL SAMPLES (6-17 FEET BGS)

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 5-7 REV 0



NOTES:

1. SOIL SAMPLES WERE COLLECTED FROM MW-28 BUT NOT SUBMITTED FOR ANALYSIS.
2. SOIL SAMPLES WERE ANALYZED FOR TPH USING WTPH 418.1.

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
0	E.F.	2/15/95	INITIAL ISSUE				

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3-1161-350

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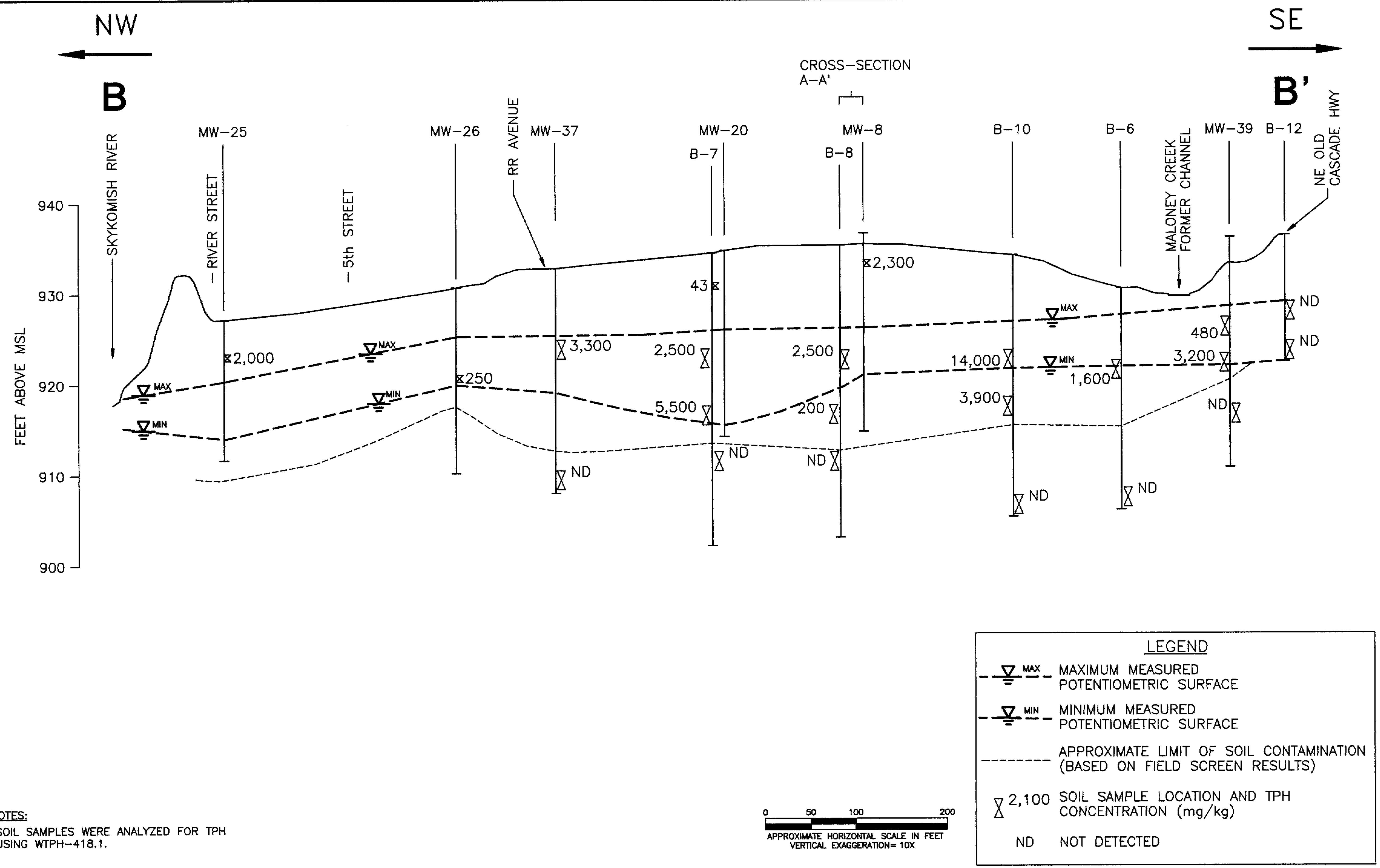
CROSS-SECTION A-A' SHOWING TPH CONCENTRATIONS IN SOIL

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 5-8 REV 0



NOTES:

SOIL SAMPLES WERE ANALYZED FOR TPH USING WTPH-418.1.

NO	DRWN	DATE	REVISION
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1	E.F.	2/15/95	REVISIONS
0	D.M.	2/6/95	INITIAL ISSUE

REFERENCE DWG DESCRIPTION | CHKD DATE | APPVD DATE

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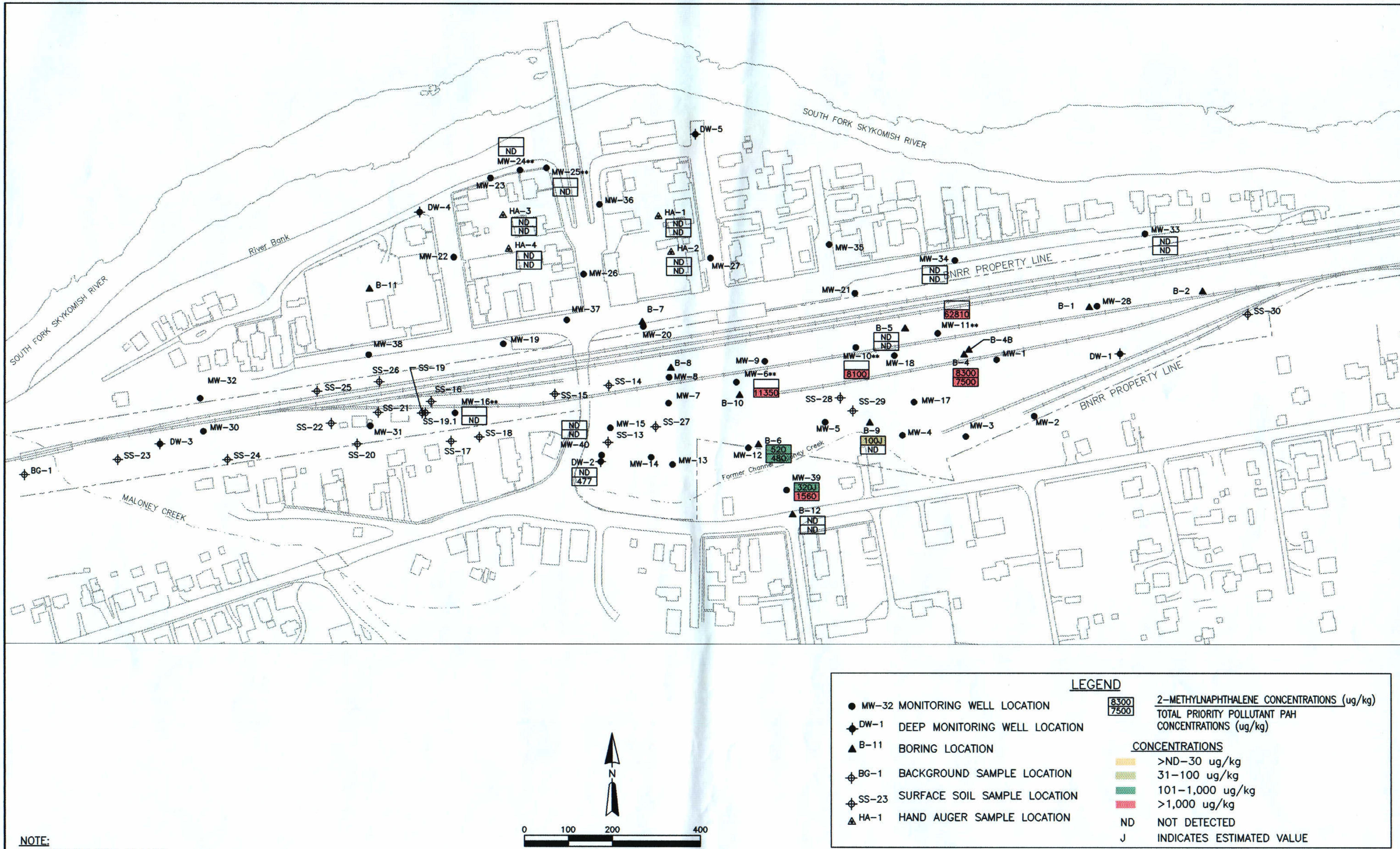
CROSS-SECTION B-B' SHOWING TPH CONCENTRATIONS IN SOIL

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 5-9 REV. 0



LEGEND

● MW-32	MONITORING WELL LOCATION	8300 / 7500	2-METHYLNAPHTHALENE CONCENTRATIONS (ug/kg) / TOTAL PRIORITY POLLUTANT PAH CONCENTRATIONS (ug/kg)
DW-1	DEEP MONITORING WELL LOCATION		CONCENTRATIONS
▲ B-11	BORING LOCATION		>ND-30 ug/kg
BG-1	BACKGROUND SAMPLE LOCATION		31-100 ug/kg
SS-23	SURFACE SOIL SAMPLE LOCATION		101-1,000 ug/kg
HA-1	HAND AUGER SAMPLE LOCATION		>1,000 ug/kg
		ND	NOT DETECTED
		J	INDICATES ESTIMATED VALUE

NOTE:
** INDICATES PRE-RI DATA

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
6							
5							
4							
3							
2							
1	E.F.	1/18/96	ADD TOTAL PAH CONCENTRATIONS				
0	E.F.	2/15/95	INITIAL ISSUE				

REFERENCE DWG | DESCRIPTION

BNRR SKYKOMISH, WASHINGTON

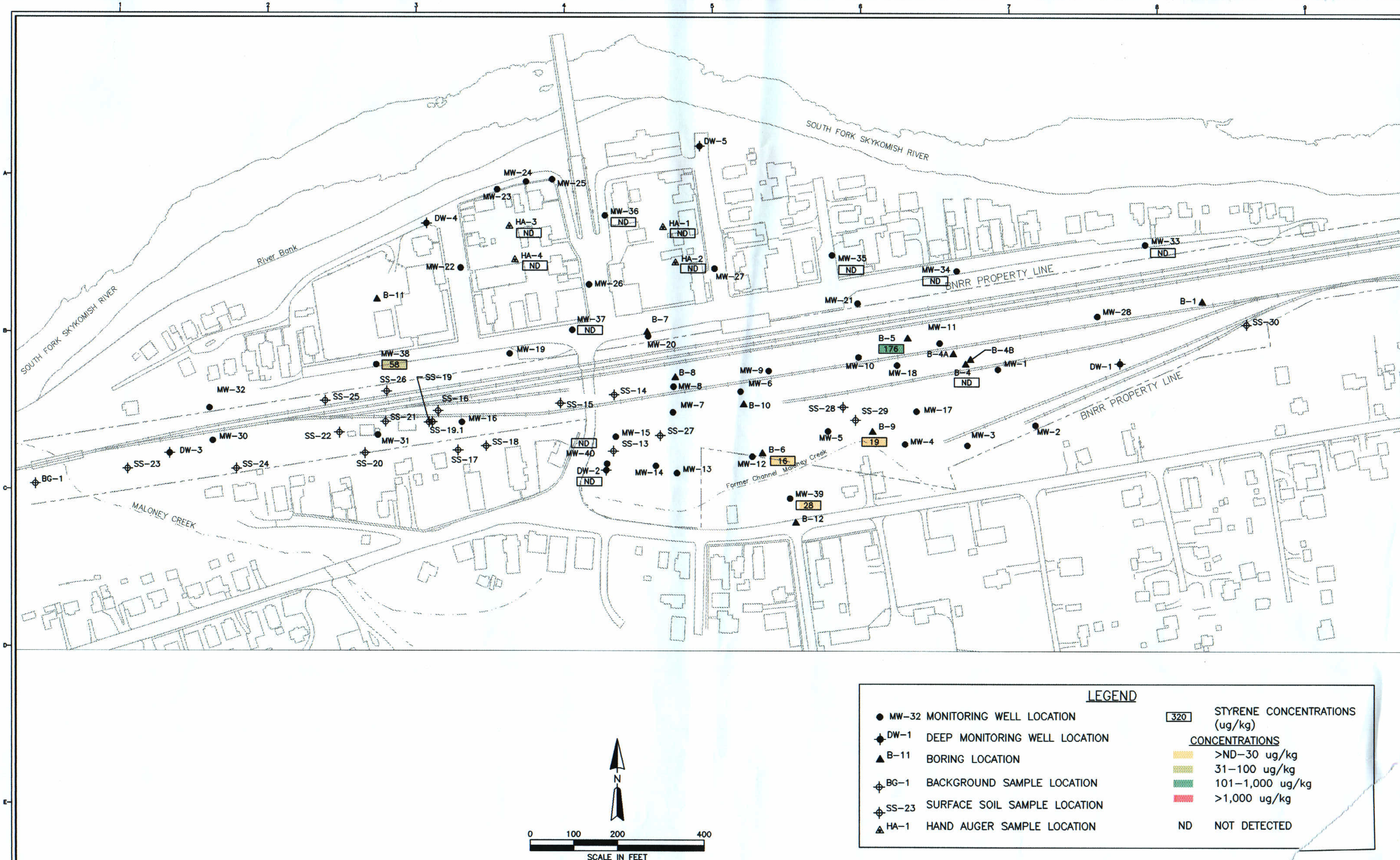
3-1161-350

CURRENT DATE: 2/15/95 | CAD FILE 1161S74S

TOTAL PAH AND
2-METHYLNAPHTHALENE CONCENTRATIONS
IN SOIL SAMPLES (0-14 FEET BGS)

RETEC
REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 5-10 | REV 0



BNRR SKYKOMISH, WASHINGTON

3-1161-350

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CURRENT DATE: 2/15/95 CAD FILE 1161S73S

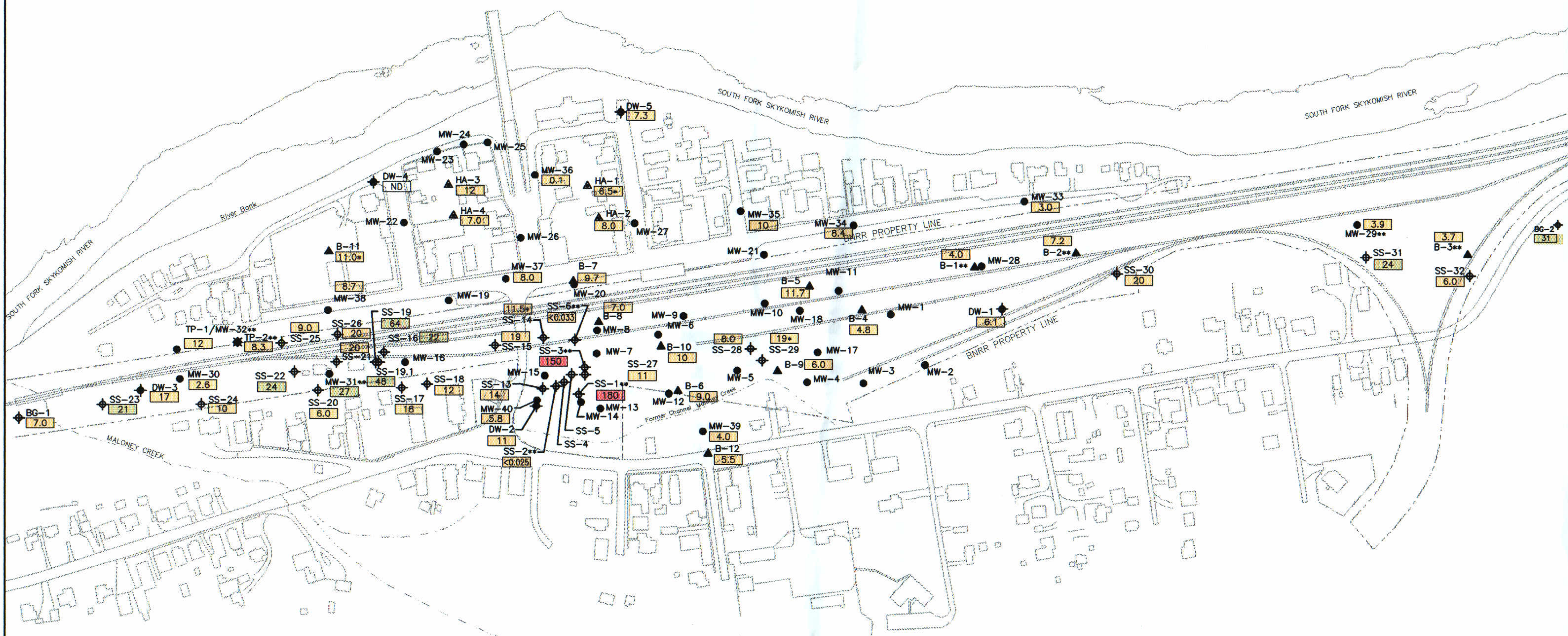
STYRENE CONCENTRATIONS IN SOIL SAMPLES (ug/kg)

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 5-11 REV 0

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
0	E.F.	2/15/95	INITIAL ISSUE				

REFERENCE DWG DESCRIPTION



NOTES:

1. * INDICATES THE AVERAGE CONCENTRATION OF DUPLICATE SAMPLES.
2. SOIL SAMPLES WERE TAKEN AT OR NEAR GROUND SURFACE (0–0.5' BGS) EXCEPT AT LOCATIONS B–1, B–2, B–3, MW–29, MW–30 AND MW–31 WHERE SAMPLES WERE COLLECTED AT 4' BGS. SAMPLE TP–2 WAS COLLECTED AT 2' BGS.
3. ** INDICATES PRE–RI DATA.

N

0 125 250 500
SCALE IN FEET

LEGEND

- ● MW–32 MONITORING WELL LOCATION
- DW–1 DEEP MONITORING WELL LOCATION
- ▲ B–11 BORING LOCATION
- BG–1 BACKGROUND SAMPLE LOCATION
- SS–23 SURFACE SOIL SAMPLE LOCATION
- HA–1 HAND AUGER SAMPLE LOCATION
- TP–2 TEST PIT LOCATION

20 ARSENIC CONCENTRATIONS (mg/kg)

CONCENTRATIONS

- >ND–20 mg/kg
- 21–100 mg/kg
- >100 mg/kg
- ND NOT DETECTED

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
6							
5							
4							
3							
2							
1	E.F.	1/16/98	REVISIONS				
0	E.F.	2/15/95	INITIAL ISSUE				

REFERENCE DWG DESCRIPTION

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3–1161–350

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CURRENT DATE: 2/15/95 CAD FILE 1161S13S

ARSENIC CONCENTRATIONS IN SOIL SAMPLES (mg/kg)

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 5–12 REV 0

LEGEND

● MW-32	MONITORING WELL LOCATION
DW-1	DEEP MONITORING WELL LOCATION
▲ B-11	BORING LOCATION
BG-1	BACKGROUND SAMPLE LOCATION
SS-23	SURFACE SOIL SAMPLE LOCATION
HA-1	HAND AUGER SAMPLE LOCATION
TP-2	TEST PIT LOCATION

24	LEAD CONCENTRATIONS (mg/kg)

CONCENTRATIONS

(yellow)	>ND–100 mg/kg
(light green)	101–250 mg/kg
(green)	251–1000 mg/kg
(red)	>1000 mg/kg
ND	NOT DETECTED

NOTES:

1. * INDICATES THE AVERAGE CONCENTRATION OF DUPLICATE SAMPLES.
2. SOIL SAMPLES WERE TAKEN AT OR NEAR GROUND SURFACE (0–0.5' BGS) EXCEPT AT LOCATIONS B-1, B-2, B-3, MW-29, MW-30 AND MW-31 WHERE SAMPLES WERE COLLECTED AT 4' BGS. SAMPLE TP-2 WAS COLLECTED AT 2' BGS.
3. ** INDICATES PRE-RI DATA.

N

0 125 250 500
SCALE IN FEET

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
6							
5							
4							
3							
2							
1	E.F.	1/16/96	REVISIONS				
0	E.F.	2/15/95	INITIAL ISSUE				

REFERENCE DWG | DESCRIPTION

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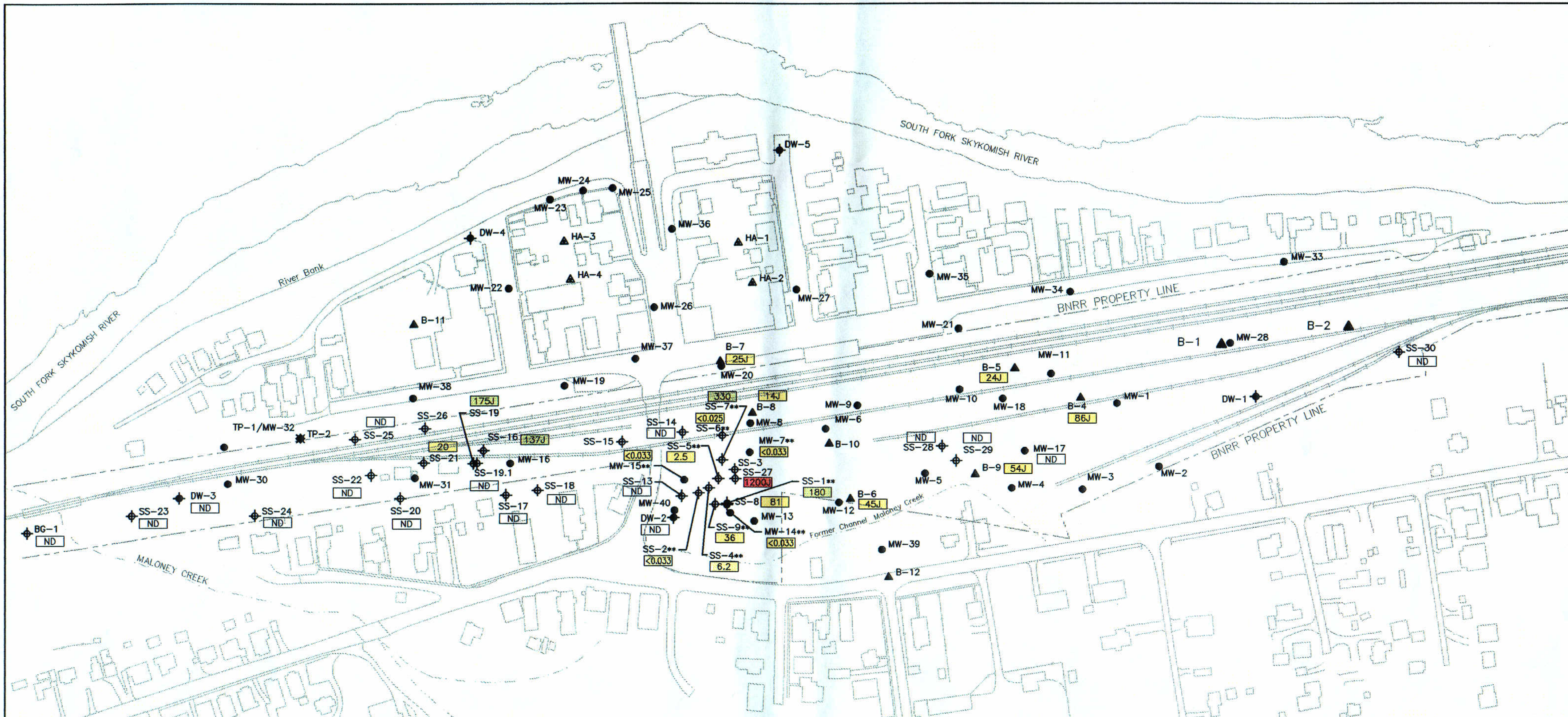
CURRENT DATE: 2/15/95 | CAD FILE 1161S12S

LEAD CONCENTRATIONS IN SOIL SAMPLES (mg/kg)

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 5-13 | REV. 0



LEGEND

● MW-32	MONITORING WELL LOCATION	24	PCB CONCENTRATIONS (ug/kg)
DW-1	DEEP MONITORING WELL LOCATION		CONCENTRATIONS
▲ B-11	BORING LOCATION		>ND-100 ug/kg
BG-1	BACKGROUND SAMPLE LOCATION		100-1000 ug/kg
SS-23	SURFACE SOIL SAMPLE LOCATION		>1000 ug/kg
HA-1	HAND AUGER SAMPLE LOCATION	ND	NOT DETECTED
TP-2	TEST PIT LOCATION	J	INDICATES ESTIMATED VALUE

NOTES:
1. ** INDICATES PRE-RI DATA.

N

0 100 200 400
SCALE IN FEET

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
6							
5							
4							
3							
2							
1	E.F.	1/16/96	REVISIONS				
0	E.F.	2/15/95	INITIAL ISSUE				

REFERENCE DWG | DESCRIPTION

BNRR SKYKOMISH, WASHINGTON

3-1161-350

CURRENT DATE: 2/15/95 | CAD FILE 1161555S

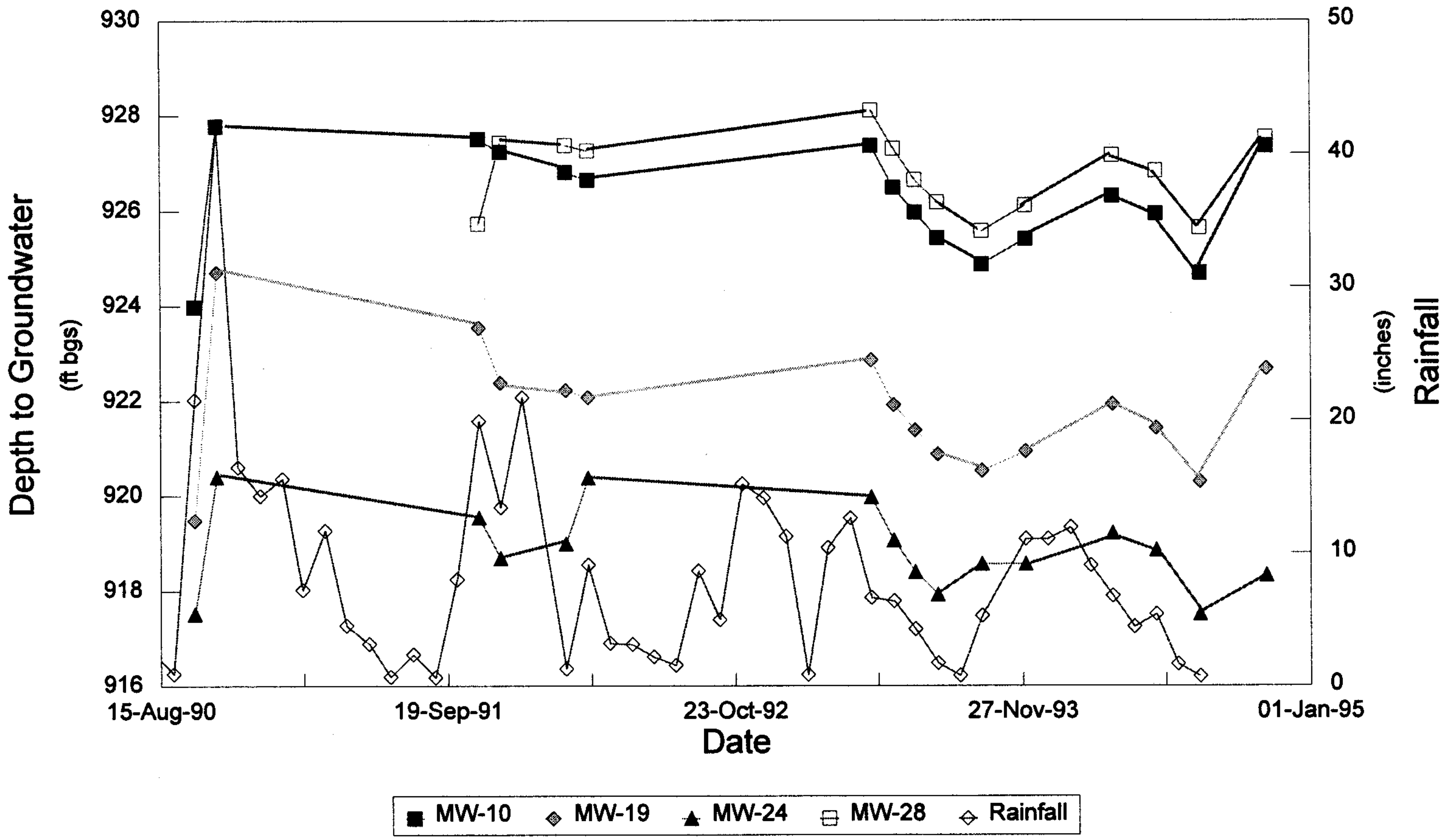
PCB CONCENTRATIONS IN SURFACE SOIL SAMPLES (ug/kg)

RETEC REMEDIATION TECHNOLOGIES INC

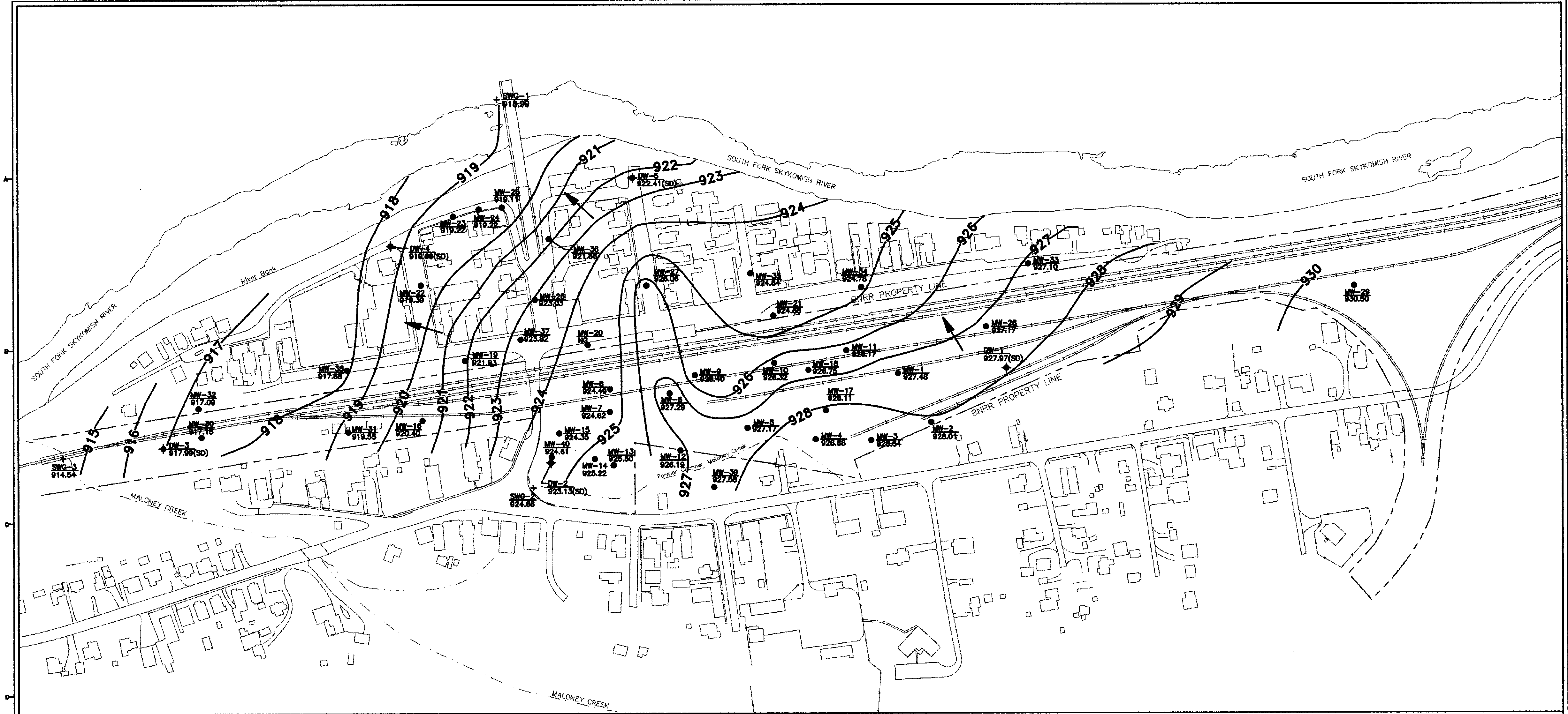
DRAWING NO. FIGURE 5-14 REV. 0

RETEC

FIGURE 6-1
HYDROGRAPH AND MONTHLY RAINFALL



HYDROGRF.WK4 02/17/95



LEGEND

- MW-20 — MONITORING WELL LOCATION
- DW-1 — DEEP MONITORING WELL LOCATION
- SWG-1 — SURFACE WATER GAUGING LOCATION
- (SD) — WELL SCREENED DEEP–NOT USED FOR DETERMINATION OF CONTOURS
- NG — NOT GAUGED
- 924 — GROUNDWATER ELEVATION CONTOUR
- (arrow) — GROUNDWATER FLOW DIRECTION

N

0 125 250 500
SCALE IN FEET

REFERENCE DWG	DESCRIPTION	NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
		6							
		5							
		4							
		3							
		2							
		1							
		0	E.F.	2/16/95	INITIAL ISSUE				

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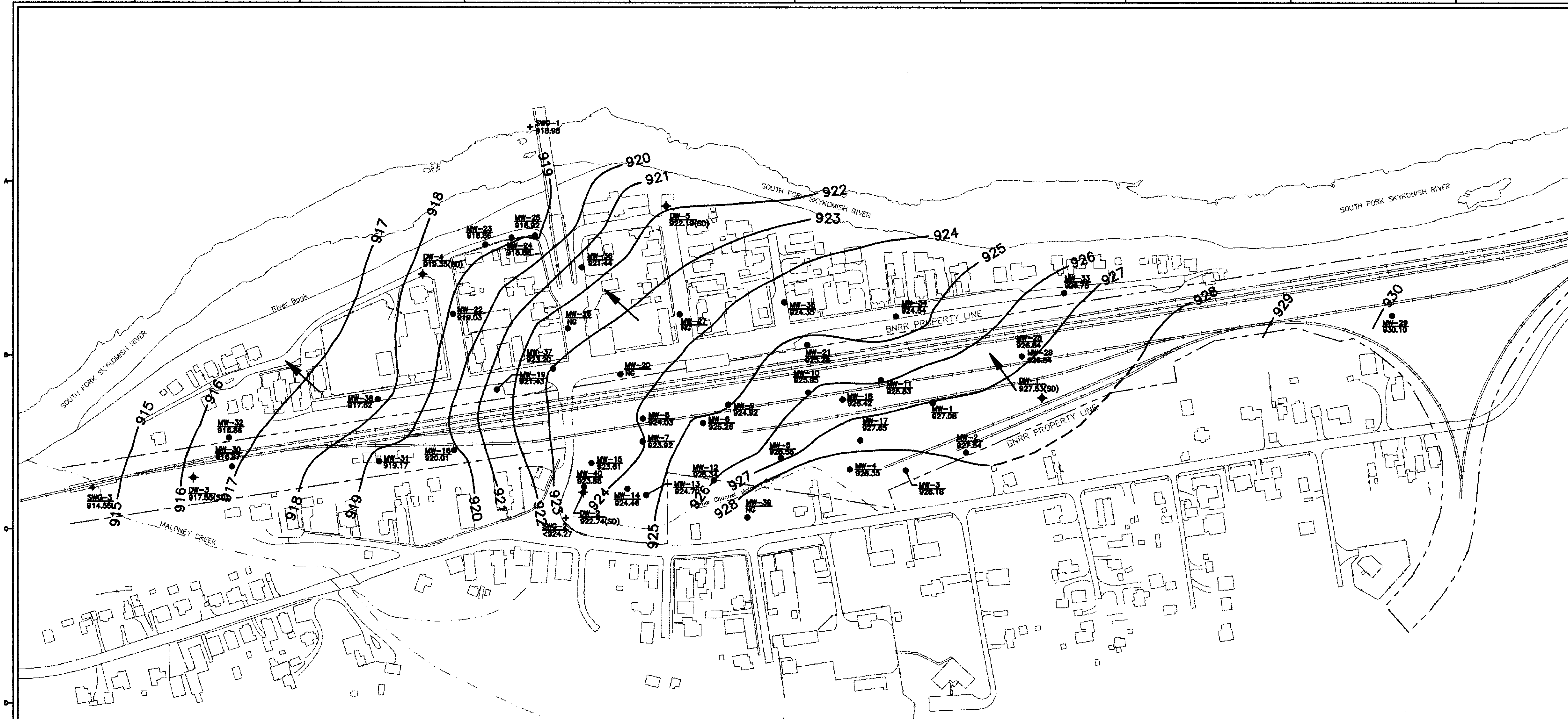
CURRENT DATE: 2/16/95 CAD FILE 11618265

GROUNDWATER CONTOUR MAP
APRIL 4, 1994

RETEC
REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 6-2 REV. 0



LEGEND

● MW-20	MONITORING WELL LOCATION
✦ DW-1	DEEP MONITORING WELL LOCATION
+ SWG-1	SURFACE WATER GAUGING LOCATION
(SD)	WELL SCREENED DEEP–NOT USED FOR DETERMINATION OF CONTOURS
NG	NOT GAUGED
924	GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
↙	GROUNDWATER FLOW DIRECTION

0 125 250 500
SCALE IN FEET

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
6							
5							
4							
3							
2							
1							
0	E.F.	2/16/95	INITIAL ISSUE				

REFERENCE DWG | DESCRIPTION

BNRR SKYKOMISH, WASHINGTON

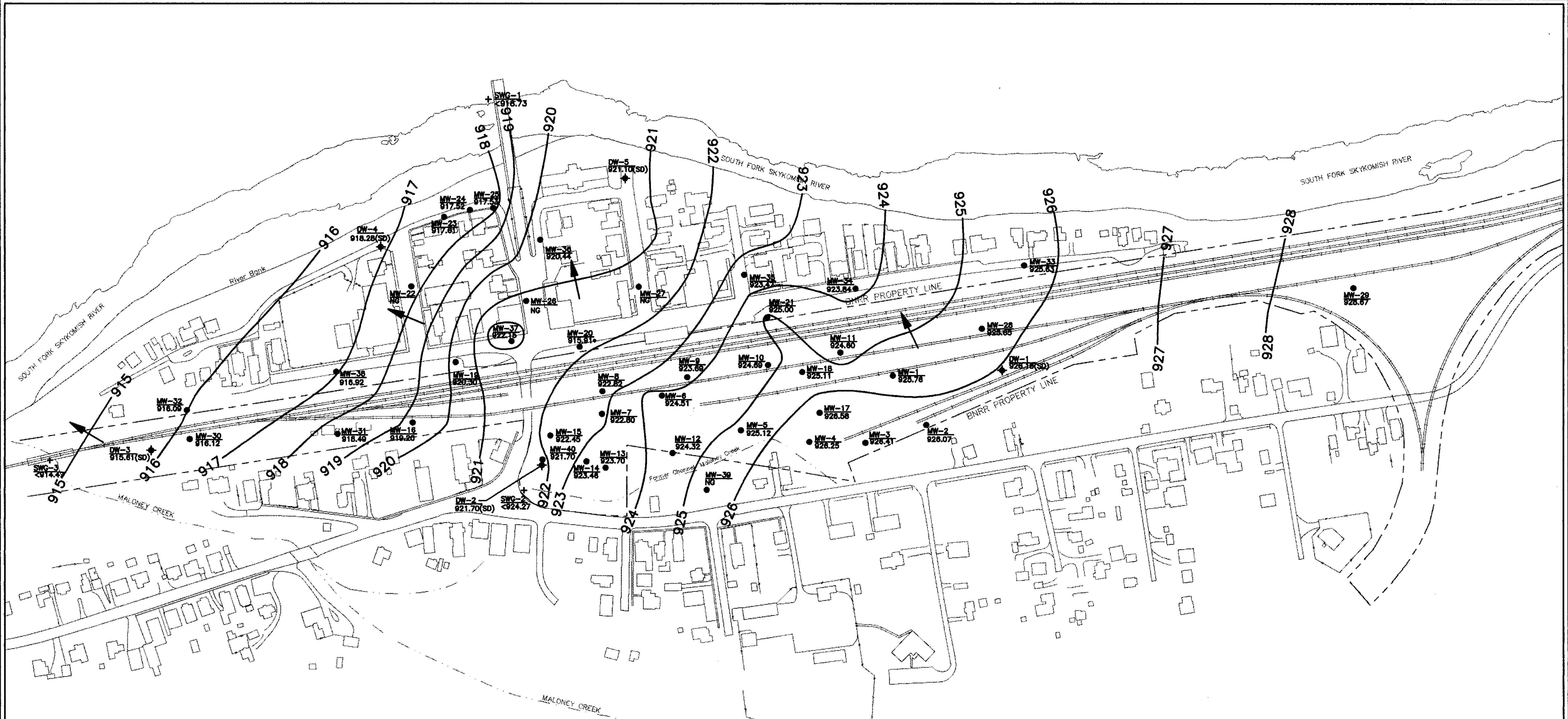
3-1161-350

CURRENT DATE: 2/16/95 | CAD FILE 1161S30S

GROUNDWATER CONTOUR MAP
JUNE 3, 1994

RETEC REMEDIATION TECHNOLOGIES INC

FIGURE 6-3 | REV. 0



LEGEND

- ● MW-20 — MONITORING WELL LOCATION
- ✦ DW-1 — DEEP MONITORING WELL LOCATION
- + SWG-1 — SURFACE WATER GAUGING LOCATION
- (SD) — WELL SCREENED DEEP–NOT USED FOR DETERMINATION OF CONTOURS
- NG — NOT GAUGED
- 924 — GROUNDWATER ELEVATION CONTOUR
- ↙ — GROUNDWATER FLOW DIRECTION

N

0 125 250 500
SCALE IN FEET

* WELLS WITH FREE PRODUCT AND ANOMALOUS WATER TABLE DATA. DATA NOT USED FOR DETERMINATION OF CONTOURS.

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
6							
5							
4							
3							
2							
1							
0	E.F.	2/16/95	INITIAL ISSUE				

REFERENCE DWG | DESCRIPTION

BNRR SKYKOMISH, WASHINGTON

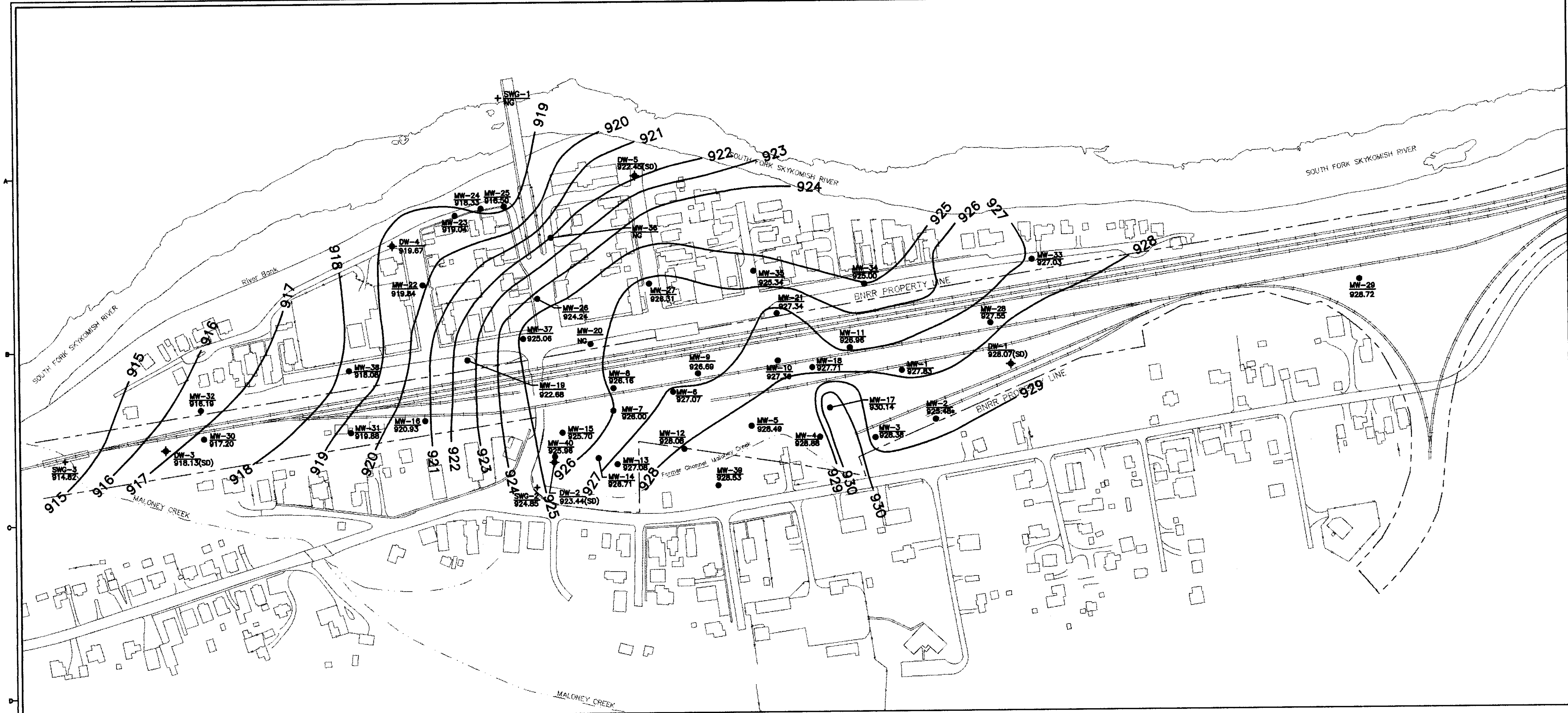
3-1161-320

CURRENT DATE: 2/16/95 | CAD FILE 1161S335

GROUNDWATER CONTOUR MAP
AUGUST 1, 1994

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 6-4 | REV 0



LEGEND

● MW-20	MONITORING WELL LOCATION
✦ DW-1	DEEP MONITORING WELL LOCATION
+ SWG-1	SURFACE WATER GAUGING LOCATION
(SD)	WELL SCREENED DEEP-NOT USED FOR DETERMINATION OF CONTOURS
NG	NOT GAUGED
924 —	GROUNDWATER ELEVATION CONTOUR
↙	GROUNDWATER FLOW DIRECTION

* WELLS WITH FREE PRODUCT AND ANOMALOUS WATER TABLE DATA. DATA NOT USED FOR DETERMINATION OF CONTOURS.

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
6							
5							
4							
3							
2							
1							
0	E.F.	2/16/95	INITIAL ISSUE				

REFERENCE DWG DESCRIPTION

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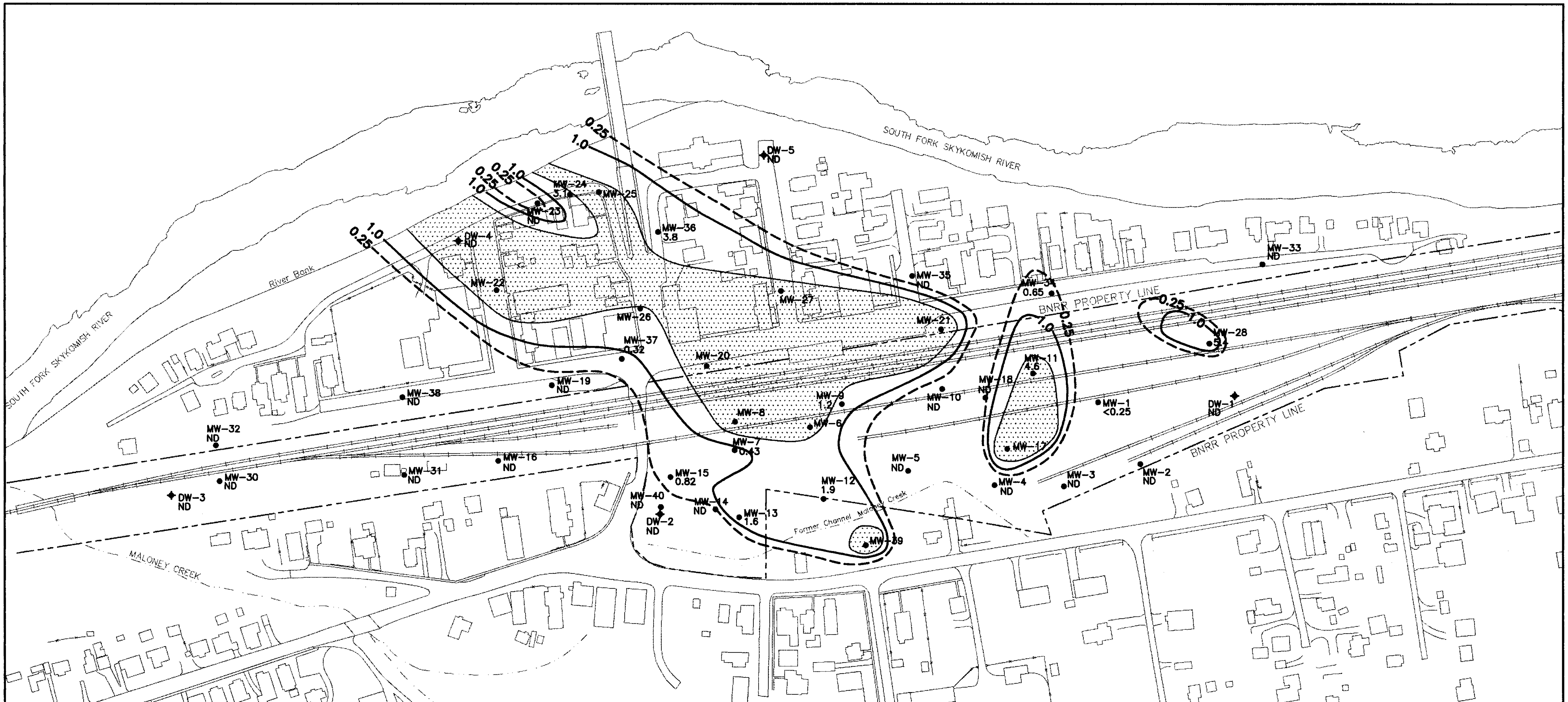
CURRENT DATE: 2/16/95 CAD FILE 1161S48S

GROUNDWATER CONTOUR MAP
NOVEMBER 7, 1994

RETEC
REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 6-5 REV. 0



LEGEND

- ● MW-37 0.52 — MONITORING WELL LOCATION TPH CONCENTRATION (mg/L)
- ✦ DW-1 — DEEP MONITORING WELL LOCATION
- ND — NOT DETECTED
- —1— TPH CONCENTRATION ISOPLETH (mg/L)
- (dotted area) — AREA OF FREE PRODUCT

TPH ANALYZED USING WTPH-D EXTENDED (C_{10} - C_{32})

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
6							
5							
4							
3							
2	E.F.	2/16/95	REVISED ISOPLETHS				
1	DAVE	2/8/95	UPDATED CONTOURS				
0	E.F.	1/27/95	INITIAL ISSUE				

REFERENCE DWG | DESCRIPTION

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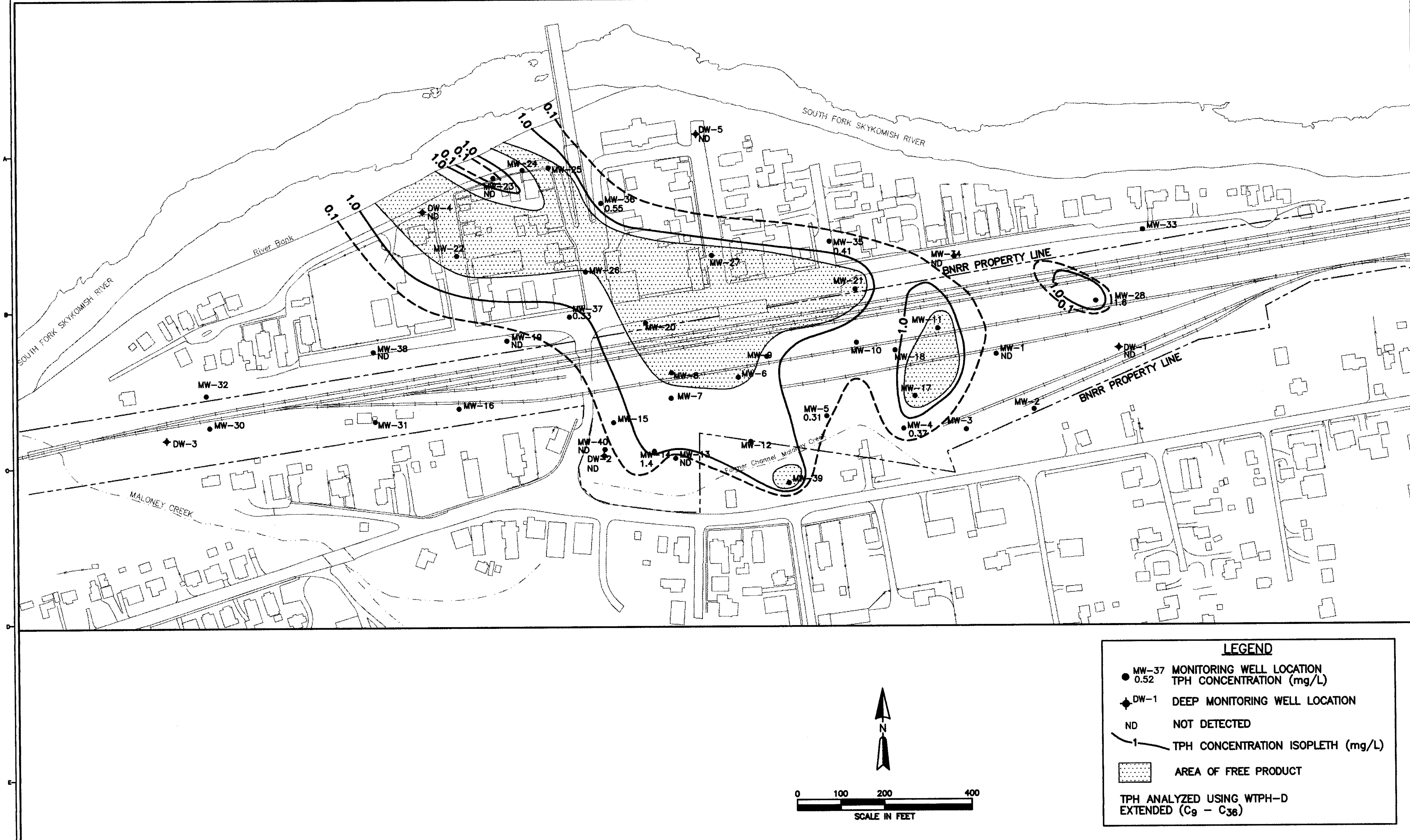
CURRENT DATE: 2/16/95 | CAD FILE 11613628

NOVEMBER 1993
TOTAL PETROLEUM HYDROCARBON CONCENTRATIONS IN GROUNDWATER (mg/L)

RETEC
REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 6-6 | REV 0



LEGEND

- MW-37 0.52 — MONITORING WELL LOCATION, TPH CONCENTRATION (mg/L)
- DW-1 — DEEP MONITORING WELL LOCATION
- ND — NOT DETECTED
- 1 — TPH CONCENTRATION ISOPLETH (mg/L)
- AREA OF FREE PRODUCT

TPH ANALYZED USING WTPH-D EXTENDED (C_9 - C_{36})

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
6							
5							
4							
3							
2	E.F.	2/16/95	REVISED CONTOURS				
1	DAVE	2/8/95	UPDATED CONTOURS				
0	E.F.	1/27/95	INITIAL ISSUE				

REFERENCE DWG | DESCRIPTION

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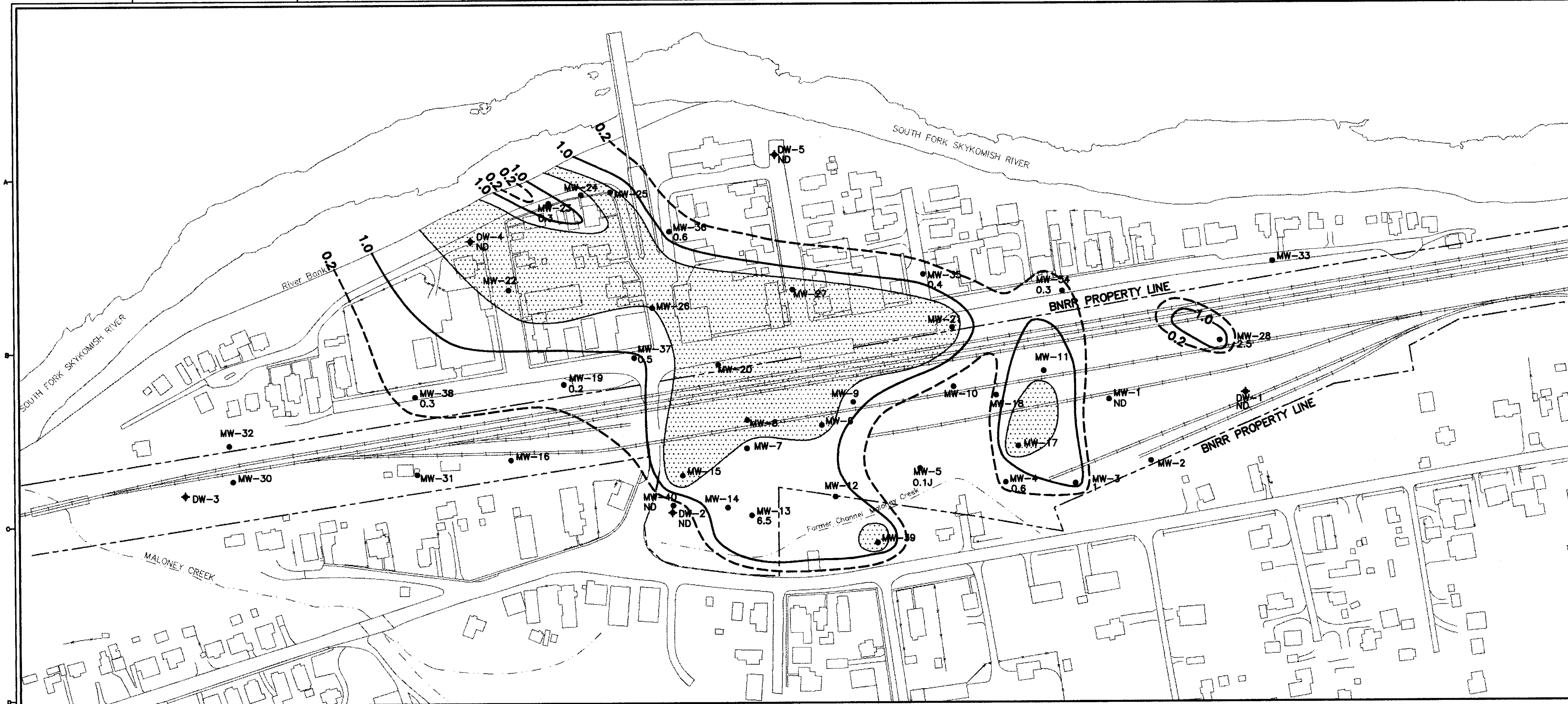
CURRENT DATE: 2/16/95 CAD FILE 1161S635

APRIL 1994
TOTAL PETROLEUM HYDROCARBON CONCENTRATIONS IN GROUNDWATER (mg/L)

RETEC REMEDIATION TECHNOLOGIES INC

FIGURE 6-7 REV. 0



LEGEND

- MW-37 0.52 — MONITORING WELL LOCATION TPH CONCENTRATION (mg/L)
- DW-1 — DEEP MONITORING WELL LOCATION
- ND — NOT DETECTED
- 1 — TPH CONCENTRATION ISOPLETH (mg/L)
- AREA OF FREE PRODUCT

TPH ANALYZED USING WTPH-D EXTENDED (C_9 – C_{36})

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
6							
5							
4							
3							
2	E.F.	2/16/95	REVISED CONTOURS				
1	DAVE	2/6/95	UPDATED CONTOURS				
0	E.F.	1/27/95	INITIAL ISSUE				

REFERENCE DWG | DESCRIPTION

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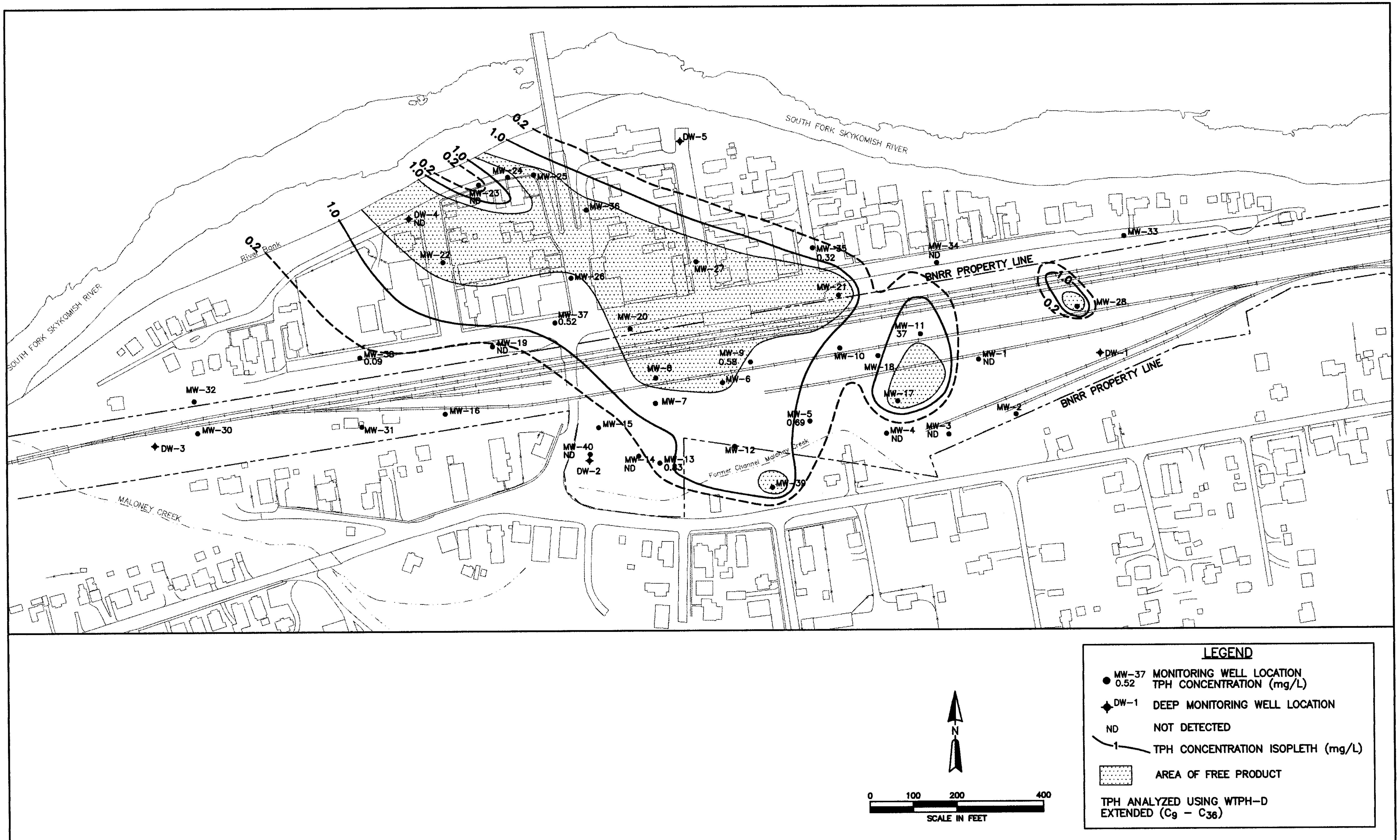
3-1161-350

CURRENT DATE: 2/16/95 CAD FILE 1161S64S

AUGUST 1994 TOTAL PETROLEUM HYDROCARBON CONCENTRATIONS IN GROUNDWATER (mg/L)

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 6-8 REV. 0



NO	DRWN	DATE	REVISION
1	E.F.	2/16/95	REVISED ISOPLETHS
0	E.F.	1/27/95	INITIAL ISSUE

BNRR SKYKOMISH, WASHINGTON

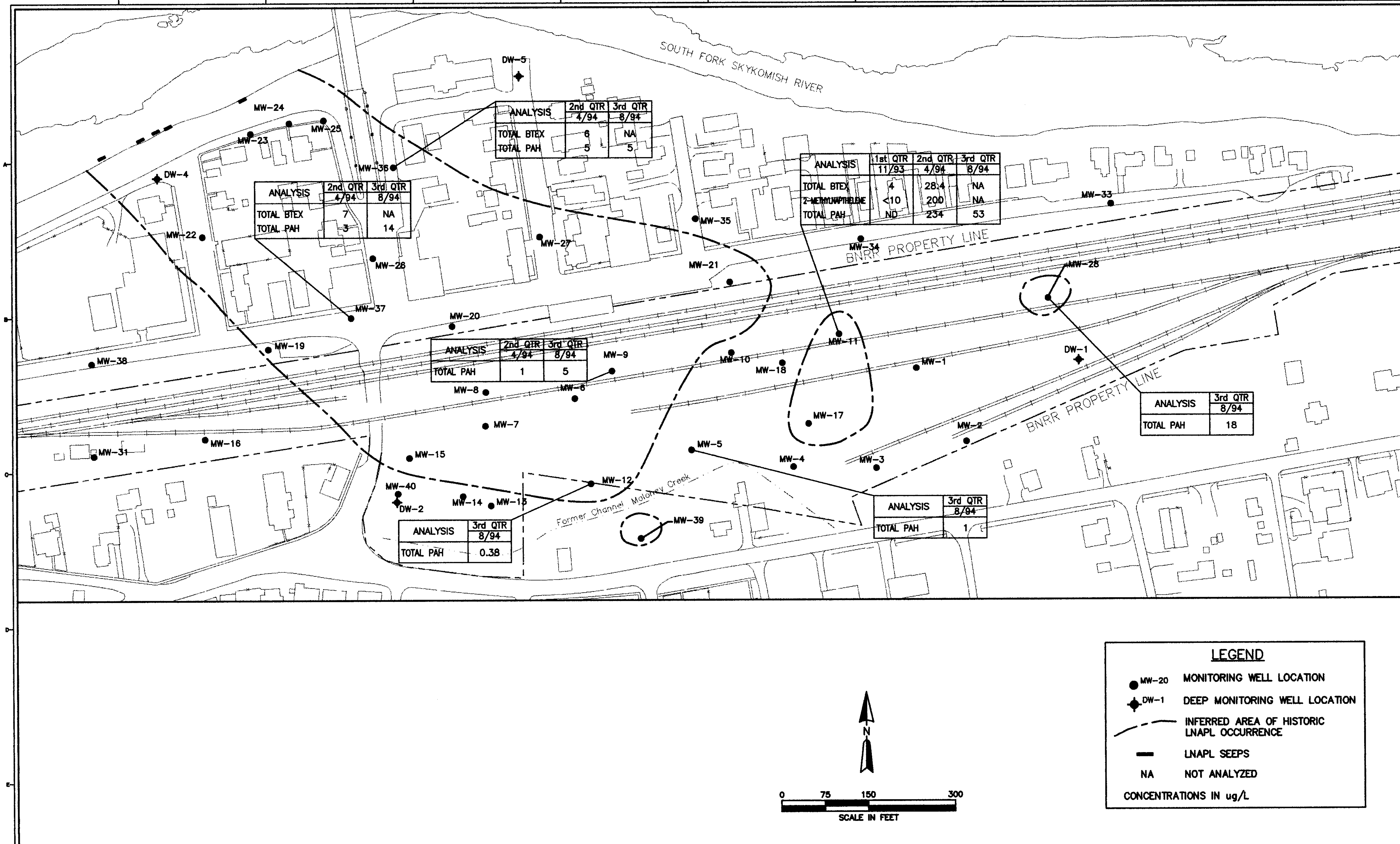
3-1161-350

CURRENT DATE: 2/16/95

NOVEMBER 1994
TOTAL PETROLEUM HYDROCARBON CONCENTRATIONS IN GROUNDWATER (mg/L)

RETEC

FIGURE 6-9



		6								
		5								
		4								
		3								
		2								
		1								
		0	E.F.	2/16/95	INITIAL ISSUE					
REFERENCE DWG	DESCRIPTION	NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE	

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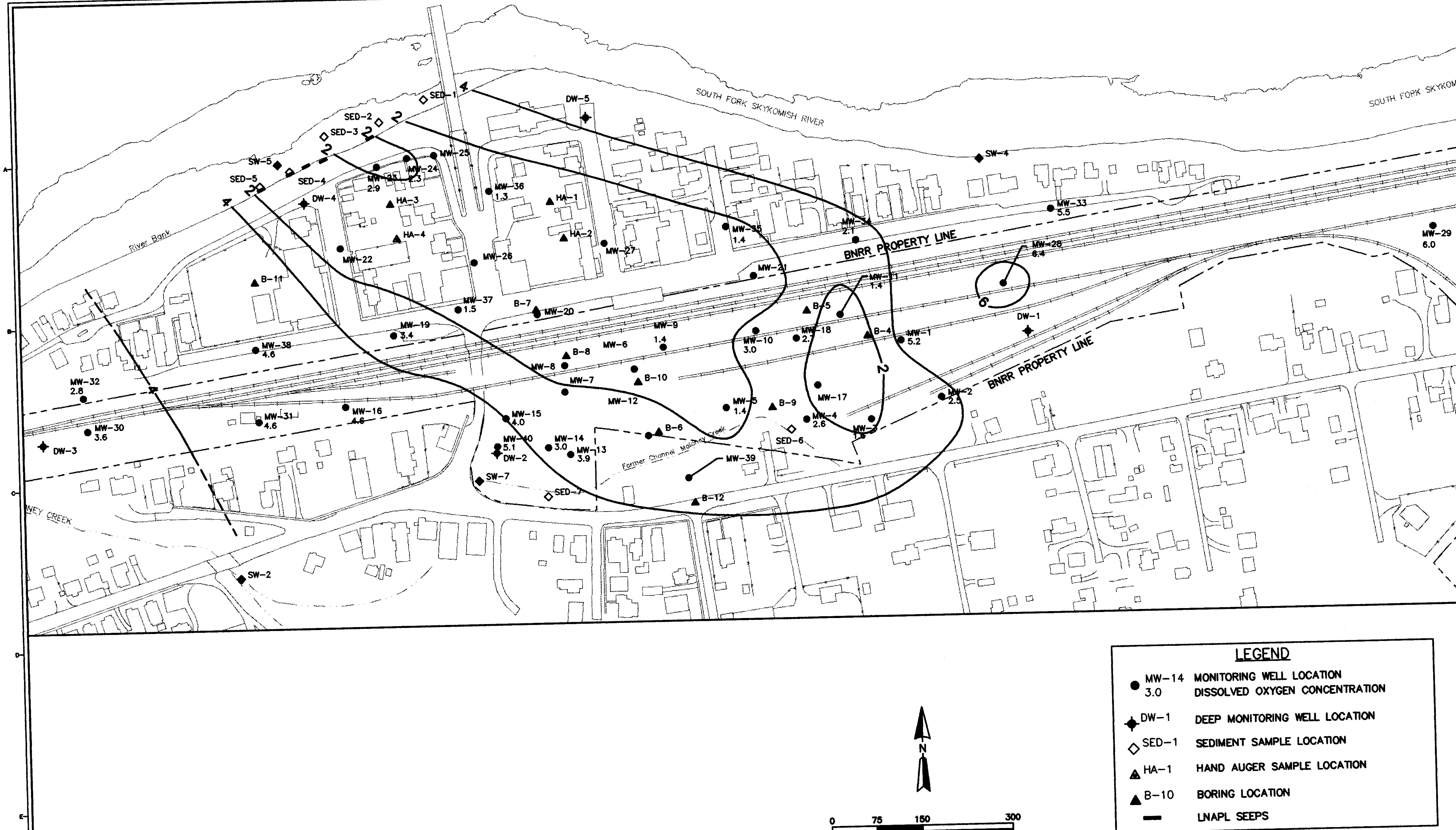
CURRENT DATE: 2/16/95 CAD FILE 11613613

VOLATILE AND SEMIVOLATILE ORGANIC COMPOUND OCCURRENCE IN GROUNDWATER

RETEC REMEDIATION TECHNOLOGIES INC.

FIGURE 6-10



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3-1161-510

DISSOLVED OXYGEN ISOPLETH MAP

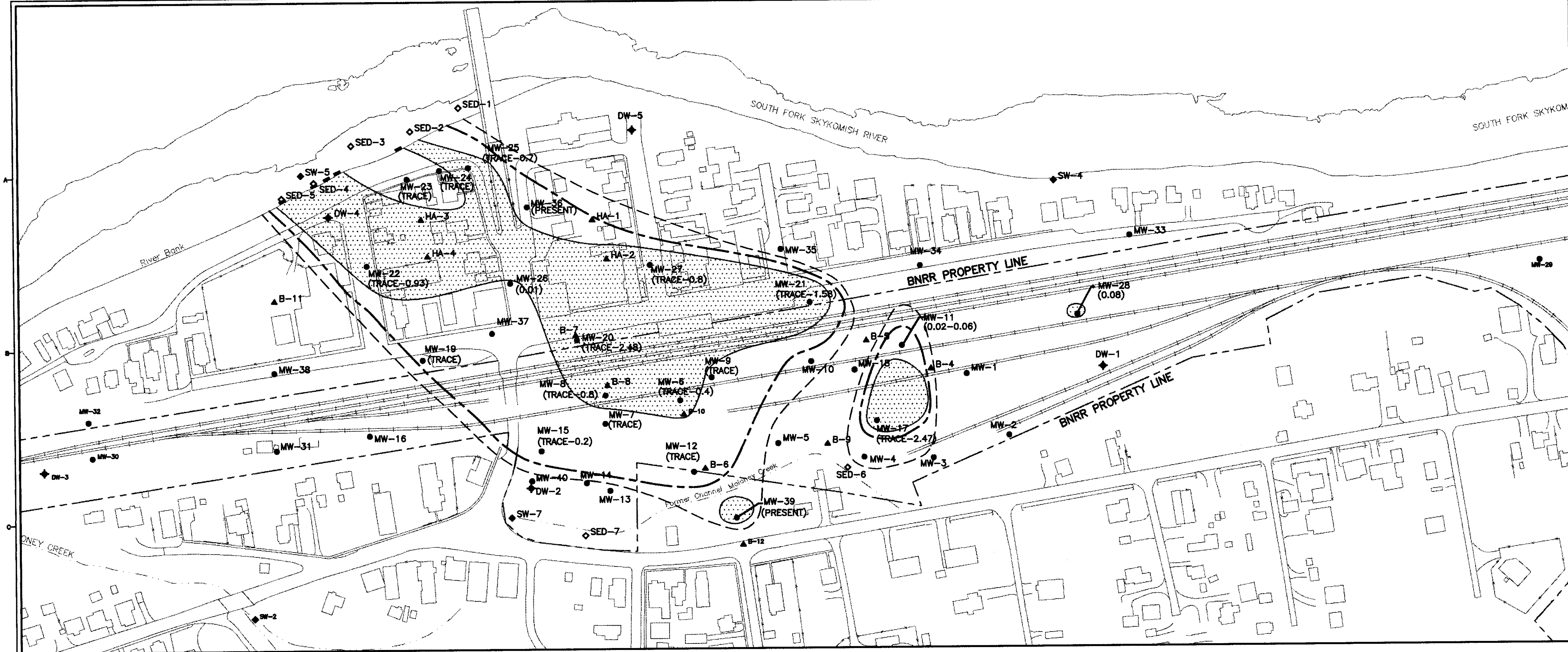
RETEC

FIGURE 6-11

CURRENT DATE: 2/16/95

CAD FILE 1161S795

0 E.F. 2/16/95 INITIAL ISSUE



LEGEND

Symbol	Description
● MW-20 (TRACE-0.02)	MONITORING WELL LOCATION; HISTORIC RANGE OF LNAPL THICKNESS (FT)
DW-1	DEEP MONITORING WELL LOCATION
◇ SED-1	SEDIMENT SAMPLE LOCATION
HA-1	HAND AUGER SAMPLE LOCATION
▲ B-10	BORING LOCATION

Symbol	Description
(solid bar)	LNAPL SEEPS
(dashed line)	AREA OF RESIDUAL LNAPL
(dash-dot line)	AREA OF HISTORIC FREE-PHASE LNAPL OCCURENCE
(stippled area)	AREA OF CONSISTENT FREE-PHASE LNAPL OCCURENCE
TRACE	INDICATES PRODUCT PRESENT AS DROPLETS OR SHEEN BUT NOT MEASURABLE THICKNESS.
PRESENT	INDICATES PRODUCT WAS PRESENT BUT THICKNESS WAS NOT RECORDED.

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
6							
5							
4							
3							
2							
1							
0	E.F.	2/28/95	INITIAL ISSUE				

REFERENCE DWG | DESCRIPTION

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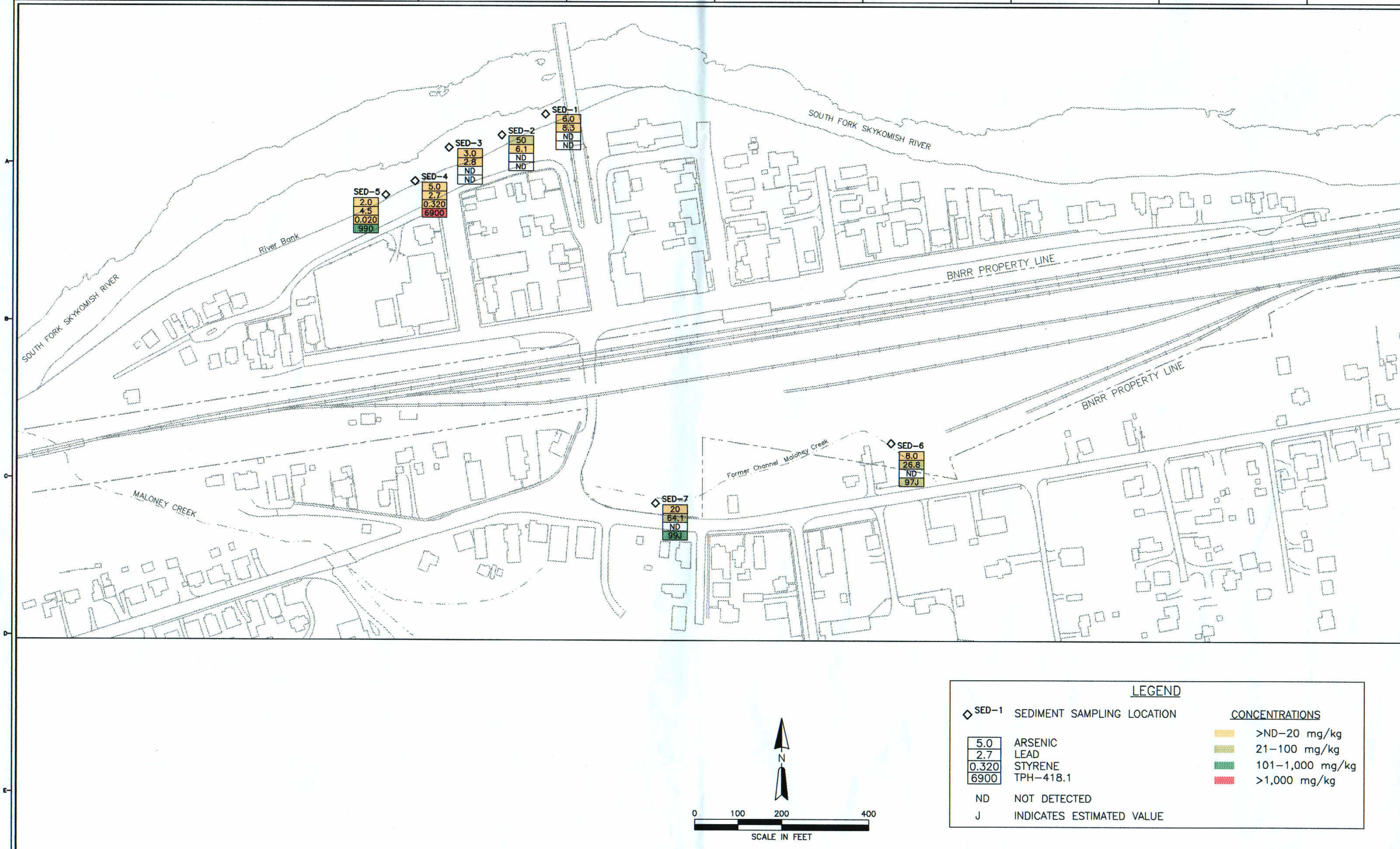
CURRENT DATE: 2/28/95 | CAD FILE 1161S31S

AREAS OF HISTORIC LNAPL OCCURRENCE

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 6-12 | REV 0



		6							
		5							
		4							
		3							
		2							
		1							
		0	E.F.	2/15/95	INITIAL ISSUE				
REFERENCE DWG	DESCRIPTION	NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE

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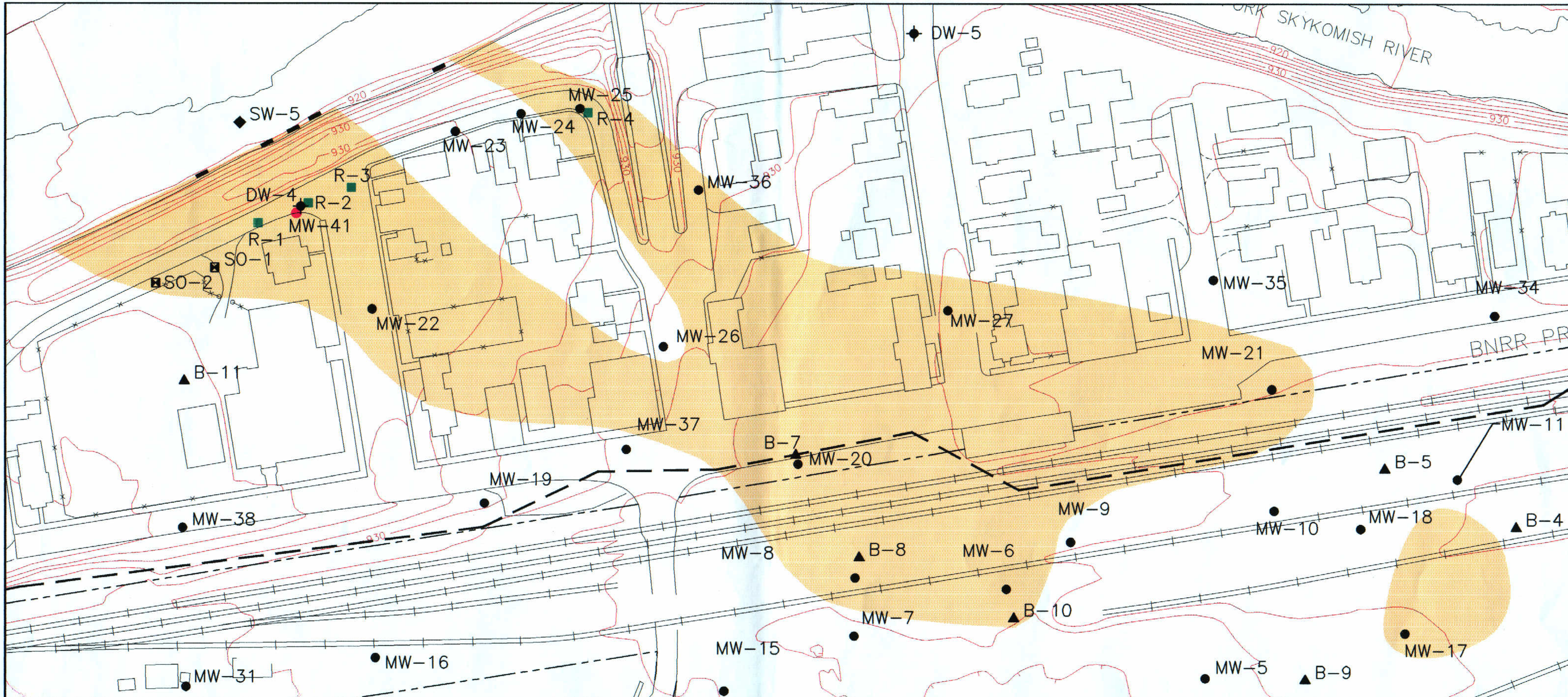
CURRENT DATE: 2/15/95 CAD FILE 1161S78S

CONSTITUENT CONCENTRATIONS IN SEDIMENT SAMPLES (mg/kg)

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 7-1 REV 0



NOTE: ALL AREAS SHOWN NORTH OF THE 100-YEAR FLOOD PLAIN BOUNDARY LIE WITHIN THE 100-YEAR FLOOD PLAIN.

LEGEND

Symbol	Description
● MW-20	MONITORING WELL LOCATION
DW-1	DEEP MONITORING WELL LOCATION
SO-1	STEPOUT BORING LOCATION
▲ B-10	BORING LOCATION
● MW-41	PROPOSED MONITORING WELL LOCATION
■ R-1	PROPOSED RECOVERY WELL LOCATION
(shaded)	AREA OF LNAPL OCCURENCE
— — —	100-YEAR FLOOD PLAIN BOUNDARY

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
6							
5							
4							
3							
2							
1							
0	E.F.	1/22/96	INITIAL ISSUE				

REFERENCE DWG | DESCRIPTION

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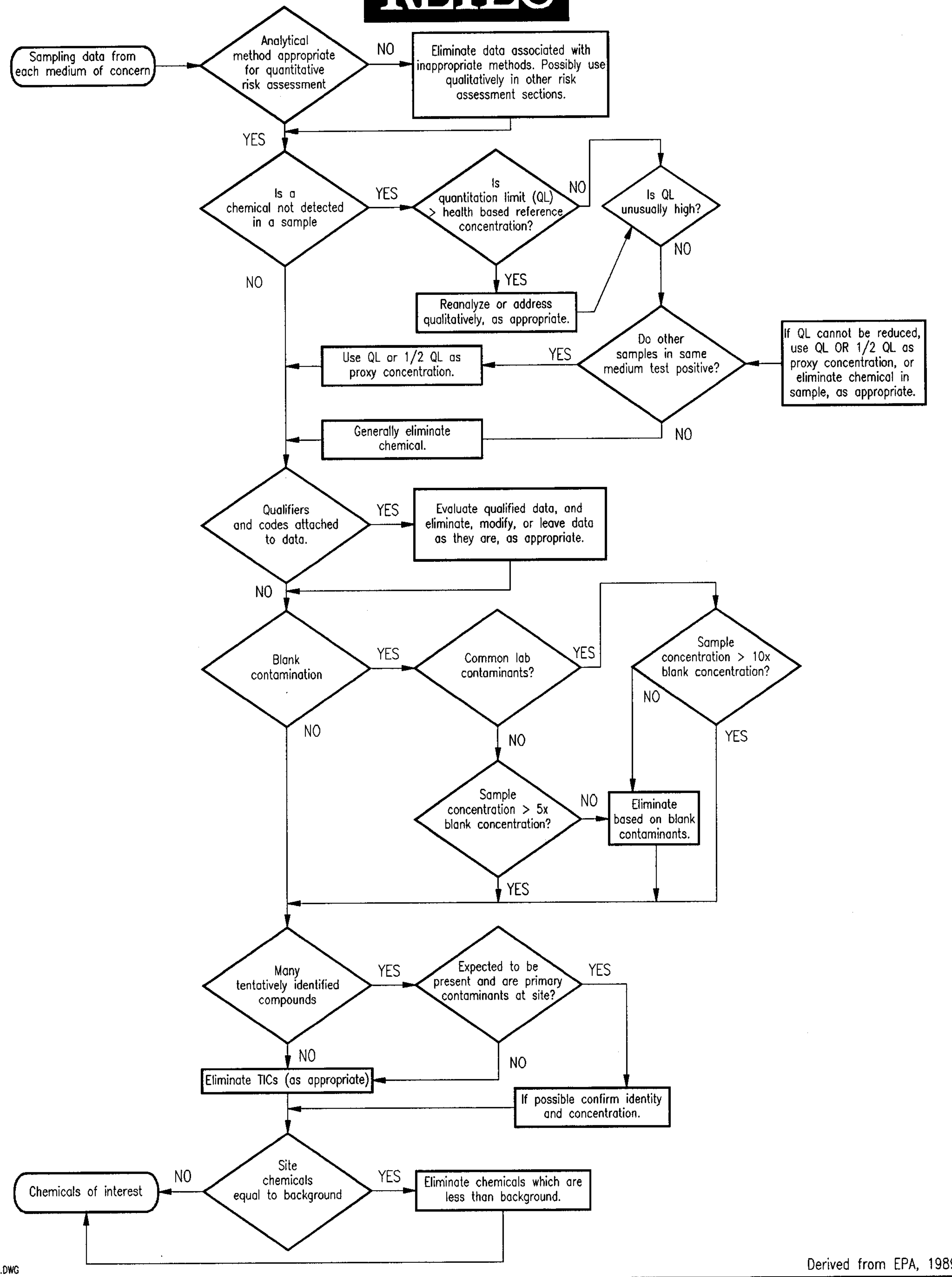
CURRENT DATE: 1/22/96 | CAD FILE 1161115S

WELL LOCATIONS

RETEC
REMEDIATION TECHNOLOGIES INC

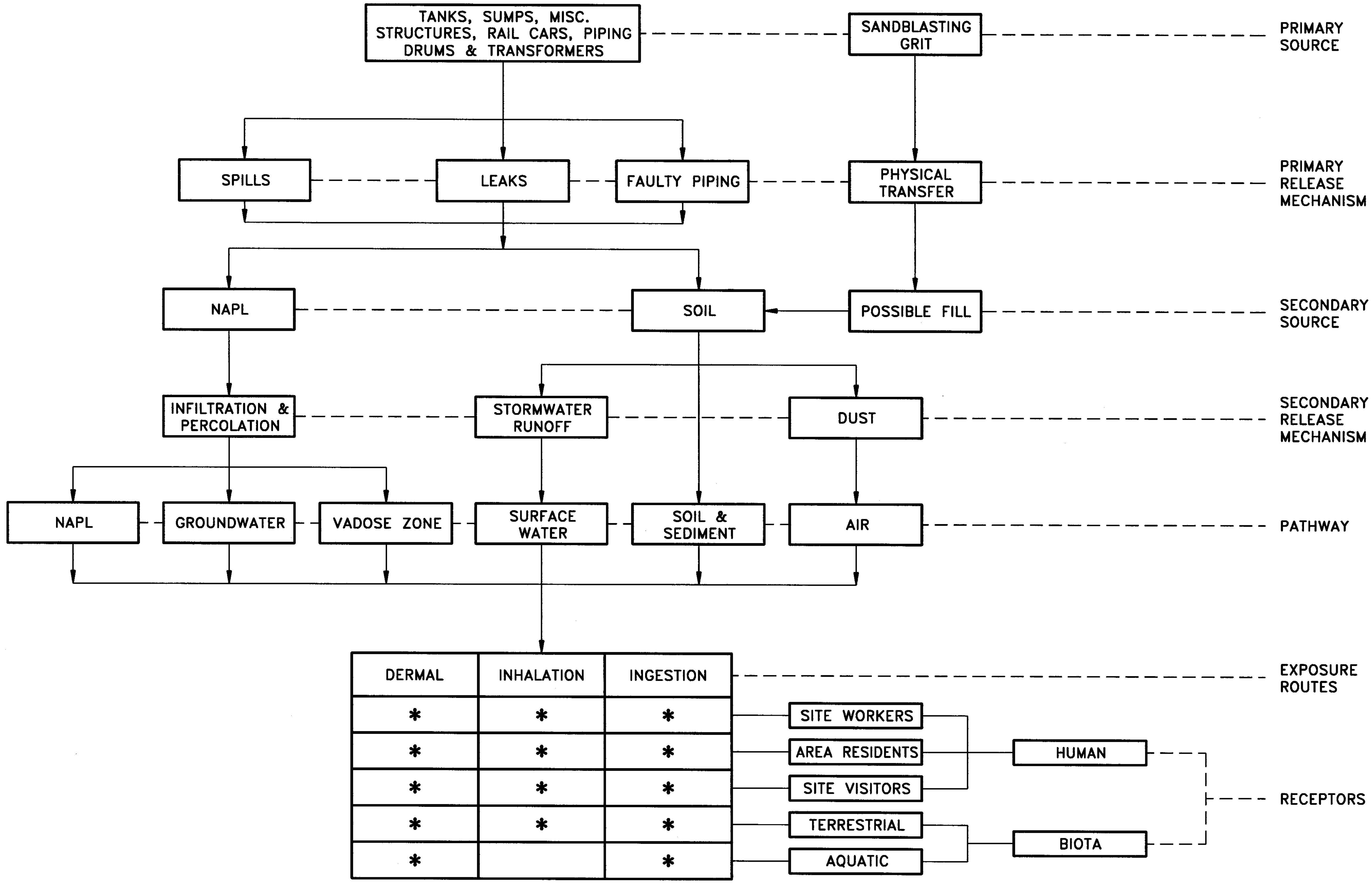
DRAWING NO. FIGURE 9-1 | REV 0



Derived from EPA, 1989a.

DATA EVALUATION PROCESS

FIGURE 11-1



NO	DRWN	DATE	REVISION
1	E.F.	1/16/96	REVISIONS
0	E.F.	2/10/95	INITIAL ISSUE

BNRR SKYKOMISH, WASHINGTON

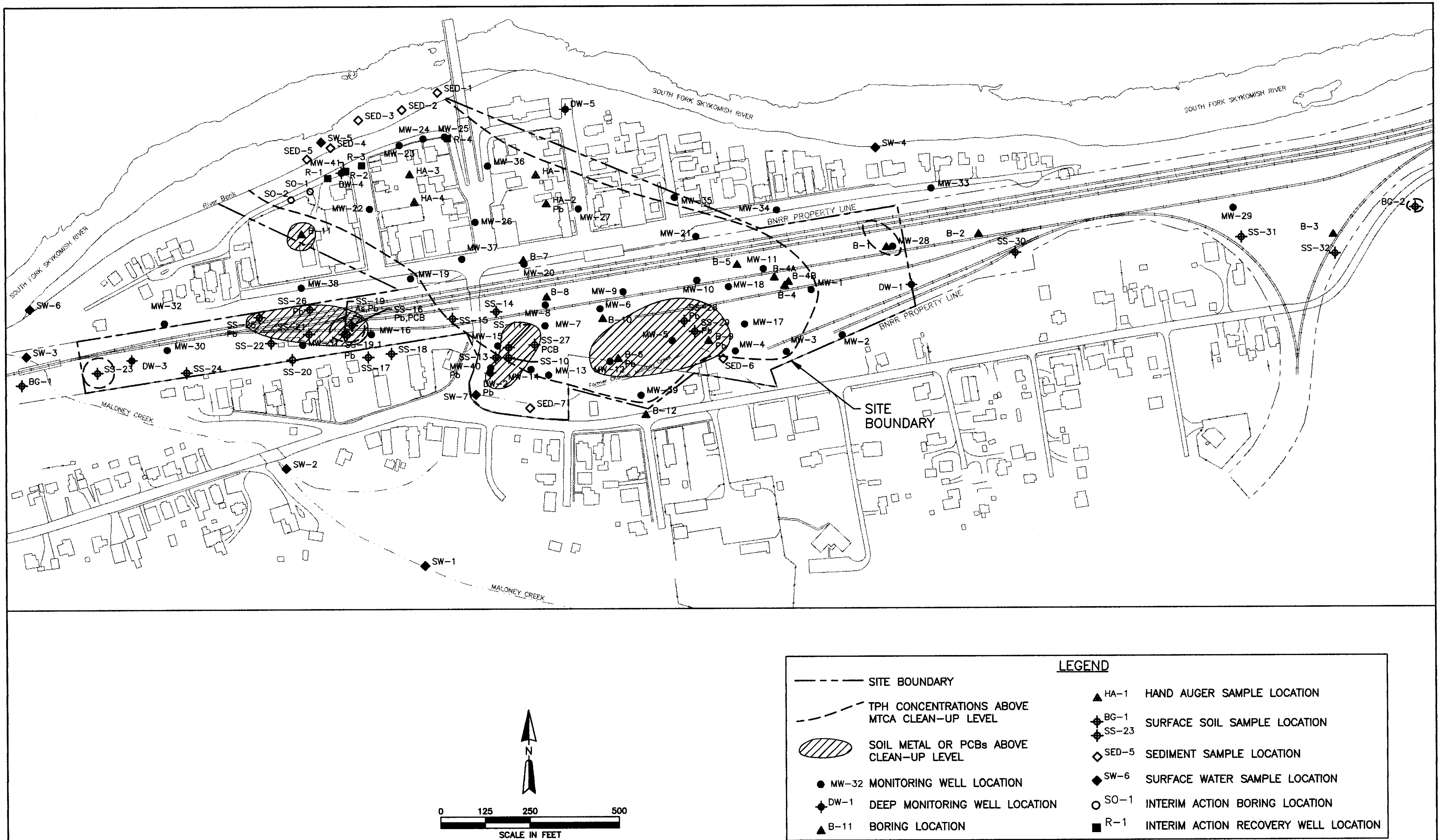
3-1161-350

CURRENT DATE: 2/10/95 CAD FILE 1161S68S

CONCEPTUAL SITE MODEL

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 11-2 REV. 0



NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
6							
5							
4							
3							
2							
1	E.F.	1/16/96	REVISIONS				
0	E.F.	1/10/96	INITIAL ISSUE				

REFERENCE DWG | DESCRIPTION

BNRR SKYKOMISH, WASHINGTON

3-1161-350

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CURRENT DATE: 1/10/96 | CAD FILE 11611135

SITE BOUNDARY AND AREAS EXCEEDING CLEAN-UP LEVELS

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 12-1 | REV. 0

NOTE: PROPERTY LINES ARE APPROXIMATE AND MAY NOT REFLECT ACTUAL CONDITIONS.

SOURCES:
FIELD MAPPING
BN PROPOSED INTERCEPTOR TRENCH MAP 9/18/73
HEDGES AND ROTH ENGINEERING, 1992

WALKER AND ASSOCIATES INC.
THIS MAP WAS CREATED BY PHOTOGRAMMETRIC METHODS FOR 1" = 100'.
MAPPING FROM PHOTO DATE: 90CT93

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
6							
5							
4							
3							
2							
1	E.F.	2/17/95	REVISIONS				
0	E.F.	2/3/95	INITIAL ISSUE				

REFERENCE DWG	DESCRIPTION

BNRR SKYKOMISH, WASHINGTON

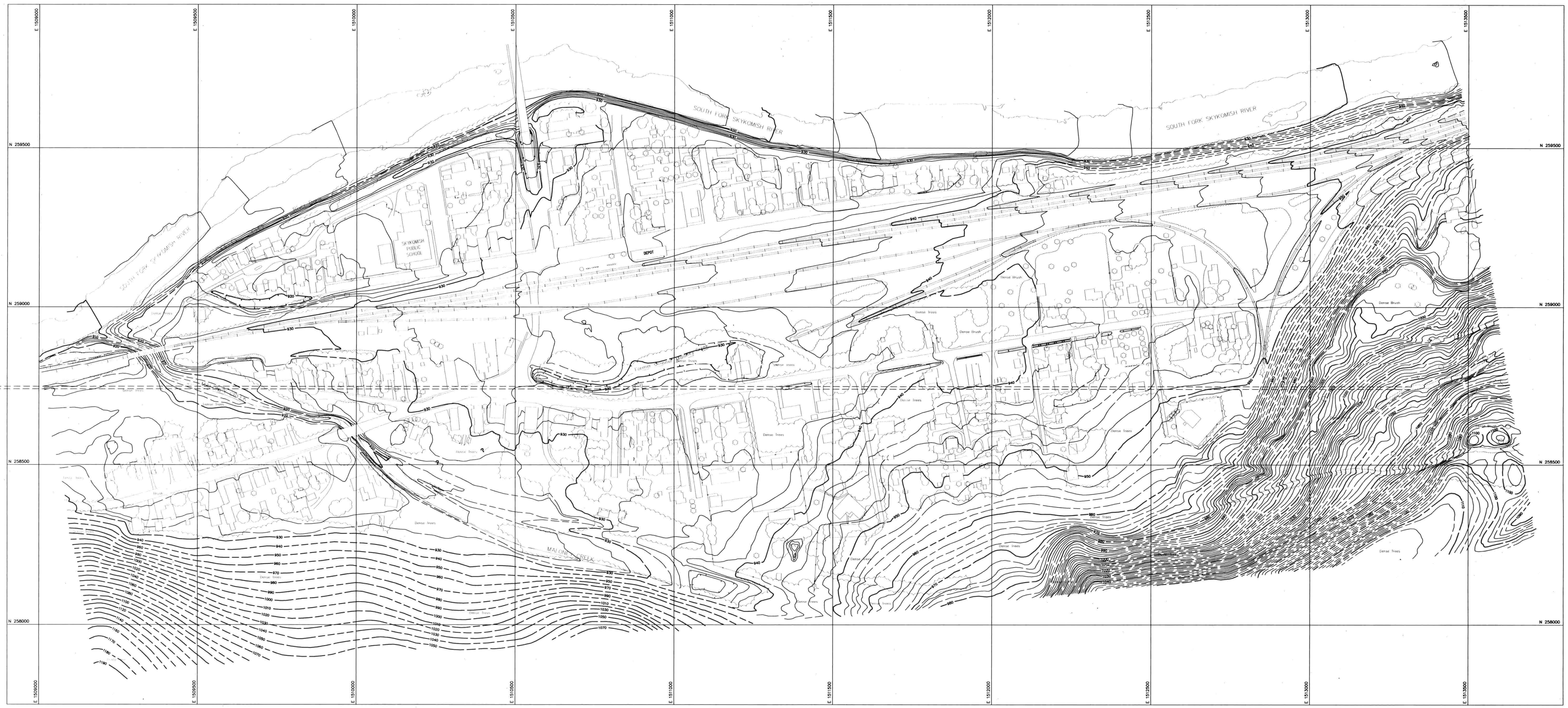
3-1161-350

CURRENT DATE: 2/17/95 CAD FILE 1161S35S

STRUCTURES AND UTILITIES MAP

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. PLATE 1 REV. 0



LEGEND

— · — · —	CREEK CHANNEL
? ? ? ?	QUERIED WHERE INFERRED
—1000— — —	CONTOUR INTERVAL* (ELEVATION FEET AMSL) (DASHED WHERE INFERED)
· — · —	FENCE

* CONTOURS AT 2' INTERVALS EXCEPT IN VERY STEEP AREAS

N

0 75 150 300
SCALE IN FEET

WALKER AND ASSOCIATES, INC.
THIS MAP WAS CREATED BY PHOTOGRAMMETRIC METHODS FOR 1" = 100'.
MAPPING FROM PHOTO DATE: 90CT93

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
6							
5							
4							
3							
2							
1							
0	E.F.	2/2/95	INITIAL ISSUE				

REFERENCE DWG | DESCRIPTION

BNRR SKYKOMISH, WASHINGTON

3-1161-350

CURRENT DATE: 2/2/95 | CAD FILE 1161S36S

TOPOGRAPHIC MAP

RETEC
REMEDIATION TECHNOLOGIES INC

DRAWING NO. PLATE 2 | REV. 0

APPENDIX A

HISTORIC PROPERTY OWNERSHIP

BNR-Skykomish
TCP 511 2.3

RECEIVED
AUG 17 1992
DEPT. OF ECOLOGY

Property History Report
Burlington Northern Rail Yard
Skykomish, Washington

August 17, 1992

Volume 1 of 2

For

Burlington Northern Railroad

GeoEngineers

File No. 0506-016-R14

GeoEngineers

August 17, 1992

Geotechnical,
Geoenvironmental and
Geologic Services

Burlington Northern Railroad
9401 Indian Creek Parkway
Suite 1400
Overland Park, Kansas 66201

Attention: Mr. David Seep

Property History Report
Burlington Northern Rail Yard
Skykomish, Washington
File No. 0506-016-R14

INTRODUCTION

This letter presents the results of GeoEngineers' historical title search of land ownership within the BNRR (Burlington Northern Railroad) Skykomish study area. The Skykomish study area will be referred to as the "site" and is shown in Figure 1. The title search was undertaken at the request of Ecology (Washington State Department of Ecology) as part of BNRR's RI/FS (Remedial Investigation/Feasibility Study) at the Skykomish site.

Title information for the properties outlined in Figure 1 was obtained from Commonwealth Land Title Insurance Company of Philadelphia located in Seattle, Washington. Deeds were used to summarize past and present ownership of properties, property transactions and times of occupation. The deeds are attached to this letter. A current property ownership map was created using a tax lot land status map as a base. The tax lot land status map was obtained from the King County Department of Assessments office.

PRESENT OWNERSHIP

Deeds provided by Commonwealth Land Title Insurance Company were used to identify current ownership within the Skykomish study area. BNRR is the current owner of the area

GeoEngineers, Inc.
8410 154th Avenue N.E.
Redmond, WA 98052
Telephone (206) 861-6000
Fax (206) 861-6050

outlined in Figure 1 (Government lots 5,6,7 and 8). The majority (114) of the 183 property lots within the study area are occupied by residences. Sixty-nine of the property lots are currently non-residential properties. Forty-four of the 69 non-residential lots are owned by the city of Skykomish or Skykomish schools. Current non-residential property owners are identified during this study and their locations are shown below.

Burlington Northern Railroad	(Maloney's 2nd Addition, lots 10-14),
West Coast Telephone	(Block 3, lots 1 & 2),
Skykomish Church	(Block 3, lots 9 & 10),
Skyriver Inn	(Block 4, lots 9-14 & 16-24),
Skykomish Schools	(Block 5, lots 7-11 & Blocks 1 & 2 in Maloney's 1st Addition),
Masonic Temple	(Maloney's 3rd Addition, lots 10 & 11),
Town of Skykomish	(various locations throughout the study area).

PAST OWNERSHIP

A title search was conducted to identify past residential and non-residential property owners within the Skykomish study site. The BNRR property was owned by St. Paul-Minneapolis & Manitoba Railroad Company prior to 1899. The deed is located on page 543. Twenty non-residential property owners have been identified occupying 98 lots within the study area. Figures 2 through 7 identify the past non-residential property owners from 1898 to the present. Tables 1 through 6 correspond with Figures 2 through 7 and present a summary of nonresidential property owners from 1898 to the present, locations of property, lot number(s), and occupation dates. Non-residential property owners were not identified in Government Lot 7 in the eastern portion of the study area. Ownership by banks or financial institutions is not included in the tables or figures.

LIMITATIONS

We have prepared this report for use by Burlington Northern Railroad. This report may be made available to regulatory agencies. The report is not intended for use by others and the information contained herein is not applicable to other sites.

A potential exists for the presence of unrecorded nonresidential property owners. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in this area at the time this report was prepared. No other conditions, express or implied, should be understood.

We appreciate the opportunity to be of service to Burlington Northern Railroad. Please call if you have any questions concerning this report or other aspects of this project.

Yours very truly,

GeoEngineers, Inc.

Barbara J. Hampshire for

David A. Cook
Staff Geologist

Terry E. Parks

Terry E. Parks
Project Geological Engineer

John H. Biggane

John H. Biggane
Principal

DAC:TEP:JHB:ira
Document ID: 0506016.HIS

cc: Department of Ecology
Northwest Regional Office
3190 - 160th Avenue S.E.
Bellevue, Washington 98008-5452
Attention: Ms. Barbara Trejo

Preston, Thorgrimson, Shidler, Gates & Ellis
5400 Columbia Center
701 Fifth Avenue
Seattle, Washington 98104
Attention: Mr. Ross Macfarlane

TABLE 1
PAST PROPERTY OWNERS
NON-RESIDENTIAL/BLOCKS 1 & 2
SKYKOMISH STUDY SITE

Block Number	Lot Number(s)	Property Owner(s)	Date(s) of Ownership
Block 1	Lots 9 & 10	Town of Skykomish	1951-present
Block 2	Lots 15-22	Town of Skykomish	1913-present
	Lot 24	Town of Skykomish	1951-present

Note:
Figure 2 outlines the past and present non-residential property owners in Blocks 1 & 2.

TABLE 2
PAST PROPERTY OWNERS
NON-RESIDENTIAL/BLOCKS 3 & 4
SKYKOMISH STUDY SITE

Block Number	Lot Number(s)	Property Owner(s)	Date(s) of Ownership
Block 3	Lots 22-30	Town of Skykomish	1955-1967
	Lots 11 & 12	Burlington Northern	1929-1955
	Lots 9 & 10	Skykomish Community Church	1937-present
	Lots 3 & 4, 36 & 37	B & B Investment Co.	1934-1936
	Lots 1 & 2	West Coast Telephone	1965-present
Block 4	Lots 6-8	Skykomish Enterprises	1950-1952
	Lots 6-8	Sweet Pea Associates[1]	1975-1980, 1982-1989
	Lots 13 & 14	Clausian Brewing Assoc.	1907-?
	Lots 9-14	Boff-Key Corp.[2]	1976-1989
	Lots 9-14	Skyriver Inn	1989-present
	Lots 19-21, A & B	Town of Skykomish	1961-?
	Lots 16-24, A & B	Security Savesco[3]	1963-1974
	Lots 16-24, A & B	Boff-Key Corp.[2]	1976-1989
	Lots 16-24, A & B	Skyriver Inn	1989-present
	Lots 15 & 25	Town of Skykomish	1924-present
	Lots 27 & 28	Town of Skykomish	1918-present

Notes:

According to information gained from the City of Skykomish:

[1]Seat Pea Association owned the Skykomish Hotel at this location.

[2]Boff-Key Corp. (Al Boffey) owned the SkyRiver Inn at this location.

[3]Security Savesco housed the Post Office at this location.

Figure 3 outlines the past and present non-residential property owners in Blocks 3 & 4.

TABLE 3
PAST PROPERTY OWNERS
NON-RESIDENTIAL/BLOCK 5
SKYKOMISH STUDY SITE

Block Number	Lot Number(s)	Property Owner(s)	Date(s) of Ownership
Block 5	Lots 5 & 6	Knutson & Nelson Partnership[1]	1943-1948
	Lots 5 & 6	Empire Millwork	1948-1956
	Lots 5 & 6	Skykomish Timber Co.	1956-1956
	Lots 5 & 6	Town of Skykomish	1956-present
	Lots 7-11	Skykomish Public Schools #192	1937-present
	Lots 13 & 14	Robinson Plywood & Timber	1959-1959
	Lots 17 & 18, B	Town of Skykomish	1951-present
	Lots 1-4, 25-27	Seattle Association of Credit Men	1938-1954

Notes:

According to information gained from the City of Skykomish:

[1]Knutson & Nelson Partnership owned a logging outfit.

Figure 4 outlines the past and present non-residential property owners in Block 5.

TABLE 4
PAST PROPERTY OWNERS
NON-RESIDENTIAL/BLOCKS 1, 2 & 3: MALONEY'S 1ST ADDITION
SKYKOMISH STUDY SITE

Block Number	Lot Number(s)	Property Owner(s)	Date(s) of Ownership
Block 1 (Maloney's 1st Addition)	All lots	Skykomish Schools #192	1909-present
Block 2 (Maloney's 1st Addition)	All lots	Skykomish Schools #192	1930-present
Block 3 (Maloney's 1st Addition)	Lots 1-3	Town of Skykomish	1924-present

Note:

Figure 5 outlines the past and present non-residential property owners in Blocks 1, 2 & 3 of Maloney's 1st Addition.

TABLE 5
PAST PROPERTY OWNERS
NON-RESIDENTIAL/BLOCK 4: MALONEY'S 2ND ADDITION
SKYKOMISH STUDY SITE

Block Number	Lot Number(s)	Property Owner(s)	Date(s) of Ownership
Block 4 (Maloney's 2nd Addition)	Lot 9	Snohomish Auto Freight	1930-1945
	Lots 10-14	Burlington Northern Railroad	1926-present

Note:

Figure 6 outlines the past and present non-residential property owners in Block 4 of Maloney's 2nd Addition.

TABLE 6
PAST PROPERTY OWNERS
NON-RESIDENTIAL/MALONEY'S 3RD ADDITION
SKYKOMISH STUDY SITE

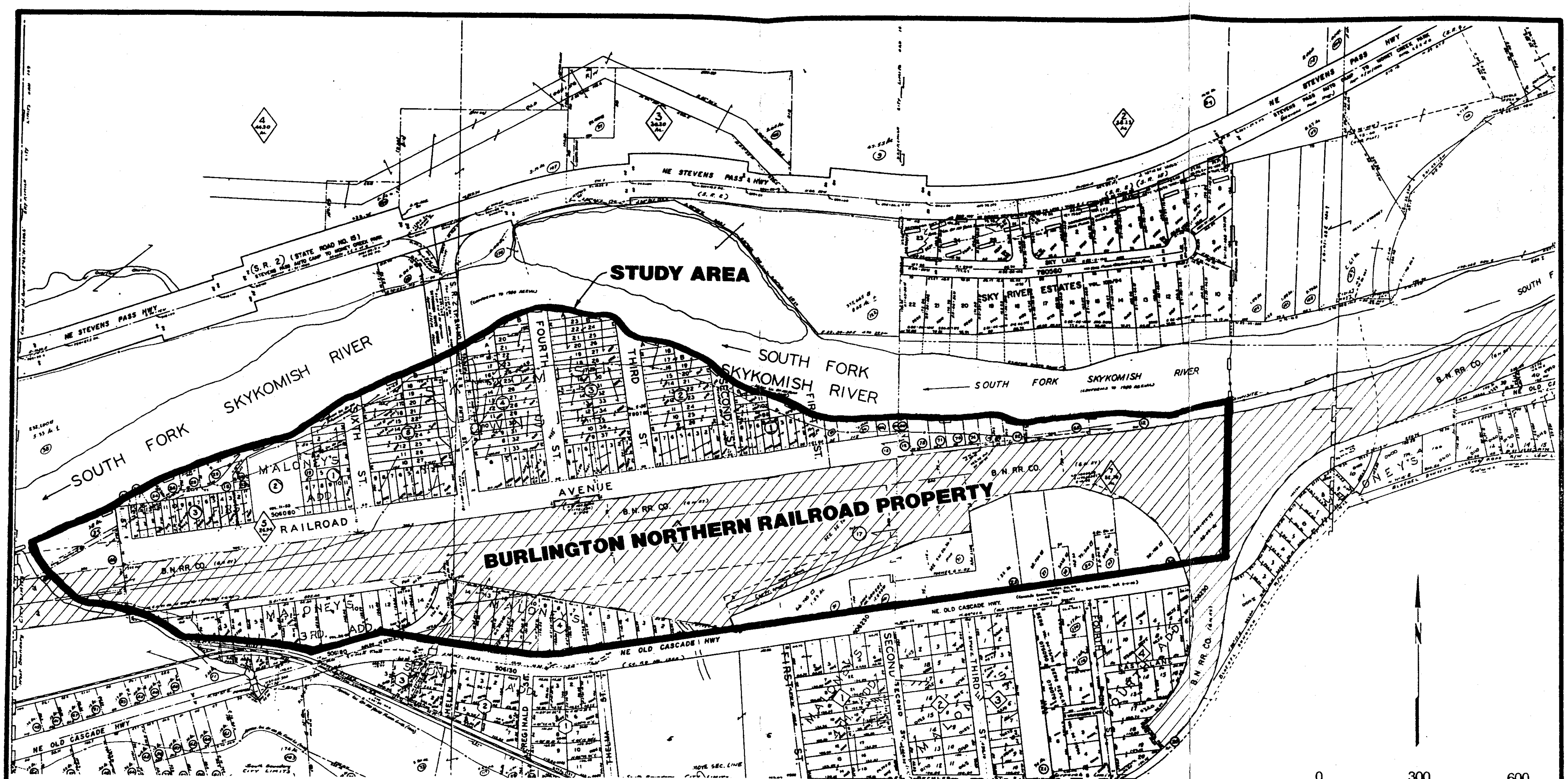
Block Number	Lot Number(s)	Property Owner(s)	Date(s) of Ownership
Malony's 3rd Addition	Lot 14	Misty Mountain Mfg. Co.[1]	1978-1987
	Lots 12-14 & 6	Seattle Association of Credit Men	1938-1954
	Lots 10 & 11	Skykomish Masonic Temple	1925-present

Notes:

According to information gained from the City of Skykomish:

[1]The Misty Mountain Mfg. Co. owned an outdoor supply store at this location.

Figure 7 outlines the past and present non-residential property owners in Maloney's 3rd Addition.



Reference: King County Department of Assessments map, undated.

GeoEngineers

TITLE SEARCH AREA

FIGURE 1

0506-016-R14 DAC:BDH 6/25/92

APPENDIX B

WELL LOGS FOR MUNICIPAL AND OTHER NEARBY WELLS

Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Permit No. ....

(1) **OWNER:** Name TimBerLane Village Address Skykomish Wash

(2) **LOCATION OF WELL:** County King — SE ¼ NE ¼ Sec. 25 T. 26 N., R. 11 W.M.

Bearing and distance from section or subdivision corner 1½ M E of Skykomish

(3) **PROPOSED USE:** Domestic ☑ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐

(4) **TYPE OF WORK:** Owner's number of well (if more than one) ....
New well ☑ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☑ Jetted ☐

(5) **DIMENSIONS:** Diameter of well ____ inches.
Drilled 373 ft. Depth of completed well ____ ft.

(6) **CONSTRUCTION DETAILS:**

Casing installed: 8 " Diam. from +1 ft. to 18 ft.
Threaded ☐ ____ " Diam. from ____ ft. to ____ ft.
Welded ☑ ____ " Diam. from ____ ft. to ____ ft.

Perforations: Yes ☐ No ☑
Type of perforator used ____
SIZE of perforations ____ in. by ____ in.
____ perforations from ____ ft. to ____ ft.
____ perforations from ____ ft. to ____ ft.
____ perforations from ____ ft. to ____ ft.

Screens: Yes ☐ No ☑
Manufacturer's Name ____
Type ____ Model No. ____
Diam. ____ Slot size ____ from ____ ft. to ____ ft.
Diam. ____ Slot size ____ from ____ ft. to ____ ft.

Gravel packed: Yes ☐ No ☑ Size of gravel: ____
Gravel placed from ____ ft. to ____ ft.

Surface seal: Yes ☑ No ☐ To what depth? 18 ft.
Material used in seal Cement
Did any strata contain unusable water? Yes ☑ No ☐
Type of water? ____ Depth of strata 20 Ft
Method of sealing strata off Was not Been done

(7) **PUMP:** Manufacturer's Name ____
Type: ____ H.P. ____

(8) **WATER LEVELS:** Land-surface elevation above mean sea level.... ____ ft.
Static level 40 ft. below top of well Date July 10
Artesian pressure ____ lbs. per square inch Date ____
Artesian water is controlled by ____ (Cap, valve, etc.)

(9) **WELL TESTS:** Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☑ If yes, by whom? ____
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
Bailed dry at 198 Ft					

Date of test ____
Bailer test ____ gal./min. with ____ ft. drawdown after ____ hrs.
Artesian flow ____ g.p.m. Date ____
Temperature of water ____ Was a chemical analysis made? Yes ☐ No ☑

(10) **WELL LOG:**

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Sand	0	5
gray granite with some Fractures	5	192
open Cavern or so soft that we had no Resistance looked like graphite Black Rock with some white quartz	192	210
Black Rock - soft & hard spots	210	372
Hole started to Cave in so was Capt & sealed - Possibly for Further use		
Water always came up to the same static head		
I felt that there was a lot of Fractures from 280 to 373 - we could not get any Returns without stopping Drill & putting down 900 cu ft of Air - Even then it would take 1 to 2 minutes to get cuttings out - were using a lot of soap		

Work started 6-18, 1977 Completed 7-12, 1977

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME H.O. Meyer Drlg Co (Person, firm, or corporation) (Type or print)

Address 6424 Lake Wn. Blvd NE Kirkland 98033

[Signed] H.O. Meyer (Well Driller)

License No. 0308 Date 7-18, 1977

(USE ADDITIONAL SHEETS IF NECESSARY)

S. F. No. 7356—OS—(Rev. 4-71).

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No. ....
Permit No. ....

(1) OWNER: Name Sky River Estates 1 Address P.O. Box 362, Mukilteo, WA

(2) LOCATION OF WELL: County King ...... ¼ ...... ¼ Sec 26 T26 N., R 11E W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☒

(4) TYPE OF WORK: Owner's number of well (if more than one) ....
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☒ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 8 inches.
Drilled 49 ft. Depth of completed well 47 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 8" Diam. from 0 ft. to 47 ft.
Threaded ☐ ......" Diam. from ...... ft. to ...... ft.
Welded ☒ ......" Diam. from ...... ft. to ...... ft.

Perforations: Yes ☐ No ☒
Type of perforator used ......
SIZE of perforations ...... in. by ...... in.
...... perforations from ...... ft. to ...... ft.
...... perforations from ...... ft. to ...... ft.
...... perforations from ...... ft. to ...... ft.

Screens: Yes ☒ No ☐
Manufacturer's Name Cook
Type SS Model No. ......
Diam. 8 Slot size 100 from 39 ft. to 44 ft.
~~Diam. ...... Slot size ...... from ...... ft. to ...... ft.~~

Gravel packed: Yes ☐ No ☒ Size of gravel: ......
Gravel placed from ...... ft. to ...... ft.

Surface seal: Yes ☒ No ☐ To what depth? 18 ft.
Material used in seal bentonite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? ...... Depth of strata ......
Method of sealing strata off ......

(7) PUMP: Manufacturer's Name ......
Type: ...... H.P. ......

(8) WATER LEVELS: Land-surface elevation above mean sea level .... ft.
Static level 12 ft. below top of well Date 8/25/78
Artesian pressure ...... lbs. per square inch Date ......
Artesian water is controlled by ...... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☒ No ☐ If yes, by whom? Robinson& Noble
Yield: 108 gal./min. with 2½ ft. drawdown after 2 hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ......
Bailer test ...... gal./min. with ...... ft. drawdown after ...... hrs.
Artesian flow ...... g.p.m. Date ......
Temperature of water ...... Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
brown sandy topsoil	0	4
grey-brown clay & gravel	4	12
brown river silt	12	25
s&g	25	26
s&g, water bearing	26	27
s&g, some clay, big gravel& boulders	27	40
clay	40	41
s&g	41	45
s&g, claybound (hard)	45	49

Work started Aug. 21, 1978. Completed Aug. 25, 1978

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Indrebo Drilling (Person, firm, or corporation) (Type or print)

Address 1653 S. 95th, Tacoma, WA 98444

[Signed] Roger Indrebo (Well Driller)

License No. 0596 Date Aug. 26, 1978

ENTERED 26/11/26

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. 11791
UNIQUE WELL I.D. # ABA 872
Water Right Permit No.

(1) OWNER: Name TOWN OF SKYKOMISH Address 4TH STREET NORTH, P.O. BOX 308, SKYKOMISH, WA

(2) LOCATION OF WELL: County KING — 1/4 SE 1/4 Sec 26 T. 26 N., R. 11 E W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) 73931 N.E. OLD CASCADE HWY (PROPERTY EAST OF SITE)

(3) PROPOSED USE: ☐ Domestic ☐ Irrigation ☐ DeWater ☐ Industrial ☐ Test Well ☒ Municipal ☐ Other

(4) TYPE OF WORK: Owner's number of well (If more than one) WELL #3
☐ Abandoned ☒ New well ☐ Deepened ☐ Reconditioned
Method: ☐ Dug ☒ Cable ☐ Rotary ☐ Bored ☐ Driven ☐ Jetted

(5) DIMENSIONS: Diameter of well 12 inches.
Drilled 219 feet. Depth of completed well 219 ft.

(6) CONSTRUCTION DETAILS:
Casing Installed: 12" Diam. from 0' ft. to 181 ft.
☐ Welded 10" Diam. from 176 ft. to 219 ft.
☒ Liner installed " Diam. from ft. to ft.
☐ Threaded

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☒ No ☐
Manufacturer's Name JOHNSON
Type STAINLESS STEEL Model No.
Diam. 10" Slot size 60 from 180.5 ft. to 184.5 ft.
Diam. Slot size ~~50~~ 80 from ~~207.5~~ 189.5 ft. to ~~216.5~~ 199.5 ft.

Gravel packed: Yes ☐ No ☒ Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 26 ft.
Material used in seal CEMENT-BENTONITE
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level 950' (APPROX) ft.
Static level 51.5 ft. below top of well Date 4/4/94
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☒ No ☐ If yes, by whom? GRAY & OBSBONE
Yield: 315 gal./min. with 17' ft. drawdown after 1 ½ hrs.
" 315 " 17' " 12 "
" 315 " 17' " 24 "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
		2 MIN	57'-1"		
0	68'-10"	10 MIN	56'-11"		
1MIN	58'-2"				

Date of test 4/12/94 TO 4/13/94
Bailer test gal./min. with ft. drawdown after hrs.
Airtest gal./min. with stem set at ft. for hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☒ No ☐

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
TOP SOIL W/LARGE COBBLES	0'	1'
DARK BROWN SAND W/SOME GRAVEL SMALL COBBLES	1'	7'
TIGHT GREY SAND W/GRAVLES	7'	11'
TIGHT GRAY DIRTY SAND W/GRAVELS TRACE OF GRAVELS, ABLE TO DRILL 1' OPEN HOLE	11'	26'
GRAYISH-BROWN SILT BOUND SAND AND GRAVEL, ABLE TO DRILL 3' OPEN HOLE	26'	37'
BROWN SILTY SAND & GRVAL W/BINDER	37'	50'
GRAYISH BROWN TIGHT COMPACTED SILTY SAND W/GRAVELS	50'	55'
VERY TIGHT BROWN CEMENTED SAND & GRAVEL	55'	58'
TIGHT WEATHERED CEMENTED SAND & GRAVEL	58'	97'
TIGHT WEATHERED CEMENTED SAND & GRAVEL W/GRANITE COBBLES	97'	133'
GREY SILTY SAND & GRAVEL	133'	138'
FINE BROWN SILTY SAND W/MICA	138'	157'
RED & BROWN SILTS W/EMBETTED GRAVEL	157'	160'
TIGHT GRAY CEMENTED SAND & GRVAL W/COBBLES	160'	170'
TIGHT GRAY CEMENTED SAND & GRAVEL W/COBBLES, TRACE OF WATER	170'	183'
TIGHT CEMENTED SAND & GRAVEL W/COBBLES	183'	191'
COURSE WATERBEARING SAND & GRAVEL W/COBBLES	191'	193'
TIGHT CEMENTED SAND & GRAVEL W/ COBBLES	193'	208'
WATERBEARING SAND & GRAVEL	208'	217'
~~WATERBEARING SAND & GRAVEL~~		
CEMENTED SAND & GRAVEL	217'	219'

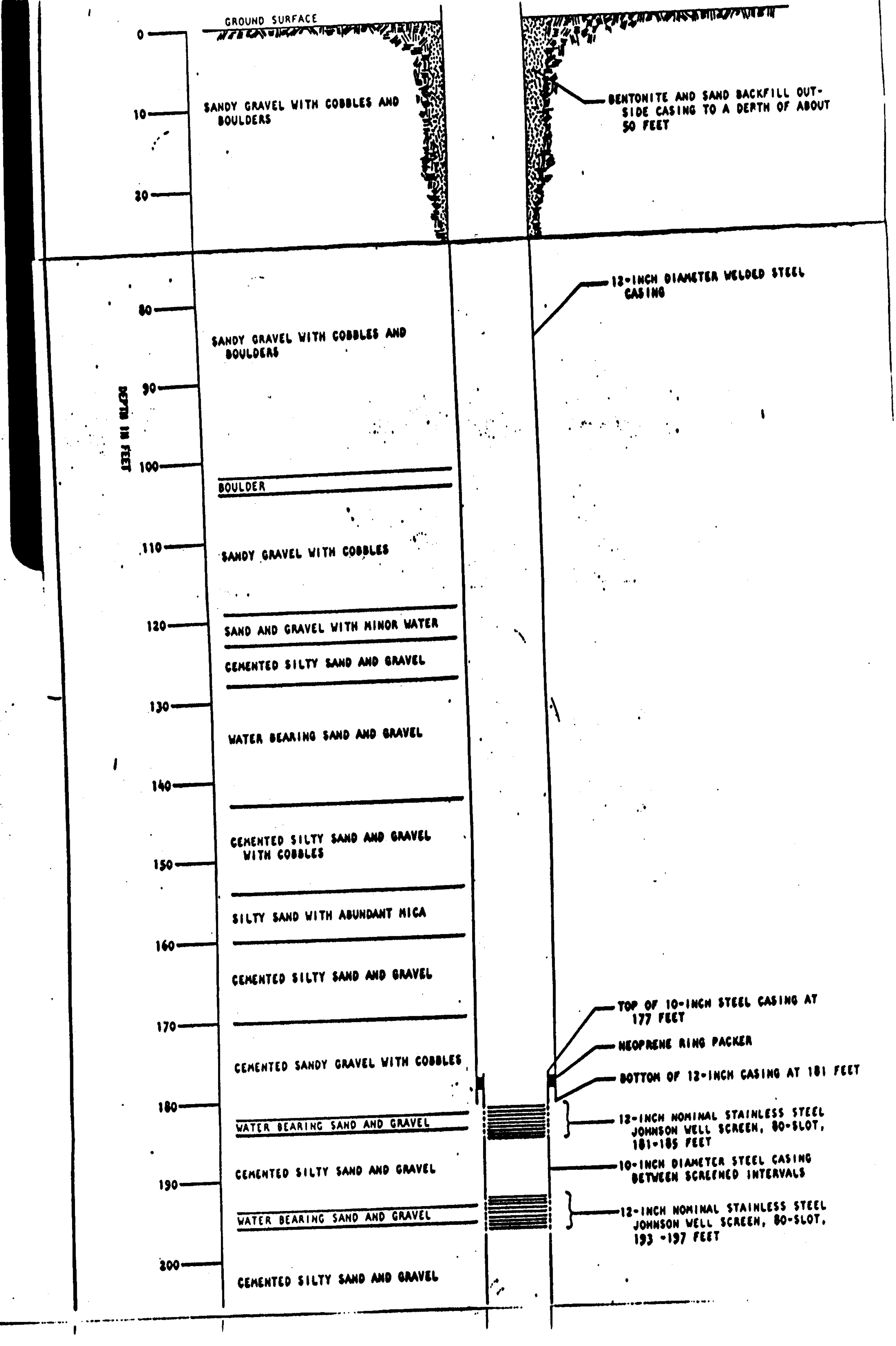
Work Started 3/14/94, 19. Completed 4/14/94, 19

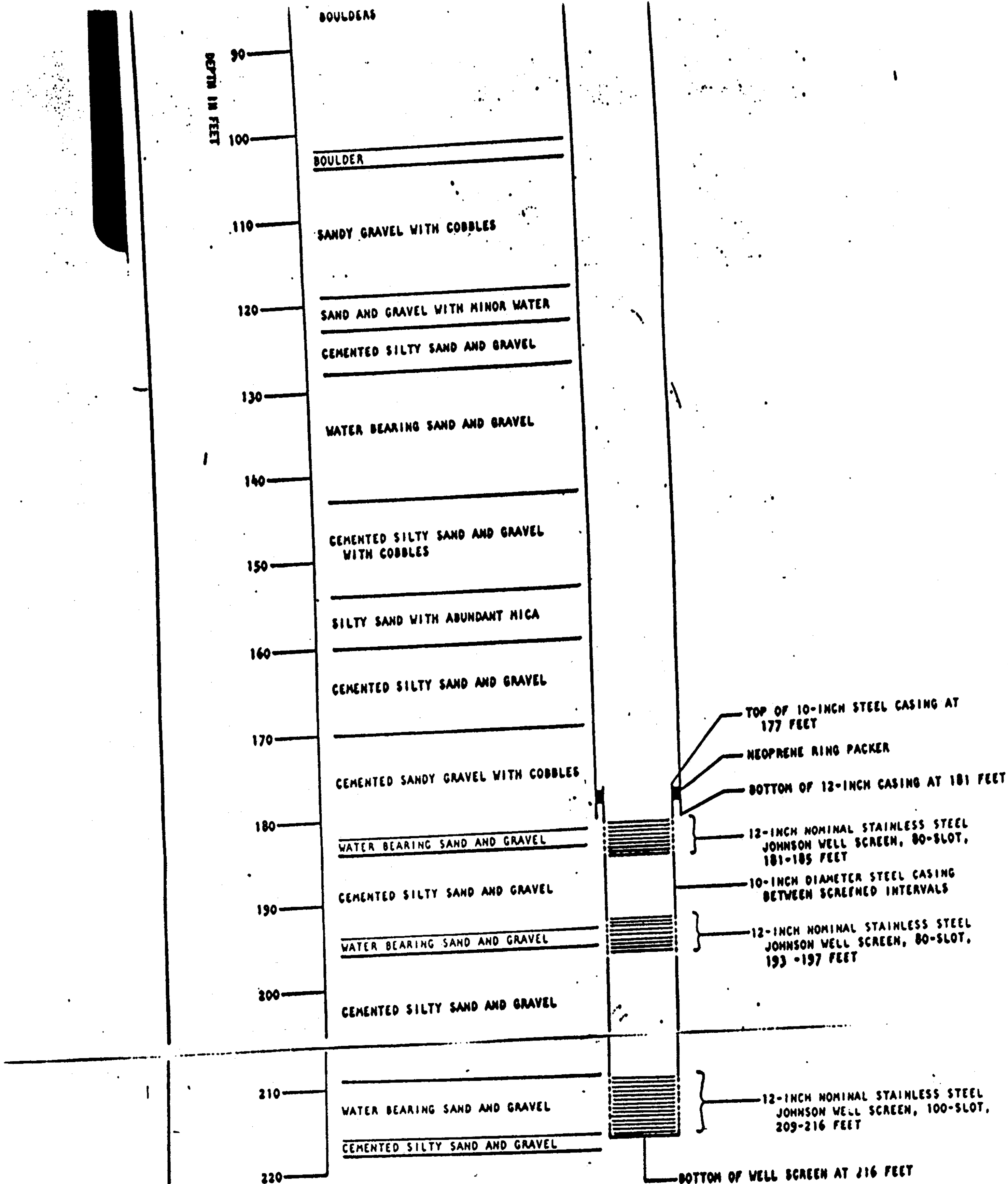
WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME HOKKAIDO DRILLING & DEVELOPING CORP (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address P.O. BOX 100, GRAHAM, WA 98338
(Signed) [signature] (WELL DRILLER) License No. 1146
Contractor's Registration No. HOKKADD178D3 Date JUNE 20, 19 94

(USE ADDITIONAL SHEETS IF NECESSARY)


GROUND SURFACE
DEPTH IN FEET
0
10
20
80
90
100
110
120
130
140
150
160
170
180
190
200
SANDY GRAVEL WITH COBBLES AND BOULDERS
BENTONITE AND SAND BACKFILL OUTSIDE CASING TO A DEPTH OF ABOUT 50 FEET
12-INCH DIAMETER WELDED STEEL CASING
SANDY GRAVEL WITH COBBLES AND BOULDERS
BOULDER
SANDY GRAVEL WITH COBBLES
SAND AND GRAVEL WITH MINOR WATER
CEMENTED SILTY SAND AND GRAVEL
WATER BEARING SAND AND GRAVEL
CEMENTED SILTY SAND AND GRAVEL WITH COBBLES
SILTY SAND WITH ABUNDANT MICA
CEMENTED SILTY SAND AND GRAVEL
CEMENTED SANDY GRAVEL WITH COBBLES
TOP OF 10-INCH STEEL CASING AT 177 FEET
NEOPRENE RING PACKER
BOTTOM OF 12-INCH CASING AT 181 FEET
WATER BEARING SAND AND GRAVEL
12-INCH NOMINAL STAINLESS STEEL JOHNSON WELL SCREEN, 80-SLOT, 181-185 FEET
CEMENTED SILTY SAND AND GRAVEL
10-INCH DIAMETER STEEL CASING BETWEEN SCREENED INTERVALS
WATER BEARING SAND AND GRAVEL
12-INCH NOMINAL STAINLESS STEEL JOHNSON WELL SCREEN, 80-SLOT, 193 -197 FEET
CEMENTED SILTY SAND AND GRAVEL



NOTES:

1. WATER WELL WAS DRILLED FROM JULY 9 THROUGH AUGUST 9, 1979.
2. PUMP TESTING OF COMPLETED WELL RESULTED IN 40 FEET OF DRAWDOWN AT PUMPING RATE OF 600 GALLONS PER MINUTE.
3. WELL LOG DATA IS BASED ON DRILLERS LOG SUBMITTED BY RICHARDSON WELL DRILLING COMPANY OF TACOMA, WASHINGTON.

APPENDIX C

SURFACE SOIL, HAND AUGER, WELL AND BORING LOGS

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVEL MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND MORE THAN 50% OF COARSE FRACTION PASSES NO. 4 SIEVE	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS MORE THAN 50% PASSES NO. 200 SIEVE	SILT AND CLAY LIQUID LIMIT LESS THAN 50	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY LIQUID LIMIT 50 OR MORE	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1. Field classification is based on visual examination of soil in general accordance with ASTM D2488-83.
2. Soil classification using laboratory tests is based on ASTM D2487-83.
3. Descriptions of soil density or consistency are based on interpretation of blowcount data, visual appearance of soils, and/or test data.

SOIL MOISTURE MODIFIERS:

Dry – Absence of moisture, dusty, dry to the touch

Moist – Damp, but no visible water

Wet – Visible free water or saturated, usually soil is obtained from below water table

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SOIL CLASSIFICATION SYSTEM

FIGURE A-1

LABORATORY TESTS:

CA Chemical Analysis

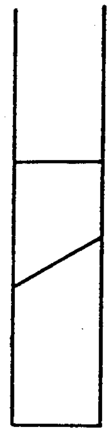
FIELD SCREENING TESTS:

Headspace vapor concentration data given in parts per million

Sheen classification system:

NS No Visible Sheen
SS Slight Sheen
MS Moderate Sheen
HS Heavy Sheen
NT Not Tested

SOIL GRAPH:



SM Soil Group Symbol (See Note 2)

Distinct Contact Between Soil Strata

Gradual or Approximate Location of Change Between Soil Strata

⊻ Water Level

Bottom of Boring

BLOW-COUNT/SAMPLE DATA:

Blows required to drive a 2.4-inch I.D. split-barrel sampler 12 inches or other indicated distances using a 300-pound hammer falling 30 inches.

- 22 ■ Location of relatively undisturbed sample
- 12 ⊠ Location of disturbed sample
- 17 □ Location of sampling attempt with no recovery

Blows required to drive a 1.5-inch I.D. (SPT) split-barrel sampler 12 inches or other indicated distances using 140-pound hammer falling 30 inches.

- 10 ◨ Location of sample obtained in general accordance with Standard Penetration Test (ASTM D-1586) procedures
- 26 ◫ Location of SPT sampling attempt with no recovery

▤ Location of grab sample

"P" indicates sampler pushed with weight of hammer or against weight of drill rig.

NOTES:

1. The reader must refer to the discussion in the report text, the Key to Boring Log Symbols and the exploration logs for a proper understanding of subsurface conditions.

2. Soil classification system is summarized in Figure A-1.

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KEY TO BORING LOG SYMBOLS

FIGURE A-2

GEI 86-6? Rev. 6/90

BORING B-1

TEST DATA

Depth (ft)	Sheen	Vapor Conc. (ppm)	Other Tests	Blow-Count	Samples	Group Symbol	DESCRIPTION Surface Elevation (ft.):
0						SM	Bluish green silty sand with occasional gravel (loose, moist)
~4	SS	< 100	CA	7	⊠		
~6.5	MS	< 100		6	⊠		Grades to reddish brown
~9	HS	< 100		6	⊠		
~10						SP—SM	Brown fine sand with silt (medium dense, moist)
~12	HS	600	CA	27	⊠		
13.0							Boring completed at 13.0 feet because of auger refusal on 11/04/91

DEPTH IN FEET (0–40)

Note: See Figure A-2 for explanation of symbols

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Log of Boring

Figure A-3

0506-016-R14 :DEH:KLB:CMS 2/24/92

BORING B-2

TEST DATA

DESCRIPTION

Surface Elevation (ft.):

Depth in Feet	Sheen	Vapor Conc. (ppm)	Other Tests	Blow-Count	Samples	Group Symbol	Description
0						SM	Dark brown silty fine sand and occasional gravel (very loose, moist)
~4	SS	< 100	CA	4	☒		Grades to light brown, gravel content decreases
~5						SP	Tan fine to medium sand (medium dense, moist)
~6.5	SS	< 100		15	☒		
~7.5						SP — SM	Tannish brown fine to medium sand with silt (medium dense, moist)
~9	SS	< 100	CA	20	☒		
~11.5	NS	< 100		35	☒		Grades to dense
~14	NS	< 100		57	☒		Grades to very dense
~16.5	NS	< 100		50/3"	☒		
~17.5						SM	Grayish brown silty fine sand (dense, wet)
~19	NS	< 100		31	☒		
20							Boring completed at 20.0 feet on 11/05/91

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40 (DEPTH IN FEET)

Note: See Figure A-2 for explanation of symbols

GeoEngineers

Log of Boring

Figure A-4

0506-016-R14 :DEH:KLB:CMS 2/24/92

TEST DATA

BORING B-3

Depth (ft)	Sheen	Vapor Conc. (ppm)	Other Tests	Blow-Count	Samples	Group Symbol	DESCRIPTION Surface Elevation (ft.):
0						SM	Grayish brown silty fine to medium sand (loose, moist)
	NS	< 100	CA	6	⊠		
5						SP—SM	Light brown fine to medium sand with silt (medium dense, moist)
	SS	< 100		27	⊠		
						SM	Grayish brown silty fine to medium sand and occasional gravel (very dense, moist)
	SS	< 100		50/3"	⊠		
10							
	SS	< 100		50/4"	⊠		
	SS	< 100	CA	50/4"	⊠		
15							
	SS	< 100		50/4"	⊠		
							Boring completed at 17.0 feet because of auger refusal on 11/05/91

DEPTH IN FEET (scale 0–40)

Note: See Figure A-2 for explanation of symbols

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Log of Boring

Figure A-5

:DEH:KLB:CMS 2/24/92

0506-016-R14

RETEC

BORING LOG
B-4

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: 3-1161 BN-Skykomish		CLIENT: Burlington Northern
LOCATION: Near former turntable; Skykomish, WA		DRILLING CO.: Cascade Drilling
START DATE: 9/28/93 TIME: 1200	BORING ID: 8"	DRILLER: R. Labrosse/B. Maloy/D. Miner
COMPLETION DATE: 9/28/93 TIME: 1315	BORING DEPTH: 12.5'	RIG TYPE: CME 75
WATER LEVEL DURING DRILLING: '	SURFACE ELEV.: 938.47' (MSL)	METHOD: HSA
DATE MEASURED:	M. P. ELEVATION:	LOGGED BY: W. Beebe

DEPTH (in feet)	TYPE	BLOWS /ft	%RECOVERY	PID (ppm)	U.S.C.S.	SOIL DESCRIPTION
0	SS	50/5	39	0	SW	GRAVELLY SAND: Black; with some silt; sub-angular to sub-rounded gravel to 2"; medium to coarse grained sand; medium dense to very dense; "wet" luster; odor; damp
	SS	7 8 10	28	0		
5	SS	2 3 6	44	0		
	SS	50/5	17	0		
10	SS	50/5	22	0		
	SS	50/5	22	0		
	SS	50/4	6	6		12.5' - becomes gray; moist
						Refusal at 12.5'
15						
						Backfilled with 4 bags Pure Gold Medium Bentonite Chips
20						
25						

REMARKS: SS = Split Spoon; ■ Analytical Sample

RETEC

BORING LOG
B-4B

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: *3-1161 BN-Skykomish*		CLIENT: *Burlington Northern*
LOCATION: *Near former turntable; Skykomish, WA*		DRILLING CO.: *Cascade Drilling*
START DATE: *10/24/93* TIME: *1100*	BORING ID: *9 3/4*	DRILLER: *S. Butler/M. Sharp/J. Trover*
COMPLETION DATE: *10/24/93* TIME: *1300*	BORING DEPTH: *27'*	RIG TYPE: *Ingersoll-Rand T3W*
WATER LEVEL DURING DRILLING: *15'*	SURFACE ELEV.: *938.26' (MSL)*	METHOD: *Air Rotary*
DATE MEASURED: *10/24/93*	M. P. ELEVATION:	LOGGED BY: *W. Beebe*

DEPTH (in feet)	SAMPLE DATA: TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION
0						SW		GRAVELLY SAND: Black; with trace organics (wood fibers); medium dense; odor; damp
8								8' – becomes brown
12								12' – no further signs of contamination
15						∇ (water level)		
17	SS	■ (17–18.5)	11 17 44	33	0			
22								22' – becomes some silt
23								Total depth = 23'

REMARKS: SS = Split Spoon; ■ Analytical Sample

RETEC

BORING LOG
B-5

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: *3-1161 BN-Skykomish*		CLIENT: *Burlington Northern*
LOCATION: *North of turntable between tracks; Skykomish, WA*		DRILLING CO.: *Cascade Drilling*
START DATE: *10/24/93* TIME: *1330*	BORING ID: *9 3/4*	DRILLER: *S. Butler/M. Sharp/J. Trover*
COMPLETION DATE: *10/24/93* TIME: *1545*	BORING DEPTH: *18.5'*	RIG TYPE: *Ingersoll-Rand T3W*
WATER LEVEL DURING DRILLING: *15'*	*SURFACE ELEV.: 936.62' (MSL)*	METHOD: *Air Rotary*
DATE MEASURED: *10/24/93*	M. P. ELEVATION:	LOGGED BY: *W. Beebe*

DEPTH (in feet)	SAMPLE DATA: TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)	U.S.C.S.	SOIL DESCRIPTION
0						SW	GRAVELLY SAND: Black; dense; oily luster; odor; damp
5							
7	SS	■	5 16 23	55	0		7' – becomes coarse grained; no signs of contamination
10							
11							11' – becomes slow drilling
13							13' – becomes minor silt
15						▽	
17	SS	■	4 8 14	50	0	SP	SAND: Gray; with minor silt; fine grained; medium dense; saturated
18.5							Total depth = 18.5'
20							
25							

REMARKS: SS = Split Spoon; ■ Analytical Sample

RETEC

BORING LOG
B-6

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: 3-1161 BN-Skykomish		CLIENT: Burlington Northern
LOCATION: East of MW-12; Skykomish, WA		DRILLING CO.: Cascade Drilling
START DATE: 10/19/93 TIME: 0730	BORING ID: 9 3/4	DRILLER: S. Butler/M. Sharp/J. Trover
COMPLETION DATE: 10/19/93 TIME: 1015	BORING DEPTH: 24.5'	RIG TYPE: Ingersoll-Rand T3W
WATER LEVEL DURING DRILLING: 9'	SURFACE ELEV.: 930.56' (MSL)	METHOD: Air Rotary
DATE MEASURED: 10/19/93	M. P. ELEVATION:	LOGGED BY: W. Beebe

DEPTH (in feet)	SAMPLE DATA: TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION
0						SW		GRAVELLY SAND: Gray; with minor organics (wood, roots); very dense; damp to moist
5								
								6' – slight sheen on cuttings
	SS	■	5 50/6	11	0.7			8' – Oily luster in cuttings
						▽ (9')		
10	SS	■	2 4 23	39	0.7			
15						SP		SAND: Brown; with some silt; fine grained sand; medium dense; wet
20						SW		GRAVELLY SAND: Brown-gray; sub-angular gravels to 1"; medium to coarse grained sand; very dense; saturated
	SS	■	5 35 36	83	0.2			
25								Total depth = 24.5'

REMARKS: SS = Split Spoon; ■ Analytical Sample

RETEC

BORING LOG
B-7

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: *3-1161 BN-Skykomish*		CLIENT: *Burlington Northern*
LOCATION: *Parking lot across from Flynn's; Skykomish, WA*		DRILLING CO.: *Cascade Drilling*
START DATE: *10/22/93* TIME: *1400*	BORING ID: *9 3/4*	DRILLER: *S. Butler/M. Sharp/J. Trover*
COMPLETION DATE: *10/22/93* TIME: *1700*	BORING DEPTH: *32'*	RIG TYPE: *Ingersoll-Rand T3W*
WATER LEVEL DURING DRILLING: *15'*	*SURFACE ELEV.: 934.53' (MSL)*	METHOD: *Air Rotary*
DATE MEASURED: *10/22/93*	M. P. ELEVATION:	LOGGED BY: *W. Beebe*

DEPTH (in feet)	SAMPLE DATA: TYPE	BLOWS /ft	%RECOVERY	PID (ppm)	U.S.C.S.	SOIL DESCRIPTION
0						ASPHALT:
					SW	GRAVELLY SAND: Black; with trace silt; dense; damp
5						5' – becomes brown
7.5						7.5' – becomes very dense
8–9.5	SS	6 21 40	22	0		9' – moderate hydrocarbon odor
11–12.5	SS	6 9 30	44	0		
13						13' – strong hydrocarbon odor; cuttings look oil stained (moist with oil
15 (water level ∇)						
17–18.5	SS	1 1 50/6	33	0		17' – becomes some silt; moderate sheen on sample
19						19' – strong hydrocarbon odor; sheen on water
20					ML	CLAYEY SILT: Gray; medium stiff; no signs of contamination; wet
22–23.5	SS	5 8 18	66	0		
25						

REMARKS: SS = Split Spoon; ■ Analytical Sample

RETEC

BORING LOG

B-7

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

DEPTH (in feet)	SAMPLE DATA: TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)	SOIL DESCRIPTION: U.S.C.S.	LITHOLOGY	
25						ML		
30								
								Total depth = 32'
35								
40								
45								
50								

REMARKS: SS = Split Spoon; ■ Analytical Sample

RETEC

BORING LOG

B-8

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: *3-1161 BN-Skykomish*		CLIENT: *Burlington Northern*
LOCATION: *North of transformer pads between tracks; Skykomish, WA*		DRILLING CO.: *Cascade Drilling*
START DATE: *10/20/93* TIME: *0730*	BORING ID: *9 3/4*	DRILLER: *S. Butler/M. Sharp/J. Trover*
COMPLETION DATE: *10/20/93* TIME: *1400*	BORING DEPTH: *32'*	RIG TYPE: *Ingersoll-Rand T3W*
WATER LEVEL DURING DRILLING: *16'*	SURFACE ELEV.: *935.13' (MSL)*	METHOD: *Air Rotary*
DATE MEASURED: *10/20/93*	M. P. ELEVATION:	LOGGED BY: *W. Beebe*

DEPTH (in feet)	SAMPLE DATA: TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION
0						SW		GRAVELLY SAND: Black; with minor silt; dense; damp
5						SP		SAND: Brown; with minor gravel; sub angular gravels to 1"; medium dense; damp
						SW		GRAVELLY SAND: Brown-gray; coarse gravels; medium grained sand; very dense; moist
10								
	SS	■	4 7 50/4	22	2			12'- becomes moist to wet with oil; hydrocarbon odor; specks of oil
15						▽ (16')		
	SS	■	3 7 13	22	2			
20								
	SS	■	5 8 13	56	2.8	CL		CLAY: Laminated reddish brown, light brown and gray; very stiff; no signs of contamination; damp
25								

REMARKS: SS = Split Spoon; ■ Analytical Sample; PID Background = 2.0-2.8

RETEC

BORING LOG
B-8

1011 SW Klickitat Way
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Seattle, WA 98134
(206) 624-9349

DEPTH (in feet)	SAMPLE DATA: TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)	SOIL DESCRIPTION: U.S.C.S.	LITHOLOGY	
25						CL / SW		GRAVELLY SAND: Gray; coarse gravels; very dense; saturated
30								
								Total depth = 32'
35								
40								
45								
50								

REMARKS: SS = Split Spoon; ■ Analytical Sample; PID Background = 2.0–2.8

RETEC

BORING LOG
B-9

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: *3-1161 BN-Skykomish*		CLIENT: *Burlington Northern*
LOCATION: *North of transformer pads between tracks; Skykomish, WA*		DRILLING CO.: *Cascade Drilling*
START DATE: *10/18/93* TIME: *1430*	BORING ID: *9 3/4*	DRILLER: *S. Butler/M. Sharp/J. Trover*
COMPLETION DATE: *10/18/93* TIME: *1730*	BORING DEPTH: *20'*	RIG TYPE: *Ingersoll-Rand T3W*
WATER LEVEL DURING DRILLING: *10'*	*SURFACE ELEV.: 934.51' (MSL)*	METHOD: *Air Rotary*
DATE MEASURED: *10/18/93*	M. P. ELEVATION:	LOGGED BY: *W. Beebe*

DEPTH (in feet)	SAMPLE DATA: TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION
0						SM		SILTY SAND: Black; with some gravel; and minor organics (roots, grasses); and trace debris (glass); gravel up to 4"; damp to moist
5						ML		CLAYEY SILT: Dark brown to gray; with minor organics (wood); and minor sand; medium grained sand; soft to medium stiff; wet
	SS	■	50/6	33	0			
10						SW ▽		GRAVELLY SAND: Brown; with minor silt; gravel to 2"; very dense; moist to wet
	SS	■	50/3	17	0	GW		SANDY GRAVEL: Gray; angular gravel to 2"; very dense; saturated
15						SW		GRAVELLY SAND: Brown; with minor silt; very dense; saturated
20								Total depth = 20'
25								

REMARKS: SS = Split Spoon; ■ Analytical Sample

RETEC

BORING LOG
B-10

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: *3-1161 BN-Skykomish*		CLIENT: *Burlington Northern*
LOCATION: *In former oil pump house; Skykomish, WA*		DRILLING CO.: *Cascade Drilling*
START DATE: *9/29/93* TIME: *1100*	BORING ID: *8"*	DRILLER: *R. Labrosse/B. Maloy/D. Miner*
COMPLETION DATE: *9/29/93* TIME: *1300*	BORING DEPTH: *15.5'*	RIG TYPE: *CME 75*
WATER LEVEL DURING DRILLING: *14'*	*SURFACE ELEV.: 934.39' (MSL)*	METHOD: *HSA*
DATE MEASURED: *9/29/93*	M. P. ELEVATION:	LOGGED BY: *W. Beebe*

DEPTH (in feet)	TYPE	BLOWS /ft	%RECOVERY	PID (ppm)	U.S.C.S.	SOIL DESCRIPTION
0	SS	26 48 32	100	0	SM	SILTY SAND: Black; with some gravel; gravel to 1"; medium dense to dense; dry
	SS	19 19 22	83	0		
5	SS	14 24 16	17	0		
	SS	10 8 15	17	0		7.5' – becomes moist
10	SS	14 16 50/5	67	0		10' – becomes very dense; wet with oil (residual oil)
	SS	50/6	33	2		
14 (water level)						
15	SS	20 40 50/2	67	17	SW	GRAVELLY SAND: Gray; gravel to 3"; coarse sand; very dense; water saturated with oil specks; saturated
						Refusal at 15.5'
20						Backfilled with 7 bags Pure Gold Medium Bentonite chips
25						

REMARKS: SS = Split Spoon; ■ Analytical Sample

BORING LOG

B-10B

RETEC

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: *3-1161 BN-Skykomish*		CLIENT: *Burlington Northern*
LOCATION: *In former oil pump house; Skykomish, WA*		DRILLING CO.: *Cascade Drilling*
START DATE: *10/18/93* TIME: *0900*	BORING ID: *9 3/4"*	DRILLER: *S. Butler/M. Sharp/J. Trover*
COMPLETION DATE: *10/18/93* TIME: *1330*	BORING DEPTH: *29'*	RIG TYPE: *Ingersoll-Rand T3W*
WATER LEVEL DURING DRILLING: *12.5'*	SURFACE ELEV.: *934.39' (MSL)*	METHOD: *Air Rotary*
DATE MEASURED: *10/18/93*	M. P. ELEVATION:	LOGGED BY: *W. Beebe*

DEPTH (in feet)	TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)	U.S.C.S.	SOIL DESCRIPTION
0						SM	SILTY SAND: Black; with some gravel; with minor organics (wood); gravel to 1"; damp
5	SS	■	-	6	0		
							7' – slight odor; moist with oil
10							10' – becomes wet with oil (residual oil)
	SS	■	1 2	17	3	SW	GRAVELLY SAND: Gray to black; gravel to 1"; medium grained sand; loose to medium dense; saturated
15							
	SS	■	8 11 15	56	0		
						ML	SANDY SILT: Light brown to reddish brown to gray; very fine grained sand; very stiff; moist to wet
20							
25						SW	

REMARKS: SS = Split Spoon; ■ Analytical Sample

RETEC
1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

BORING LOG

B-10B

DEPTH (in feet)	SAMPLE DATA: TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION
25						SW		GRAVELLY SAND: Gray; coarse grained sand; gravel to 1/2'; medium dense; saturated
	SS	■	3 3 7	33	0			
								Total depth = 29'
30								
35								Backfilled with 17 bags Pure Gold Medium Bentonite chips
40								
45								
50								

REMARKS: SS = Split Spoon; ■ Analytical Sample

RETEC

BORING LOG
B-11

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: 3-1161 BN-Skykomish		CLIENT: Burlington Northern
LOCATION: School Yard; Skykomish, WA		DRILLING CO.: Cascade Drilling
START DATE: 9/27/93 TIME: 1530	BORING ID: 8"	DRILLER: R. Labrosse/B. Maloy/D. Miner
COMPLETION DATE: 9/27/93 TIME: 1630	BORING DEPTH: 10.5'	RIG TYPE: CME 75
WATER LEVEL DURING DRILLING: 9'	SURFACE ELEV.: 923.81' (MSL)	METHOD: HSA
DATE MEASURED: 9/27/93	M. P. ELEVATION:	LOGGED BY: W. Beebe

DEPTH (in feet)	SAMPLE DATA: TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION
0	SS	■	50/6	44	0			TOPSOIL: Dark brown to black; silty sand; with some gravel; and some organics; dense; damp
	SS		50/5	28	0	SW		GRAVELLY SAND: Brown; with trace silt; sub-angular to sub-rounded gravel to 3"; medium to coarse grained sand; very dense; damp
5	SS	■	50/5	11	0			
	SS		50/4	33	0			7.5' - becomes moist
						▽		
10	SS	■	50/5	33	0			10' - becomes saturated
								Total depth = 10.5'
15								Backfilled with 3 bags Pure Gold Medium Bentonite Chips
20								
25								

REMARKS: SS = Split Spoon; ■ Analytical Sample

RETEC

BORING LOG
B-12

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: *3-1161 BN-Skykomish*		CLIENT: *Burlington Northern*
LOCATION: *Old Cascade Highway; Skykomish, WA*		DRILLING CO.: *Cascade Drilling*
START DATE: *10/29/93* TIME: *0930*	BORING ID: *7"*	DRILLER: *S. Butler/M. Sharp/J. Trover*
COMPLETION DATE: *10/29/93* TIME: *1100*	BORING DEPTH: *13.5'*	RIG TYPE: *Ingersoll-Rand T3W*
WATER LEVEL DURING DRILLING: *10'*	*SURFACE ELEV.: 936.22' (MSL)*	METHOD: *Air Rotary*
DATE MEASURED: *10/29/93*	M. P. ELEVATION:	LOGGED BY: *W. Beebe*

DEPTH (in feet)	SAMPLE DATA: TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION
0								ASPHALT OVERLAY:
						SW		ASPHALT BASE:
								GRAVELLY SAND: Brown; gravel to 1/2"; medium grained sand; medium dense; moist
						SP		SAND: Brown; medium grained sand; loose to medium dense; damp
5								
	SS	■	17 34 25	6	0	SW		GRAVELLY SAND: Brown; with trace silt; gravel to >2"; medium to coarse grained sand; very dense; moist
10						▽		10' - becomes saturated
	SS	■	18 50/6	50	0			
								Total depth = 13.5
15								
20								
25								

REMARKS: SS = Split Spoon; ■ Analytical Sample

RETEC

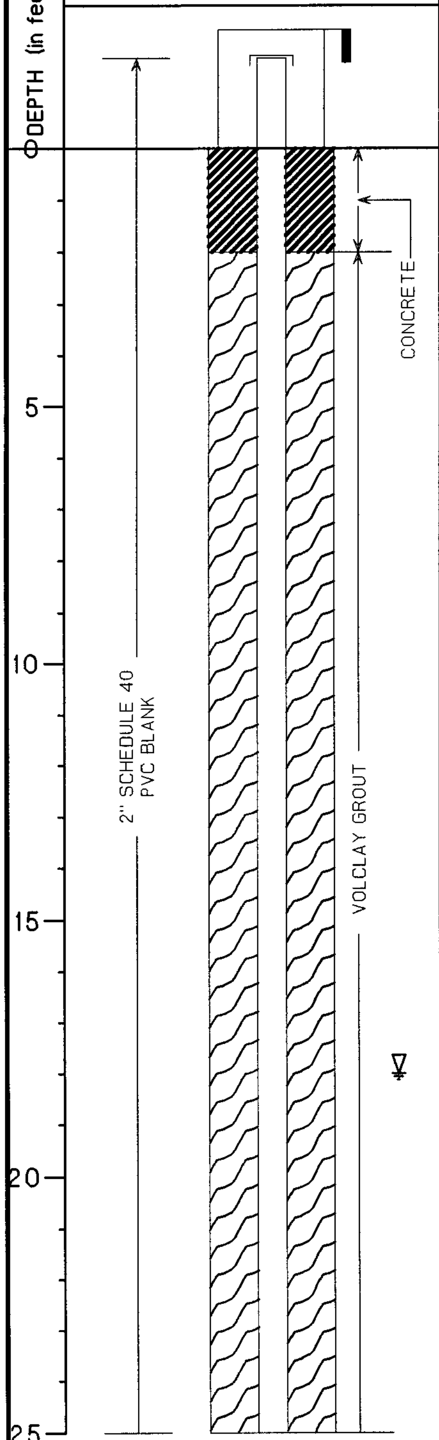
BORING/WELL INSTALLATION LOG

Monitoring Well DW-1

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: 3-1161 BN-Skykomish		CLIENT: Burlington Northern
LOCATION: East end of site; Skykomish, WA		DRILLING CO.: Cascade Drilling
START DATE: 9/28/93 TIME: 0815	BORING ID: 8"	DRILLER: R. Labrosse/B. Maloy/D. Miner
COMPLETION DATE: 9/28/93 TIME: 1200	TOTAL DEPTH: 37 feet	RIG TYPE: CME 75
WATER LEVEL DURING DRILLING: 18'bgs	PVC STICK-UP: 2.82	METHOD: HSA
SURFACE ELEV.: 940.10	MP ELEV.: 942.92 TOC PVC	LOGGED BY: W. Beebe

WELL CONSTRUCTION



SOIL DESCRIPTION

U.S.C.S.	Soil Description
	TOPSOIL: Dark brown to brown; gravelly sand; with some silt; and minor organics; medium to coarse grained sand; medium dense; dry
SP	SAND: Light brown; medium grained sand; medium dense; damp to moist 7.5' – becomes variable medium grained and medium to coarse grained
SW	GRAVELLY SAND: Brown; with minor silt; gravels to 6" (in cuttings); medium to coarse grained sand; very dense; moist to wet 16' – becomes coarse gravels
SM	SILTY SAND Brown gray; fine grained sand; dense; wet
SP	

SAMPLE DATA

TYPE	BLOWS /ft	%RECOVERY	PID (ppm)
SS	50/6	33	0
SS	10 11 15	50	0
SS	7 7 9	39	0
SS	7 9 11	100	0
SS	50/4	0	NR
SS	50/4	22	0
SS	50/3	0	NR
SS	50/6	0	NR
SS	10 11 22	72	0

REMARKS: SS = Split Spoon;
Could not sample 17.5' due to coarse gravels;
■ Analytical Sample

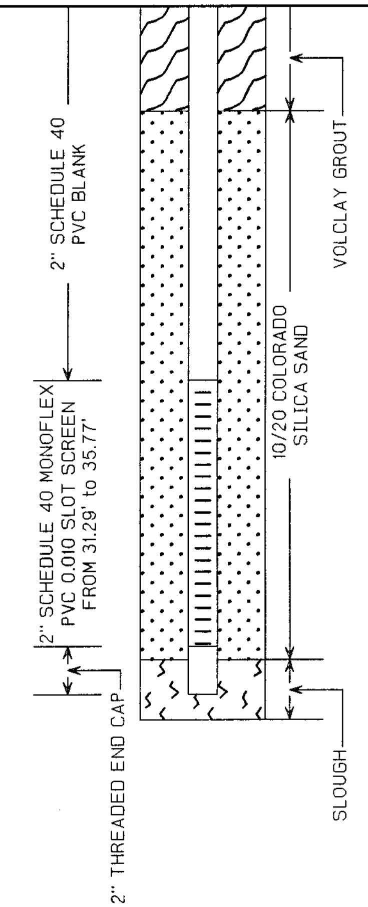
RETEC

BORING/WELL INSTALLATION LOG

Monitoring Well DW-1

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

WELL CONSTRUCTION



SOIL DESCRIPTION

DEPTH (in feet)	U.S.C.S.	Description
25	SP	SAND Brown; coarse grained sand; very dense; saturated
	SM	SILTY SAND Brown; fine grained sand; very dense; wet
	SW	GRAVELLY SAND Brown; sub-angular gravels to 2"; medium to coarse grained sand; very dense; saturated
		Refusal at 37.25'
40		Backfilled with 4 bags sand; 4 bags Volclay Grout; 11 bags concrete

SAMPLE DATA

TYPE	BLOWS /ft	%RECOVERY	PID (ppm)
SS	22 50/6	83	0
SS	22 50/6	83	0
SS	50/5	44	0
SS	50/6	0	NR
SS	50/4	17	0
SS	50/3	22	0

REMARKS: SS = Split Spoon;
Could not sample 17.5' due to coarse gravels;
■ Analytical Sample

RETEC

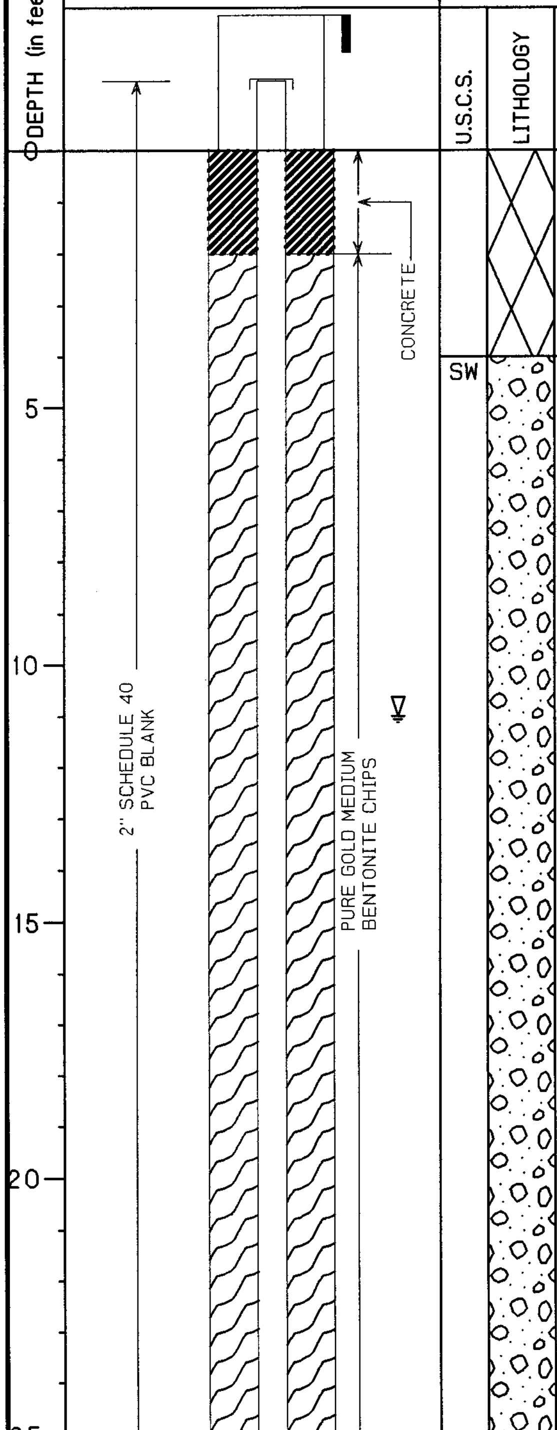
BORING/WELL INSTALLATION LOG

Monitoring Well DW-2

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: *3-1161 BN-Skykomish*		CLIENT: *Burlington Northern*
LOCATION: *Corner 5th Street & Old Cascade Highway; Skykomish, WA*		DRILLING CO.: *Cascade Drilling*
START DATE: *9/27/93* TIME: *0900*	BORING ID: *8"*	DRILLER: *R. Labrosse/B. Maloy/B. Gose*
COMPLETION DATE: *9/27/93* TIME: *1300*	TOTAL DEPTH: *44 feet*	RIG TYPE: *CME 75*
WATER LEVEL DURING DRILLING: *11'bgs*	PVC STICK-UP: *+1.34*	METHOD: *HSA*
SURFACE ELEV.: *933.20*	MP ELEV.: *934.54 TOC PVC*	LOGGED BY: *W. Beebe*

DEPTH (in feet) — WELL CONSTRUCTION



SOIL DESCRIPTION (U.S.C.S. / LITHOLOGY)

<u>TOPSOIL:</u> Dark brown to black; silty sand; with some gravel; and some organics; loose to medium dense; damp

SW — <u>SAND:</u> Brown; with minor gravel; and minor silt; medium grained sand; loose; damp

<u>GRAVELLY SAND:</u> Brown; with trace silt; rounded to sub-rounded gravel to 2"; medium to coarse grained sand; dense to very dense; damp

11' - becomes saturated

12.5' - becomes sub-angular to sub-rounded

20' - becomes sub-rounded

SAMPLE DATA

TYPE	BLOWS /ft	%RECOVERY	PID (ppm)
SS	11 16 21	50	0
SS	6 7 10	33	0
SS	3 4 4	11	0
SS	11 15 17	50	0
SS	32 50/5	6	0
SS	50/6	33	0
SS	27 50/6	67	0
SS	28 50/4	33	0
SS	50/6	17	0

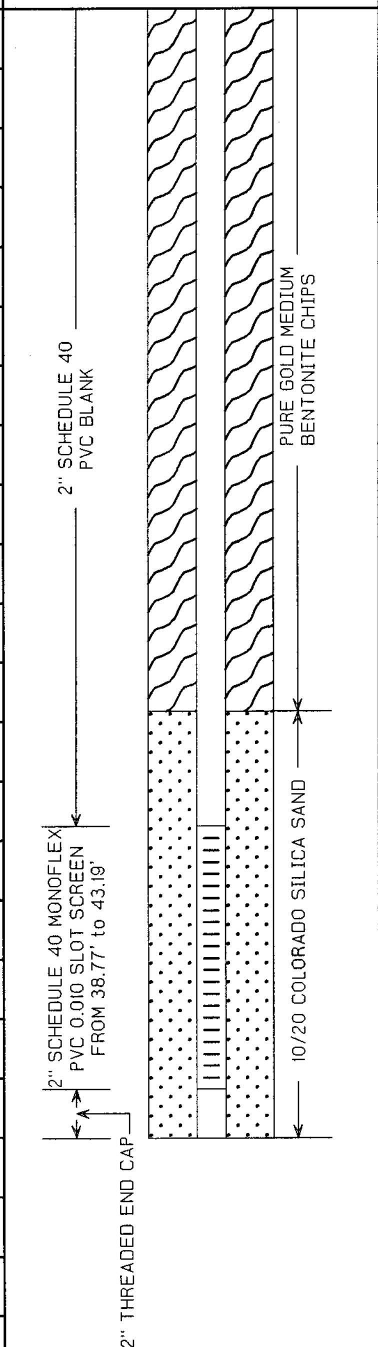
REMARKS: SS = Split Spoon
17.5' No sample due to large cobble
■ Analytical Sample

RETEC

BORING/WELL INSTALLATION LOG
Monitoring Well DW-2

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

WELL CONSTRUCTION



SOIL DESCRIPTION

DEPTH (in feet)	U.S.C.S.	SOIL DESCRIPTION
25–27	SW	
27–32	SM	SILTY SAND: Brown; very fine grained sand; very dense; rapid dilatency; saturated
32–35	SW	GRAVELLY SAND: Brown; with trace silt; gravel to 3/8"; coarse grained sand; very dense; saturated
35–40	SM	SILTY SAND: Brown gray; very fine sand; very dense; saturated
40–44	SW	GRAVELLY SAND: Brown; gravel to 1"; medium to fine grained sand; very dense; saturated 42' – becomes medium to coarse grained sand
44		Refusal at 44'
		Backfilled with 3 bags sand; 13 bags chips;

SAMPLE DATA

TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)
SS		50/5	22	0
SS		18 50/6	56	0
SS		50/6	0	NR
SS		50/6	56	0
SS		23 50/6	39	0
SS		32 50/6	67	0
SS		33 50/6	61	0
SS		18 50/6	67	0

REMARKS: SS = Split Spoon
17.5' No sample due to large cobble
■ Analytical Sample

RETEC

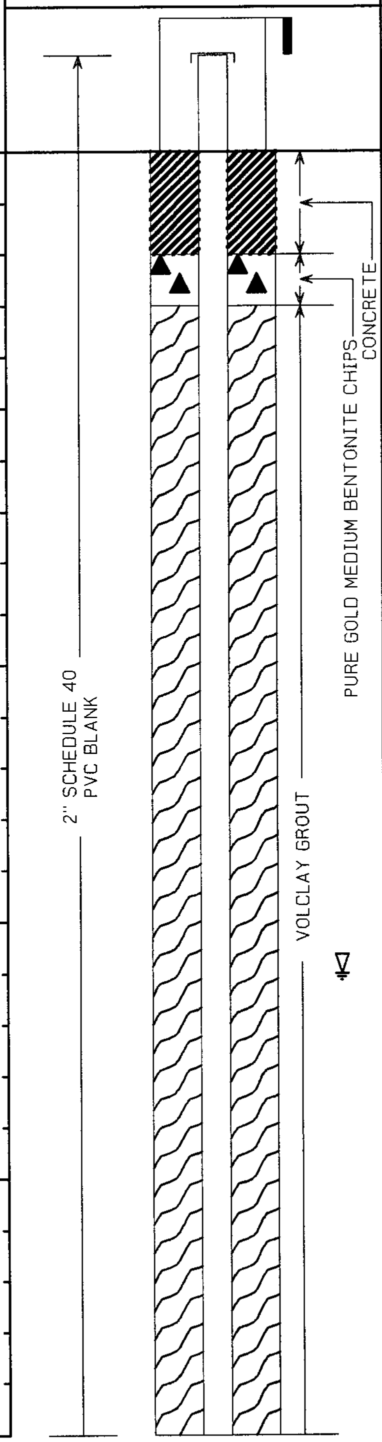
BORING/WELL INSTALLATION LOG

Monitoring Well DW-3

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: 3-1161 BN-Skykomish		CLIENT: Burlington Northern
LOCATION: West end of site Skykomish, WA		DRILLING CO.: Cascade Drilling
START DATE: 9/29/93 TIME: 0800	BORING ID: 8"	DRILLER: R. Labrosse/B. Maloy/D. Miner
COMPLETION DATE: 9/29/93 TIME: 1100	TOTAL DEPTH: 45.5 feet	RIG TYPE: CME 75
WATER LEVEL DURING DRILLING: 16'bgs	PVC STICK-UP: +1.79'	METHOD: HSA
SURFACE ELEV.: 928.30	MP ELEV.: 930.09 TOC PVC	LOGGED BY: W. Beebe

WELL CONSTRUCTION



DEPTH (in feet)	U.S.C.S.	SOIL DESCRIPTION
0	SM	SILTY SAND: Dark brown to black; with some gravel; dense; damp
	SP	SAND: Brown; fine to medium grained sand; medium dense; damp
	SW	GRAVELLY SAND: Brown; sub-angular gravel to 1"; medium grained sand; dense; moist
10	SP	SAND Light brown; fine to medium grained; medium dense; layering due to color and grain size; medium dense; moist
15		15' – becomes very dense; saturated
	SW	GRAVELLY SAND Brown; with minor silt, gravel to 3/8"; coarse grained sand; very dense; saturated
25		

SAMPLE DATA

TYPE	BLOWS/ft	%RECOVERY	PID (ppm)
SS	27 24 20	67	0
SS	6 6 7	17	0
SS	7 8 10	56	0
SS	15 18 22	17	0
SS	10 11 13	100	0
SS	6 6 7	100	0
SS	50/6	44	0
SS	30 50/6	67	0
SS	50/6	0	NR
SS	50/6	50	0

REMARKS: SS = Split Spoon
■ Analytical Sample

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Seattle, WA Billings, MT St. Paul, MN Mandeville, LA Tucson, AZ

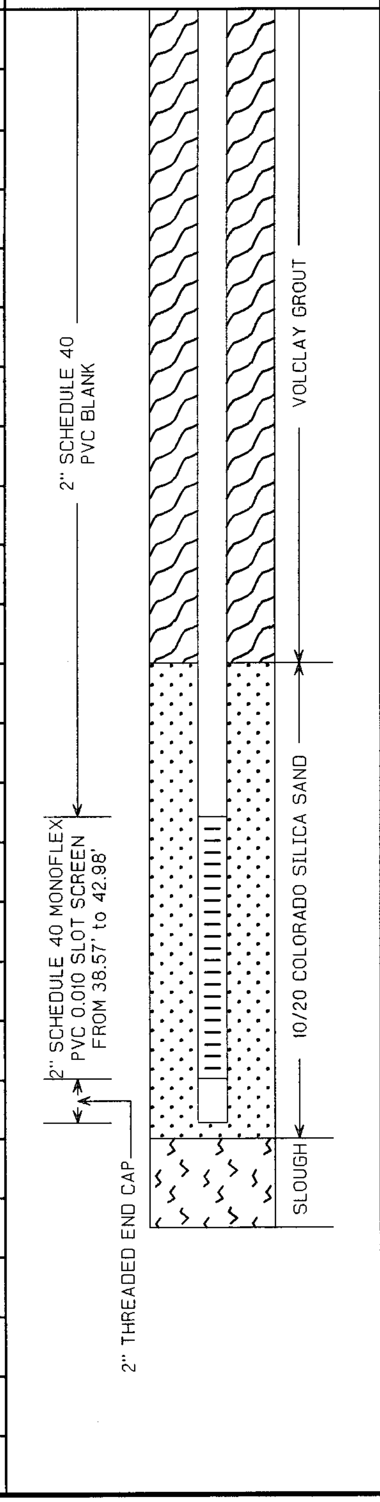
BORING/WELL INSTALLATION LOG

Monitoring Well DW-3

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

DEPTH (in feet): 25 – 50

WELL CONSTRUCTION



SOIL DESCRIPTION

U.S.C.S.	Description
SW	
ML	SILT Gray; with minor sand; fine grained sand; hard; saturated
SW	GRAVELLY SAND Brown; with minor silt; sub-angular gravels to 1"; medium to coarse grained sand; very dense; saturated
ML	SILT Gray; with trace sand; hard; saturated
SW	GRAVELLY SAND Brown; sub-angular gravels to 2"; coarse grained sand; very dense; saturated

Refusal at 45.5'

Backfilled with 4 bags sand; 3 bags Volclay Grout; 1 bag chips; 11 bags concrete

SAMPLE DATA

TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)
SS		50/4	44	0
SS		31 50/2	50	0
SS		18 35 38	100	0
SS		18 32 39	44	0
SS		50/5	17	0
SS		26 50/4	17	0
SS		50/4	28	0
SS		13 16 19	67	0
SS		50/5	17	0

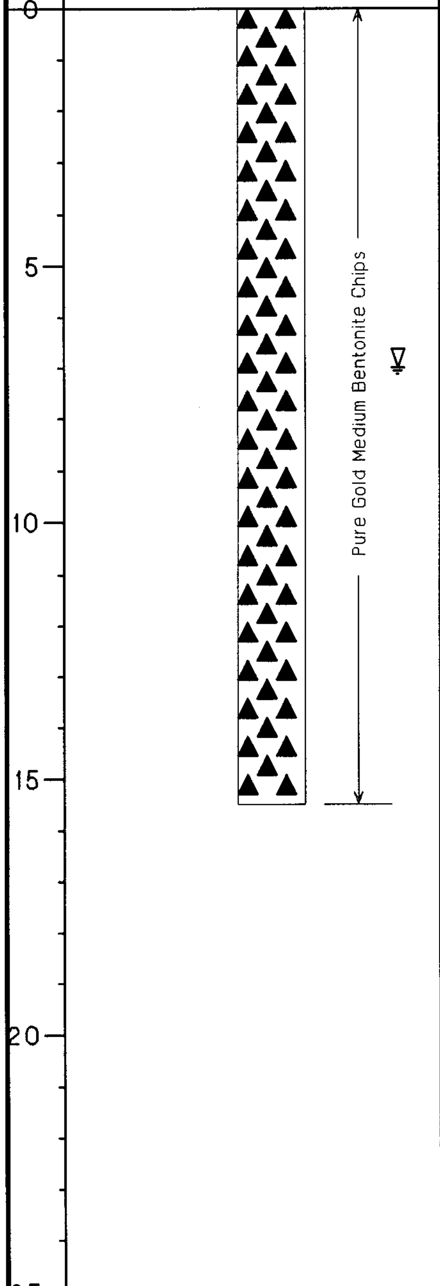
REMARKS: SS = Split Spoon
■ Analytical Sample

RETEC

BORING/WELL INSTALLATION LOG
Abandoned Deep Well DW-4

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: 3-1161 BN-Skykomish		CLIENT: Burlington Northern
LOCATION: North of School; Skykomish, WA		DRILLING CO.: Cascade Drilling
START DATE: 9/27/93 TIME: 1640	BORING ID: 8"	DRILLER: R. Labrosse/B. Maloy/D. Miner
COMPLETION DATE: 9/27/93 TIME: 1800	TOTAL DEPTH: 15 feet	RIG TYPE: CME 75
WATER LEVEL DURING DRILLING: 7'bgs	PVC STICK-UP:	METHOD: HSA
SURFACE ELEV.: 925.18	MP ELEV.:	LOGGED BY: W. Beebe

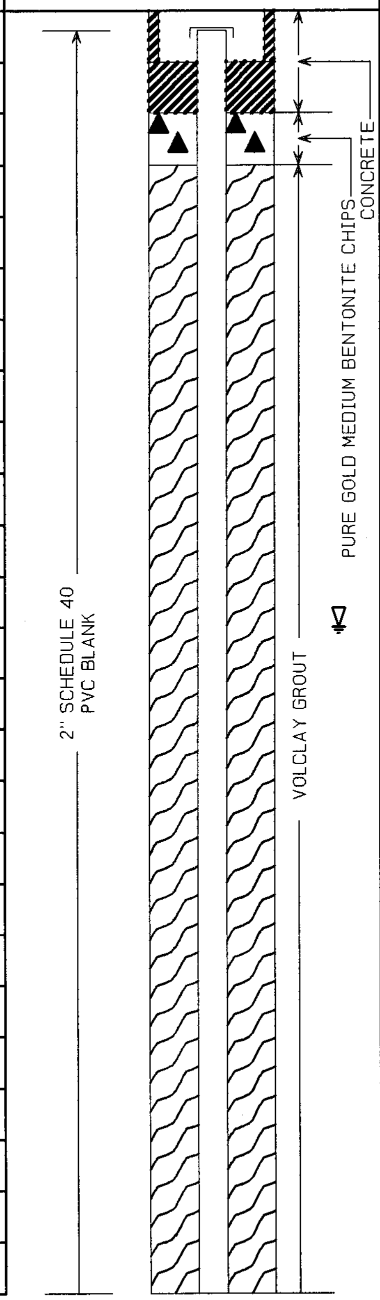


DEPTH (in feet)	U.S.C.S.	SOIL DESCRIPTION	TYPE	BLOWS /ft	%RECOVERY	PID (ppm)
0		ASPHALT:	SS	23 31 42	50	0
	SW	GRAVELLY SAND: Brown; with trace silt; sub-angular to sub-rounded gravel to 2"; dense to very dense; damp	SS	50/6	39	0
5			SS	50/4	6	0
		7.5' - Wet with oil	SS	18 21 23	17	15
10		10' - Sheen on water; odor	SS	50/6	44	3
		12.5' - Slight sheen on water	SS	50/5	61	2
15		15' - Slight sheen on water	SS	50/5	44	1
		Refusal at 15.5'				
20		Backfilled with 9 bags Pure Gold Medium Bentonite chips; 2 bags concrete				
25						

REMARKS: SS = Split Spoon;
■ Analytical Sample

RETEC	BORING/WELL INSTALLATION LOG Monitoring Well DW-4B	1011 SW Klickitat Way Suite 207 Seattle, WA 98134 (206) 624-9349

PROJECT NO: *3-1161 BN-Skykomish*		CLIENT: *Burlington Northern*
LOCATION: *North of School; Skykomish, WA*		DRILLING CO.: *Cascade Drilling*
START DATE: *10/20/93* TIME: *1500*	BORING ID: *9 3/4"*	DRILLER: *S. Butler/M.Sharp/J. Trover*
COMPLETION DATE: *10/21/93* TIME: *1300*	TOTAL DEPTH: *44 feet*	RIG TYPE: *Ingersoll-Rand T3W*
WATER LEVEL DURING DRILLING: *12'bgs*	PVC STICK-UP: *-0.39'*	METHOD: *Air Rotary*
SURFACE ELEV.: *925.18*	MP ELEV.: *924.79 TOC PVC*	LOGGED BY: *W. Beebe*



DEPTH (in feet)	U.S.C.S.	SOIL DESCRIPTION	TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)
0		ASPHALT:					
	SW	GRAVELLY SAND: Brown, with trace silt; sub-angular to sub-=rounded gravel to 2"; dense to very dense; damp					
8		8' - strong hydrocarbon odor	SS	■	35 13 19	22	0
14		14' - sheen on water; oil on gravels					
15	CL	SILTY CLAY: Brown; with some sand; no sign of contamination; saturated					
	SW	GRAVELLY SAND: Brown; medium to coarse grained sand; medium dense to dense; no sign of contamination; saturated					
25							

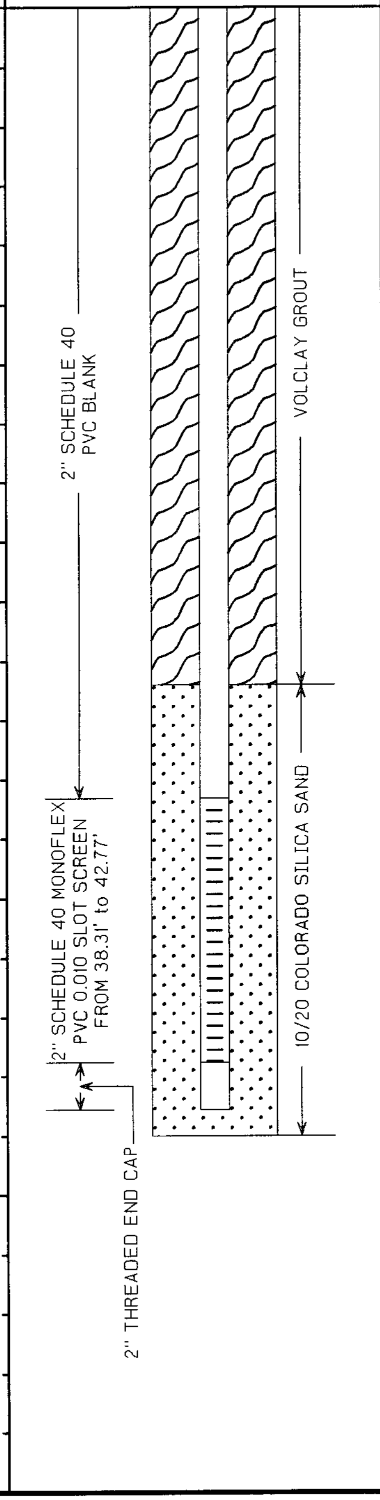
REMARKS: SS = Split Spoon
■ Analytical Sample

BORING/WELL INSTALLATION LOG

Monitoring Well DW-4B

RETEC
1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

DEPTH (in feet)	WELL CONSTRUCTION	SOIL DESCRIPTION: U.S.C.S.	SOIL DESCRIPTION: LITHOLOGY	SOIL DESCRIPTION	SAMPLE DATA: TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)
25–44		SW							
44				Total depth = 44'					
45–50									



REMARKS: SS = Split Spoon
▮ Analytical Sample

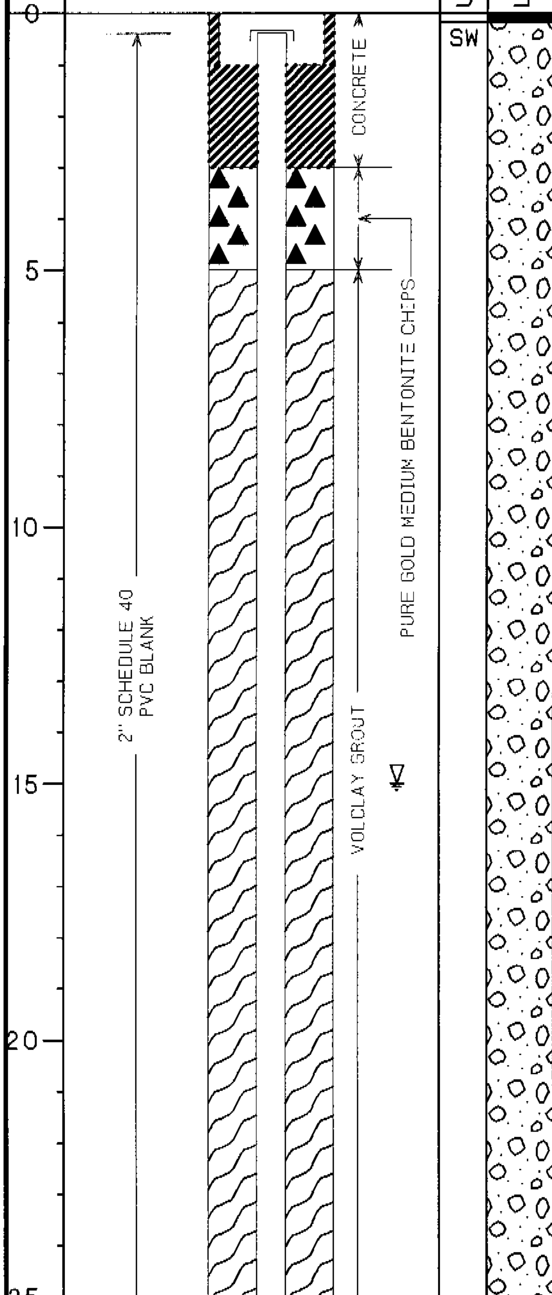
BORING/WELL INSTALLATION LOG
Monitoring Well DW-5

RETEC

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: 3-1161 BN-Skykomish		CLIENT: Burlington Northern
LOCATION: North of School; Skykomish, WA		DRILLING CO.: Cascade Drilling
START DATE: 10/21/93 TIME: 1725	BORING ID: 9 3/4"	DRILLER: S. Butler/M.Sharp/J. Trover
COMPLETION DATE: 10/21/93 TIME:	TOTAL DEPTH: 45.7 feet	RIG TYPE: Ingersoll-Rand T3W
WATER LEVEL DURING DRILLING: 15'bgs	PVC STICK-UP: -0.37'	METHOD: Air Rotary
SURFACE ELEV.: 932.91	MP ELEV.: 932.54 TOC PVC	LOGGED BY: W. Beebe

WELL CONSTRUCTION (DEPTH (in feet): 0–25)



SOIL DESCRIPTION

U.S.C.S.	LITHOLOGY	Description
SW		<u>ASPHALT:</u>
		<u>GRAVELLY SAND:</u> Brown, with trace silt, dense to very dense, damp, with trace silt
		15'- Becomes saturated
		17'- Becomes fine to medium sand, with some silt

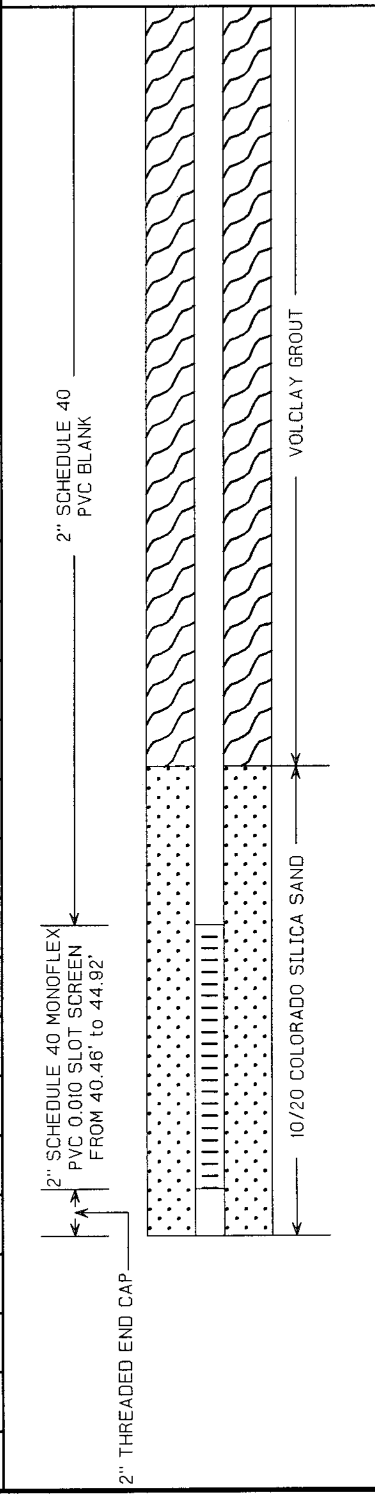
SAMPLE DATA

TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)
SS	■	4 8 18	33	0
SS	■	4 5 14	22	0

REMARKS: SS = Split Spoon
■ Analytical Sample

RETEC	BORING/WELL INSTALLATION LOG Monitoring Well DW-5	1011 SW Klickitat Way Suite 207 Seattle, WA 98134 (206) 624-9349

DEPTH (in feet)	WELL CONSTRUCTION	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION	TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)
25		SW		25' – Becomes medium sand, with minor silt					
				27' – Becomes trace silt					
30									
35				36' – Becomes coarse gravel					
40				42' – Heavy water flow					
45				Total depth = 45.7'					
50									



REMARKS: SS = Split Spoon
■ Analytical Sample

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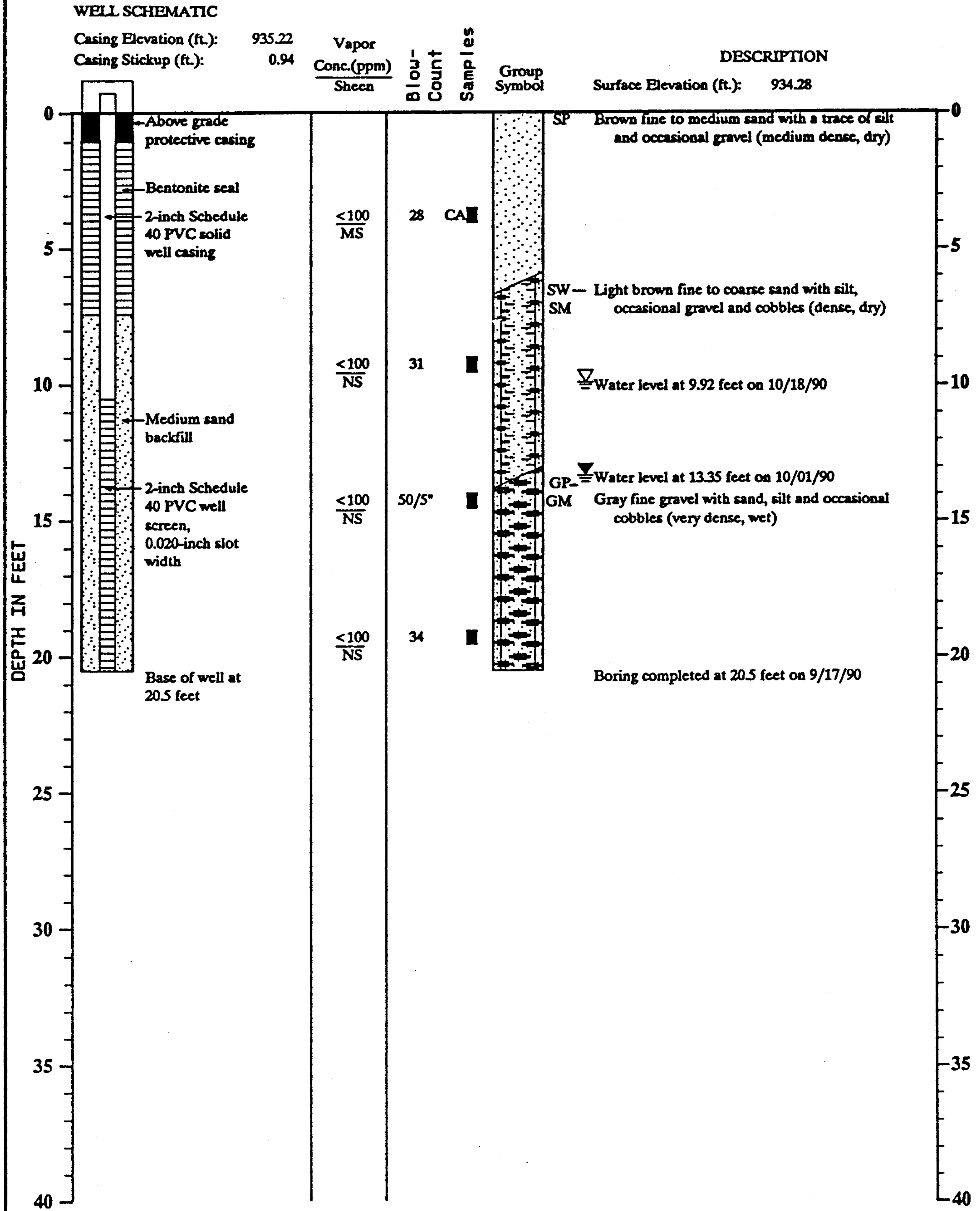
Seattle, WA Billings, MT St. Paul, MN Mandeville, LA Tucson, AZ

MONITOR WELL NO. MW-1



Note: See Figure A-2 for explanation of symbols

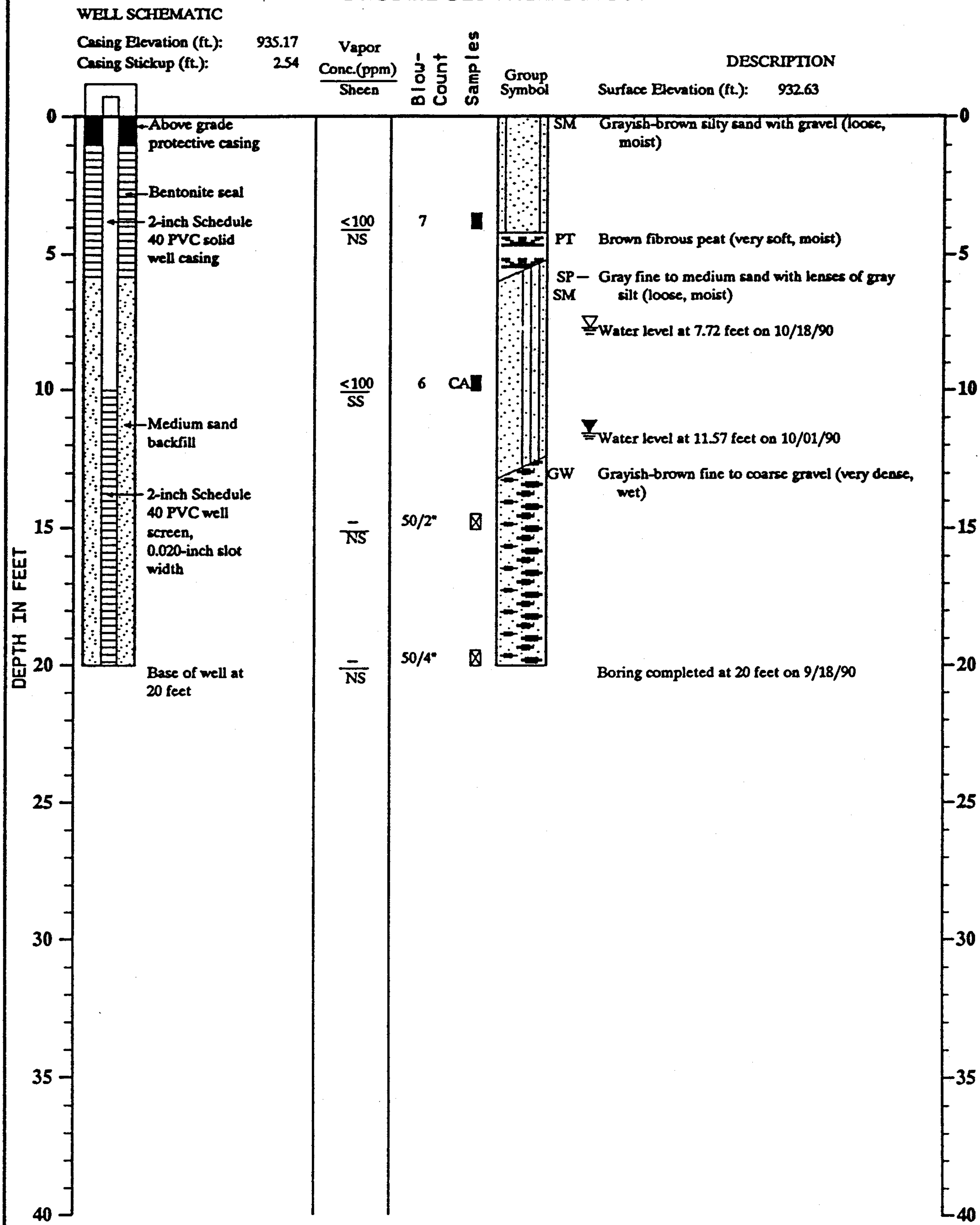
GeoEngineers

Log of Monitor Well

Figure A-3

0506-018-B14 : CRW: TEP: JHB: KKT 6/8/91

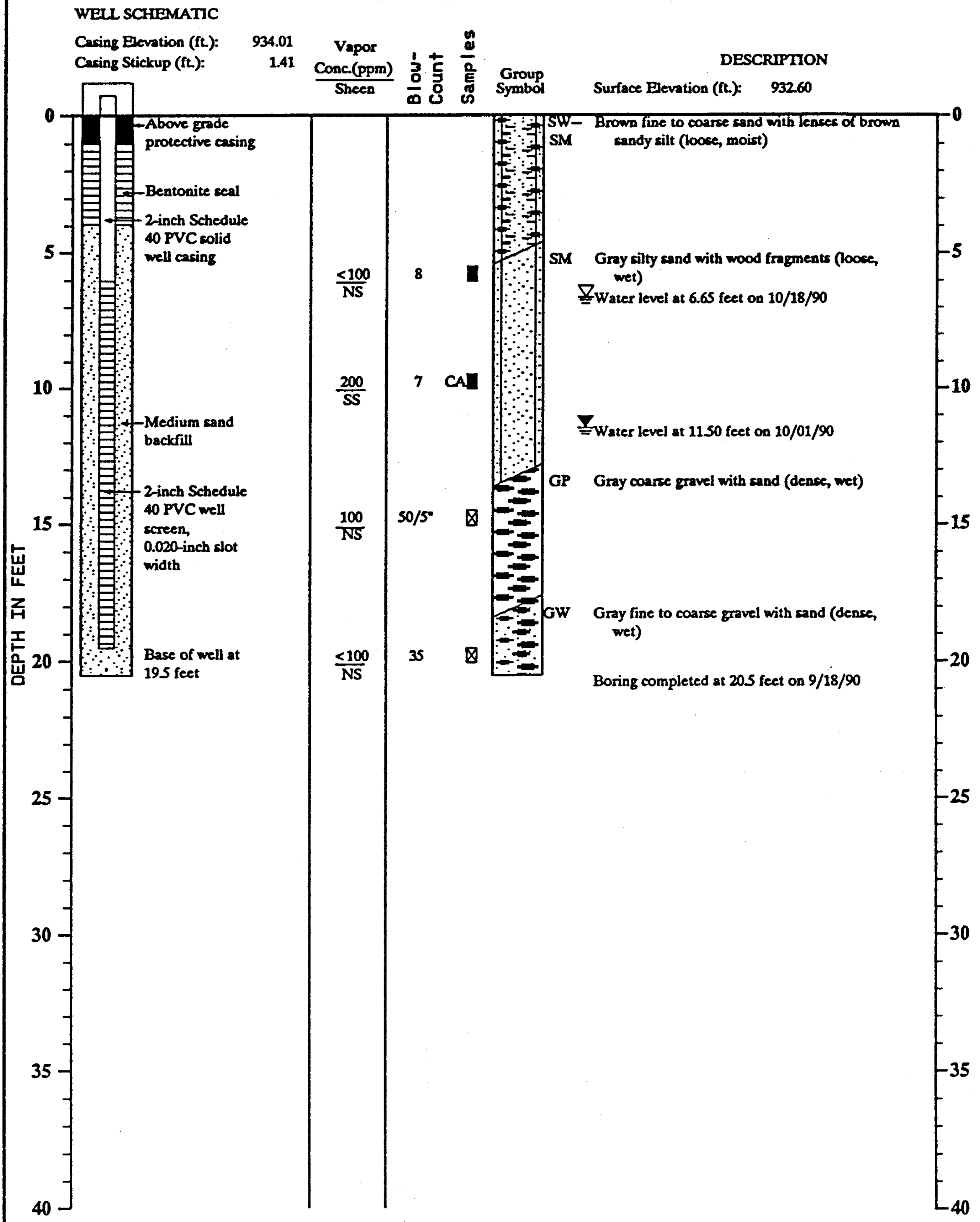
MONITOR WELL NO. MW-2



Note: See Figure A-2 for explanation of symbols

GeoEngineers	Log of Monitor Well
	Figure A-4

MONITOR WELL NO. MW-3



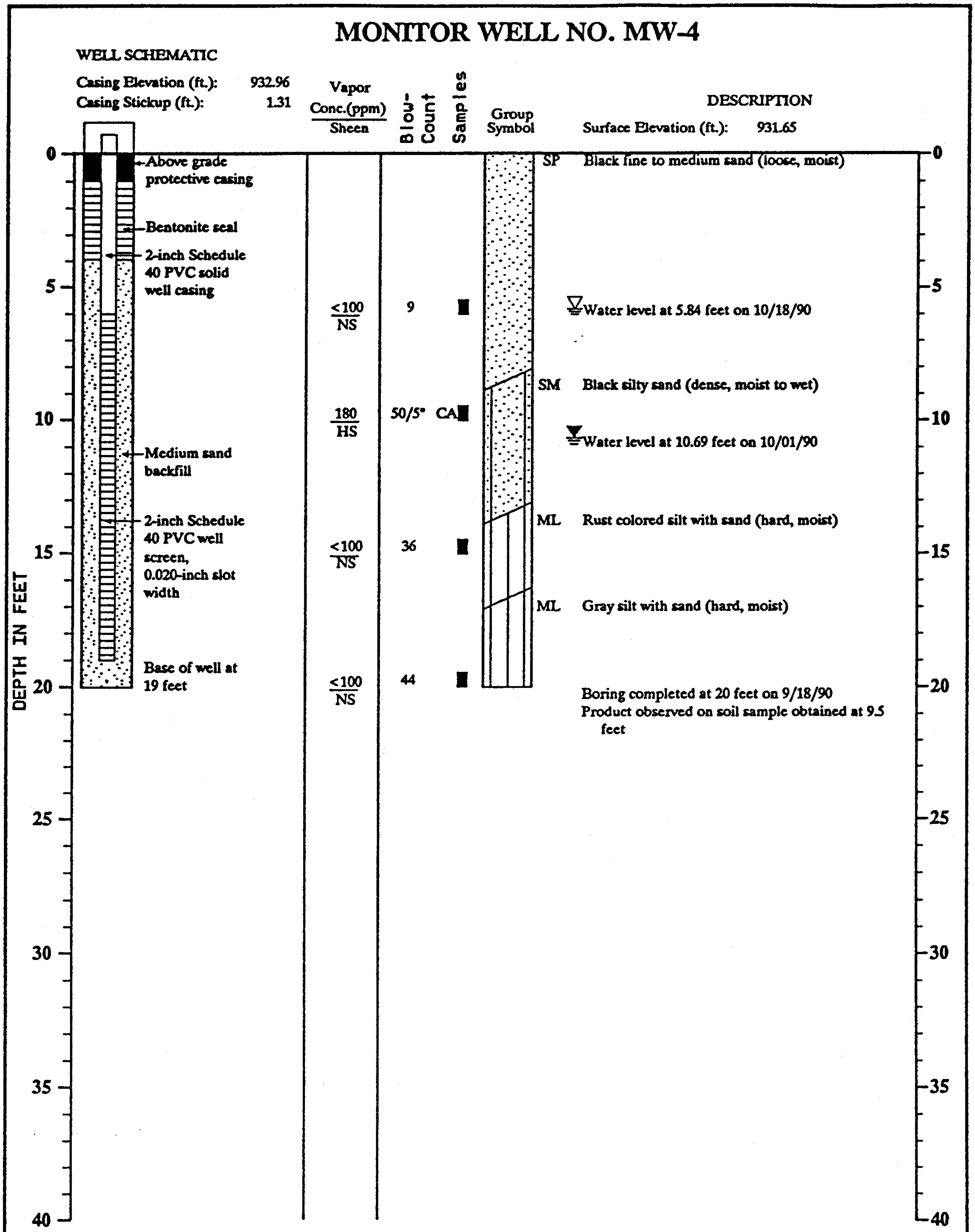
Note: See Figure A-2 for explanation of symbols

GeoEngineers

Log of Monitor Well

Figure A-5

0506-018-B14 :CRW:TEP:JHB:KKT 8/7/91



Note: See Figure A-2 for explanation of symbols

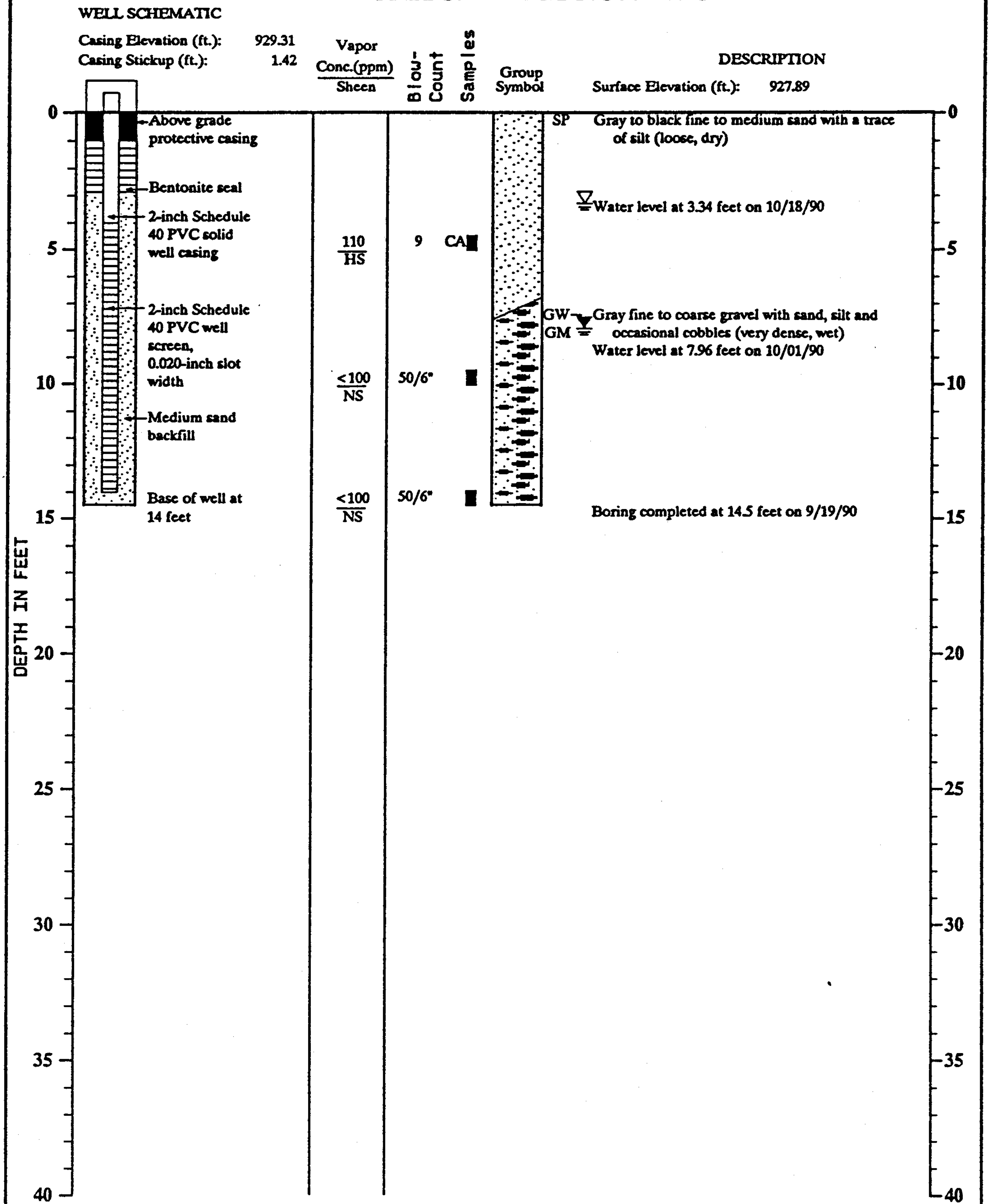
GeoEngineers

Log of Monitor Well

Figure A-6

0508-016-B14 :CRW:TEP:JHB:KKT 6/7/91

MONITOR WELL NO. MW-5



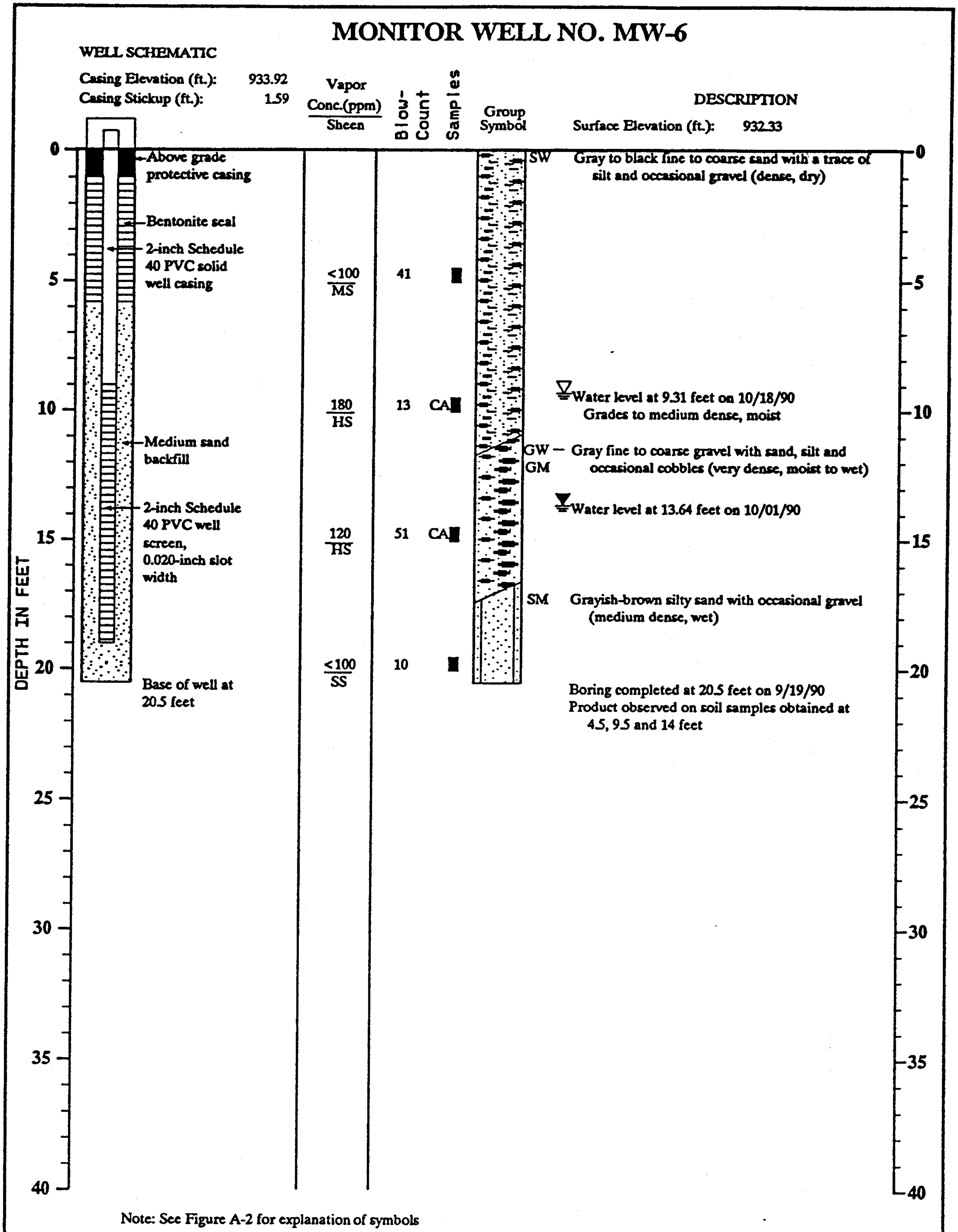
Note: See Figure A-2 for explanation of symbols

GeoEngineers

Log of Monitor Well

Figure A-7

0506-018-B14 :CRW:TEP:JHB:KKT 8/7/91



GeoEngineers

Log of Monitor Well

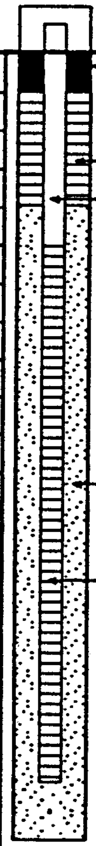
Figure A-8

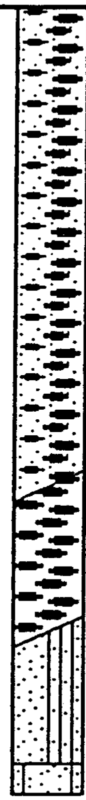
MONITOR WELL NO. MW-7

WELL SCHEMATIC

Casing Elevation (ft.): 932.84
Casing Stickup (ft.): 2.64

Surface Elevation (ft.): 930.20





Depth in Feet	Vapor Conc.(ppm) / Sheen	Blow-Count	Samples	Group Symbol	Description
0				GW–GM	Gray fine to coarse gravel with sand, a trace of silt and occasional cobbles (medium dense to dense, dry)
5	<100 / SS	30	■		
7.76					▽ Water level at 7.76 feet on 10/18/90
10	<100 / SS	20	CA ■		
12.19				GP	▼ Water level at 12.19 feet on 10/01/90 Gray fine to coarse gravel (very dense, wet)
15	<100 / HS	50/3"	☒		
17				SP–SM	Gray fine to medium sand with silt (medium dense, wet)
20	<100 / NS	15	■	SM	Brown silty sand (medium dense, wet) Boring completed at 20.5 feet on 9/19/90

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40 (DEPTH IN FEET)

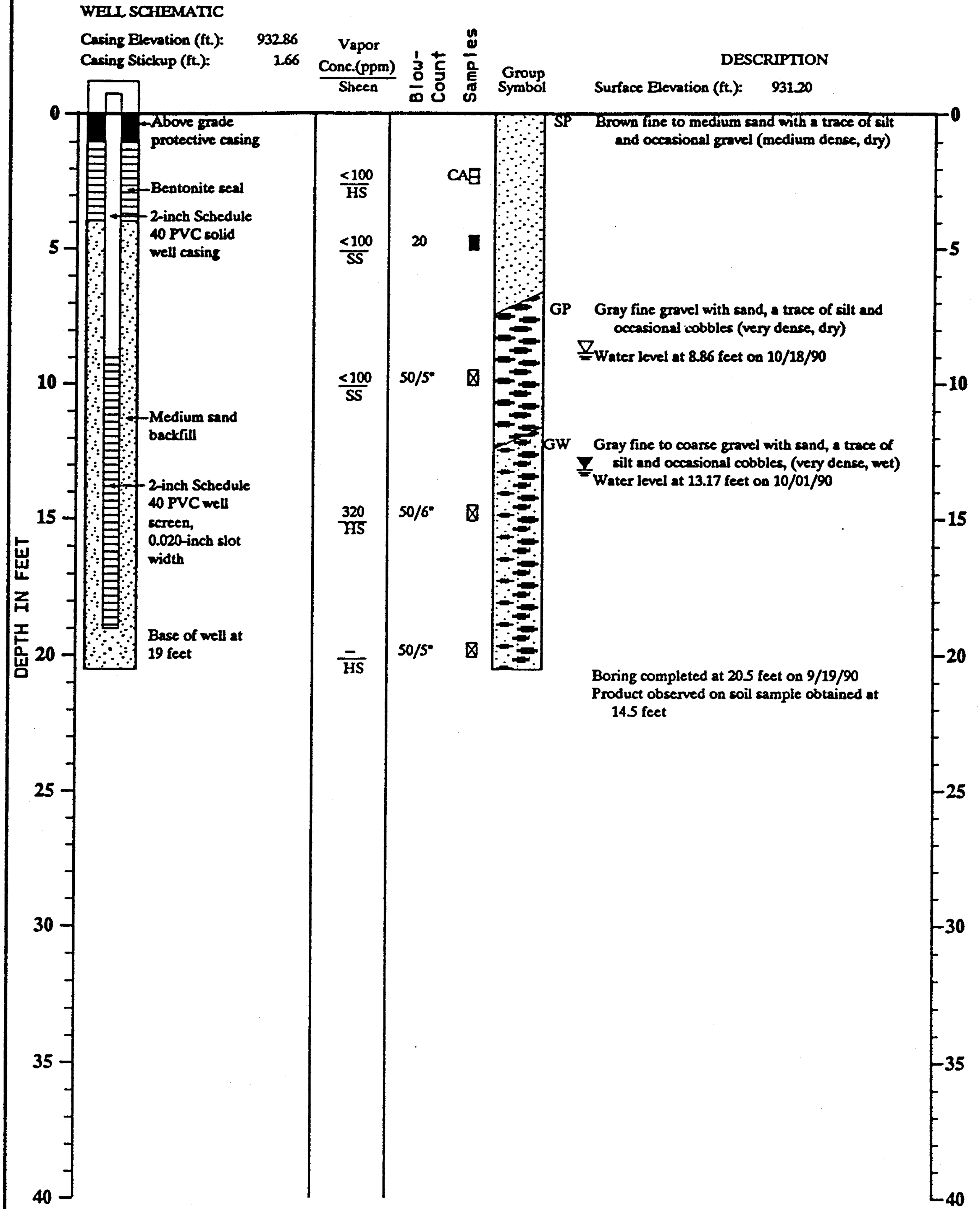
Note: See Figure A-2 for explanation of symbols

GeoEngineers

Log of Monitor Well

Figure A-9

MONITOR WELL NO. MW-8



Note: See Figure A-2 for explanation of symbols

GeoEngineers

Log of Monitor Well

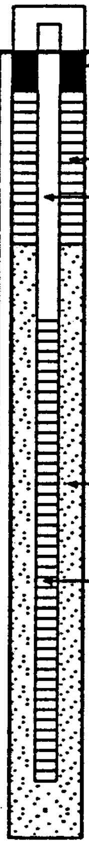
Figure A-10

0500-016-014 YCRW:TEP:JHB:KKT 8/7/91

MONITOR WELL NO. MW-9

WELL SCHEMATIC

Casing Elevation (ft.): 933.52
Casing Stickup (ft.): 1.49



DESCRIPTION

Surface Elevation (ft.): 932.03

Depth in Feet	Vapor Conc.(ppm) / Sheen	Blow-Count	Samples	Group Symbol	Description
0				SP	Brown fine to medium sand with a trace of silt and occasional gravel (medium dense, dry)
5	– / NS	19	CA ■		
~6.5				GP	Gray fine gravel (very dense, moist)
~9					Water level at 8.97 feet on 10/18/90
10	– / SS	50/6"	□		
~11				GP–GM	Gray fine gravel with silt, sand and occasional cobbles (very dense, wet)
~13					Water level at 13.23 feet on 10/01/90
15	– / HS	50/5"	□		Grades to very dense, wet
20	≤100 / HS	50/2"	⊠		

Boring completed at 20.5 feet on 9/20/90
Product observed on soil sample obtained at 14.5 feet

Note: See Figure A-2 for explanation of symbols

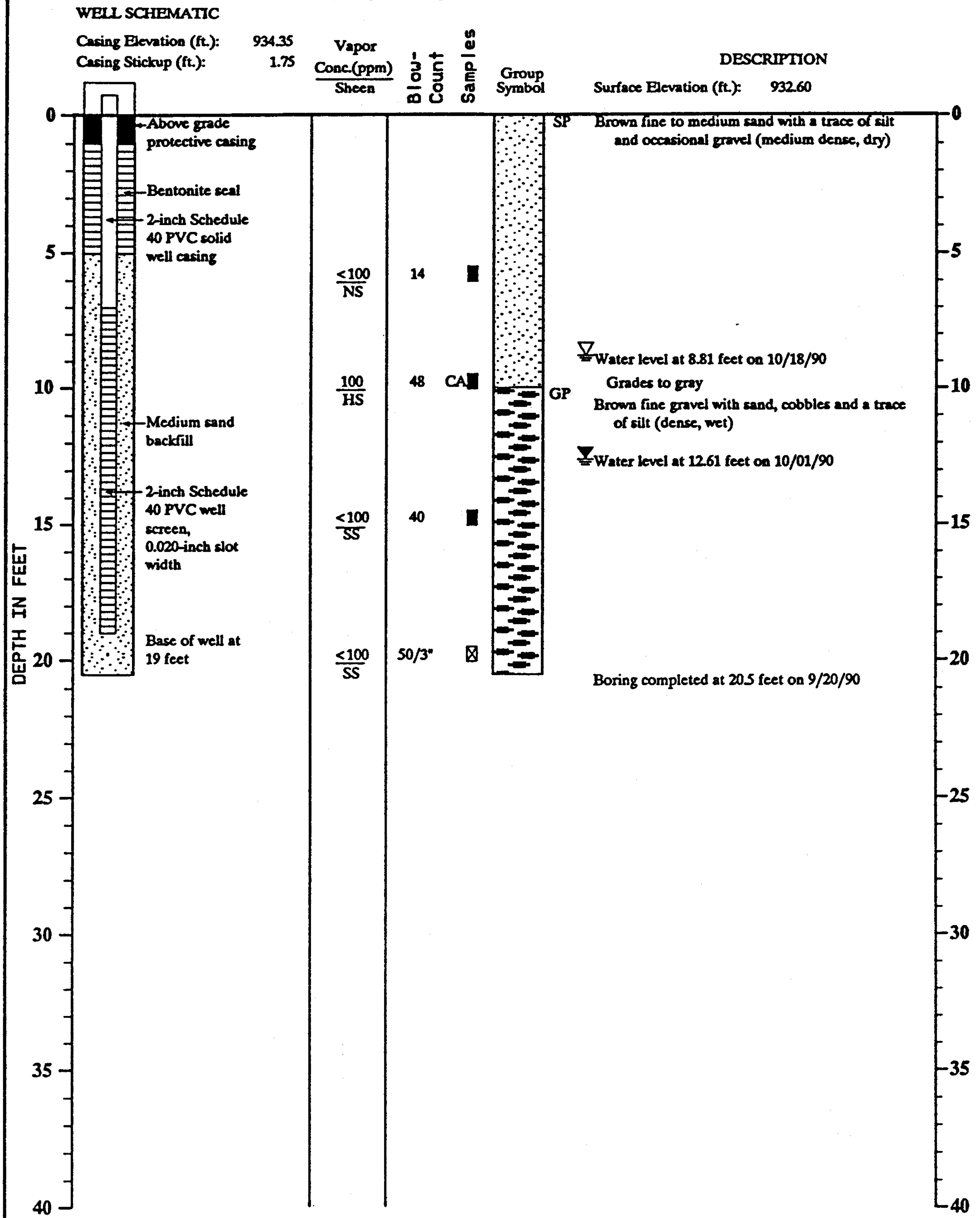
GeoEngineers

Log of Monitor Well

Figure A-11

0500-018-B14 :CRW:TEP:JHB:KKT 8/7/91

MONITOR WELL NO. MW-10



Note: See Figure A-2 for explanation of symbols

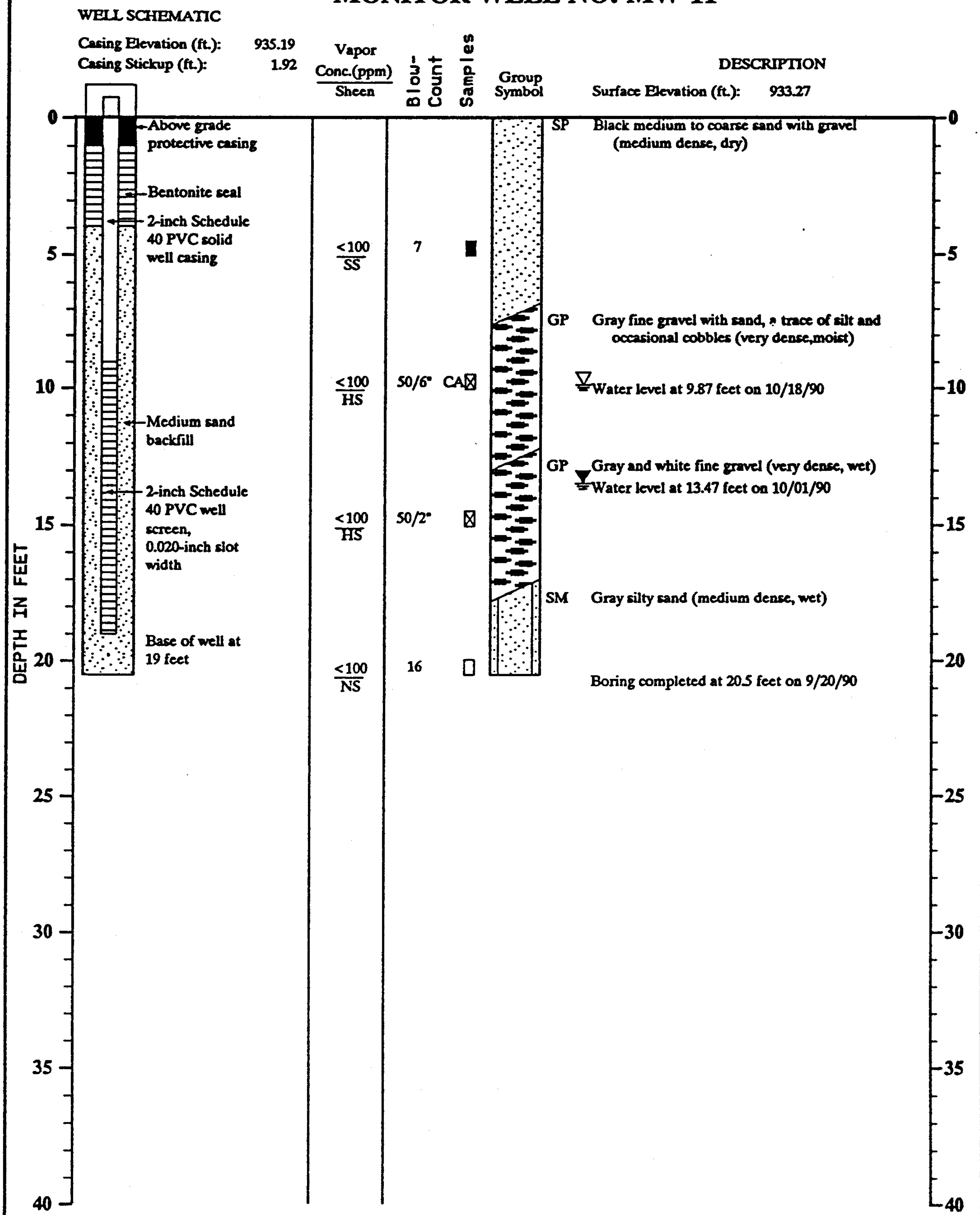
GeoEngineers

Log of Monitor Well

Figure A-12

0508-018-B14 :CRW:TEP:JHB:KKT 8/8/91

MONITOR WELL NO. MW-11



Note: See Figure A-2 for explanation of symbols

GeoEngineers

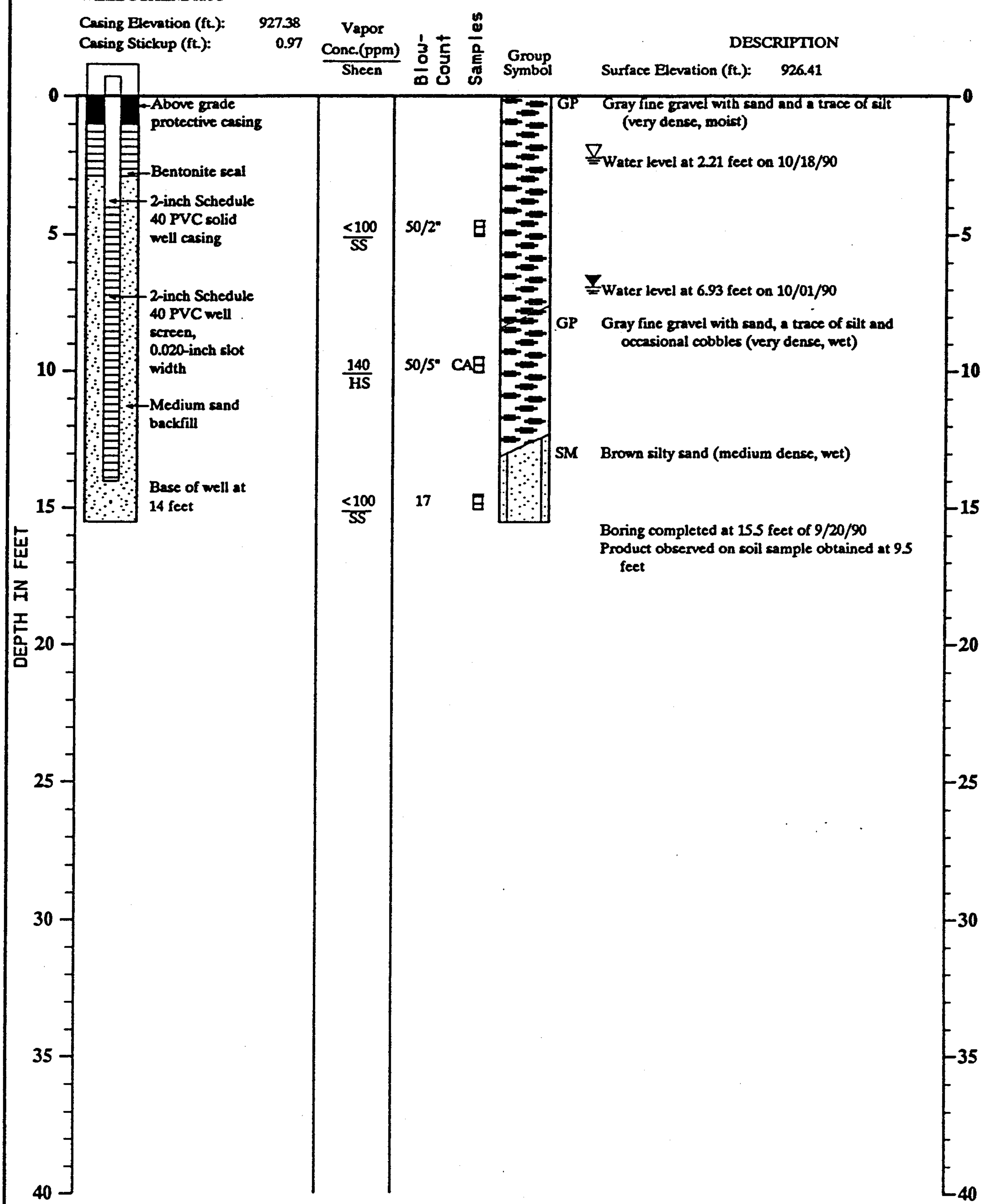
Log of Monitor Well

Figure A-13

MONITOR WELL NO. MW-12

WELL SCHEMATIC

Casing Elevation (ft.): 927.38
Casing Stickup (ft.): 0.97



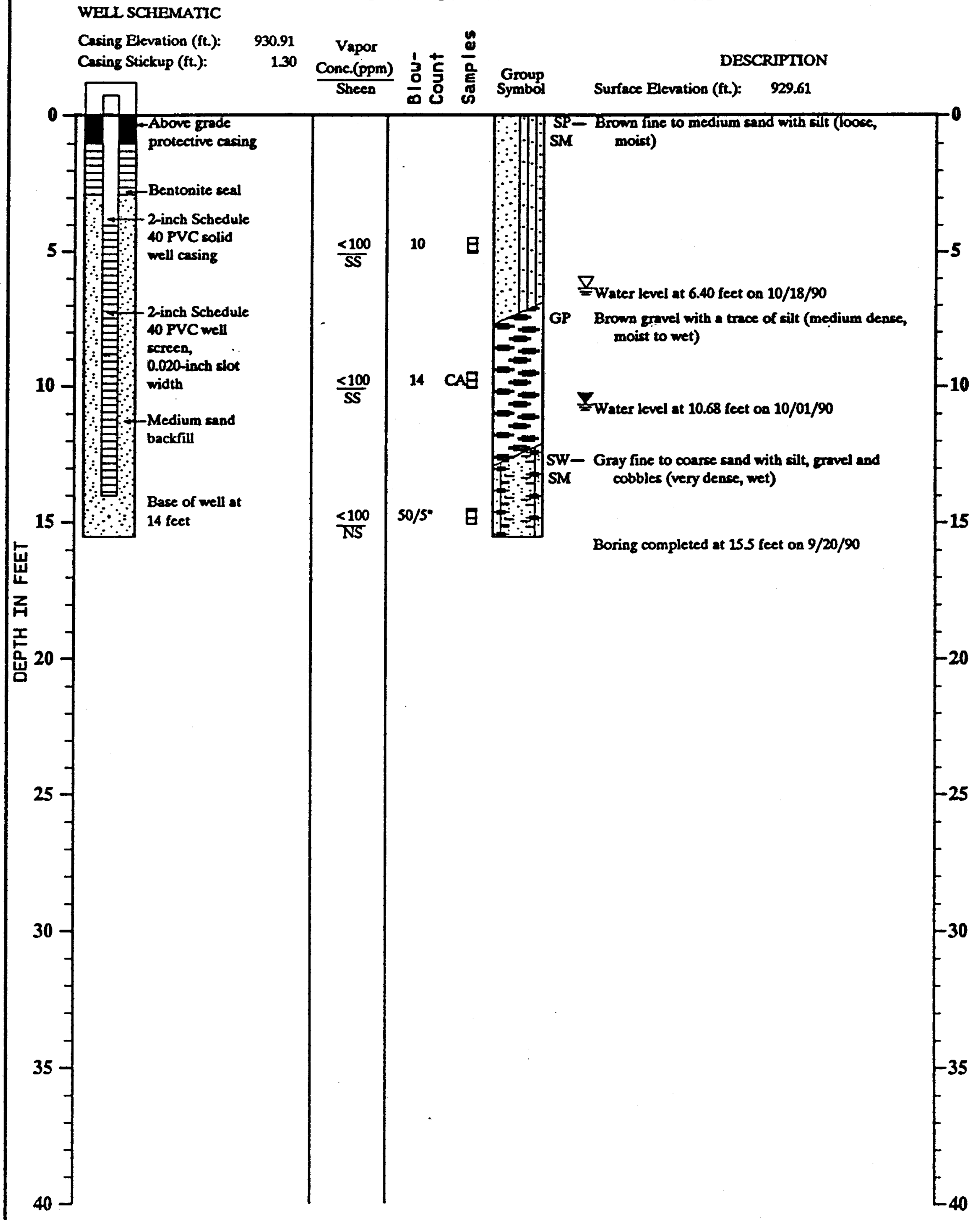
Note: See Figure A-2 for explanation of symbols

GeoEngineers

Log of Monitor Well

Figure A-14

MONITOR WELL NO. MW-13



Note: See Figure A-2 for explanation of symbols

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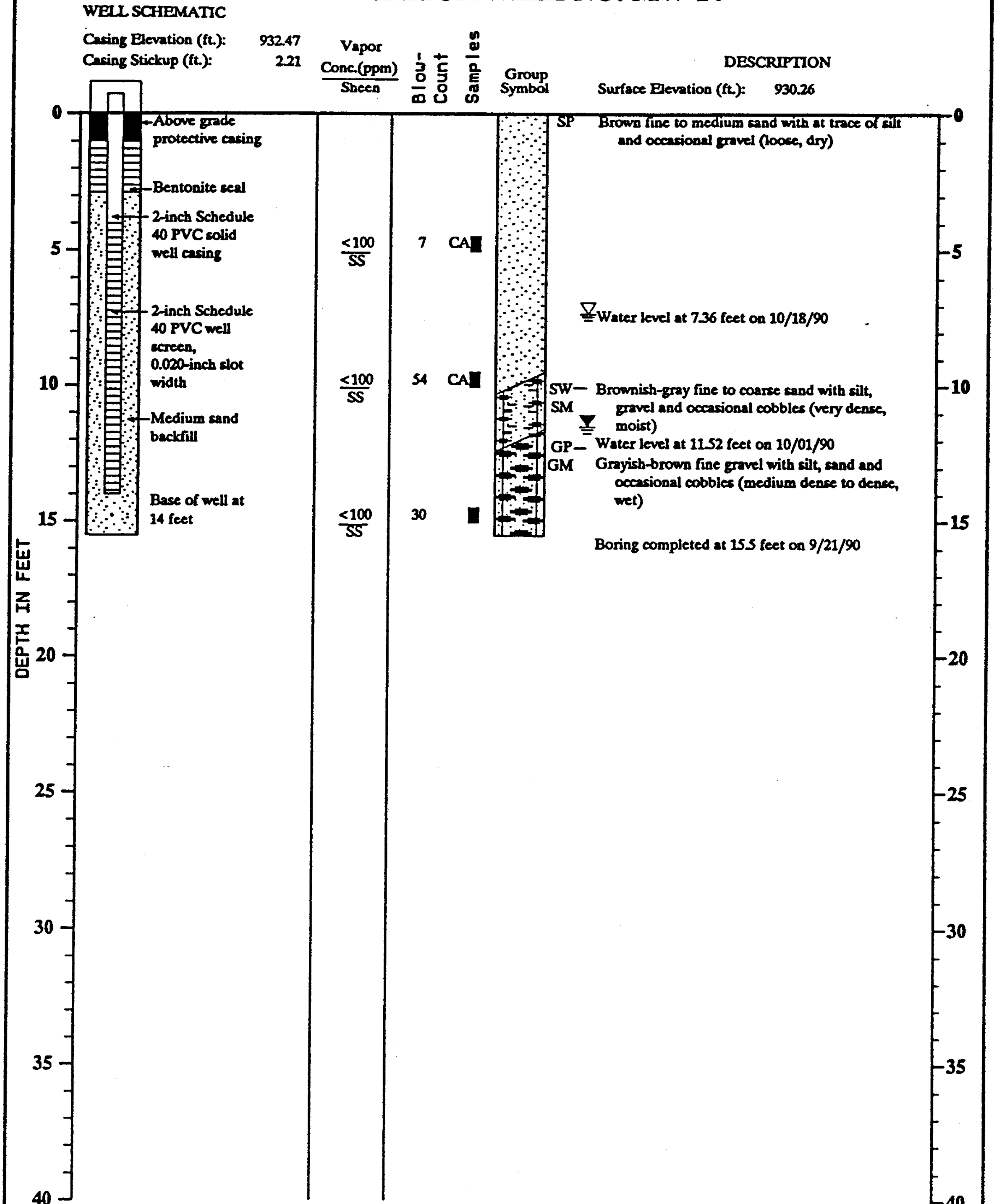
Log of Monitor Well

Figure A-15

0508-018-B14 :CRW:TEP:JHB:KKT 8/8/91

MONITOR WELL NO. MW-14



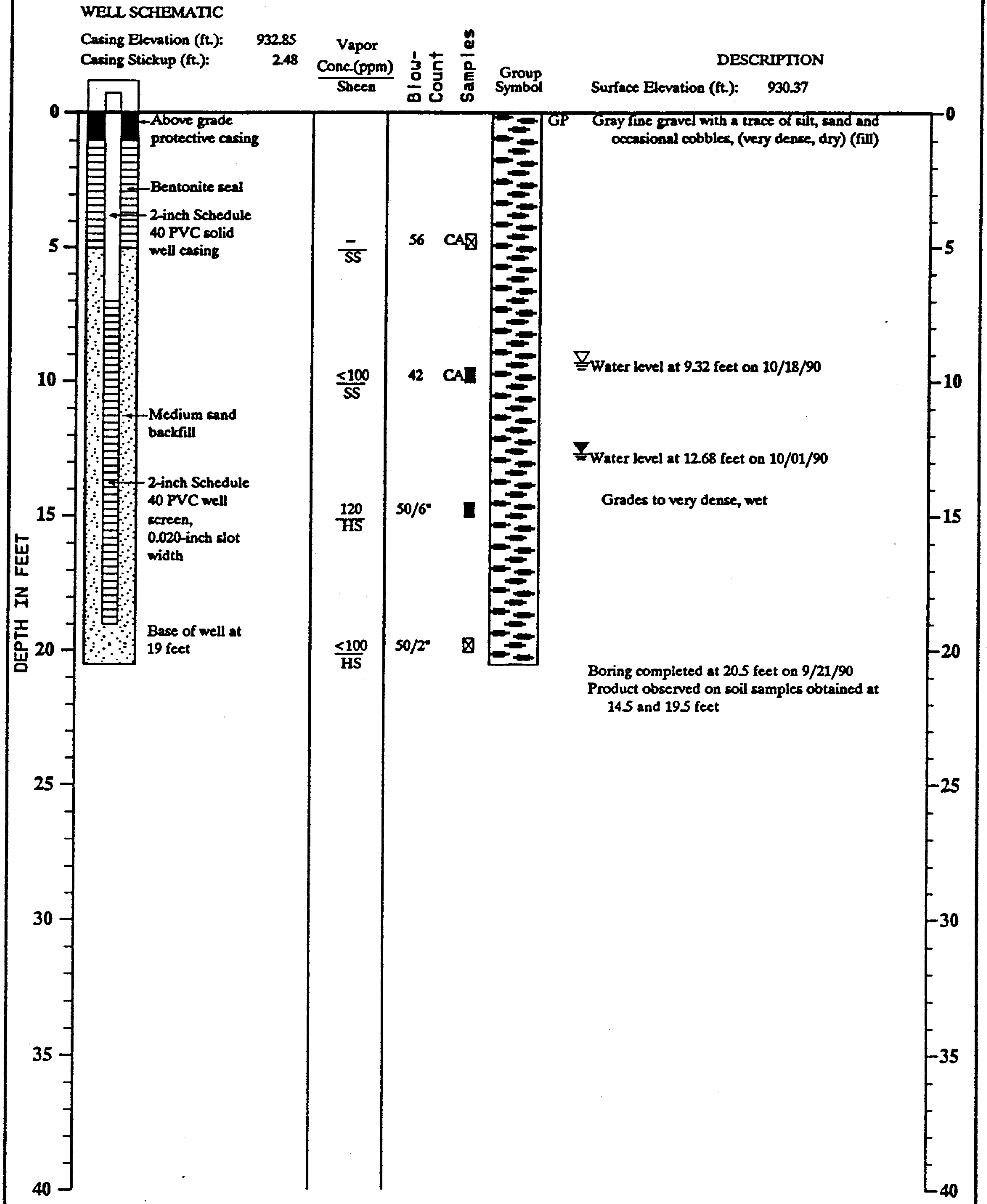
Note: See Figure A-2 for explanation of symbols

GeoEngineers

Log of Monitor Well

Figure A-16

MONITOR WELL NO. MW-15



Note: See Figure A-2 for explanation of symbols

GeoEngineers

Log of Monitor Well

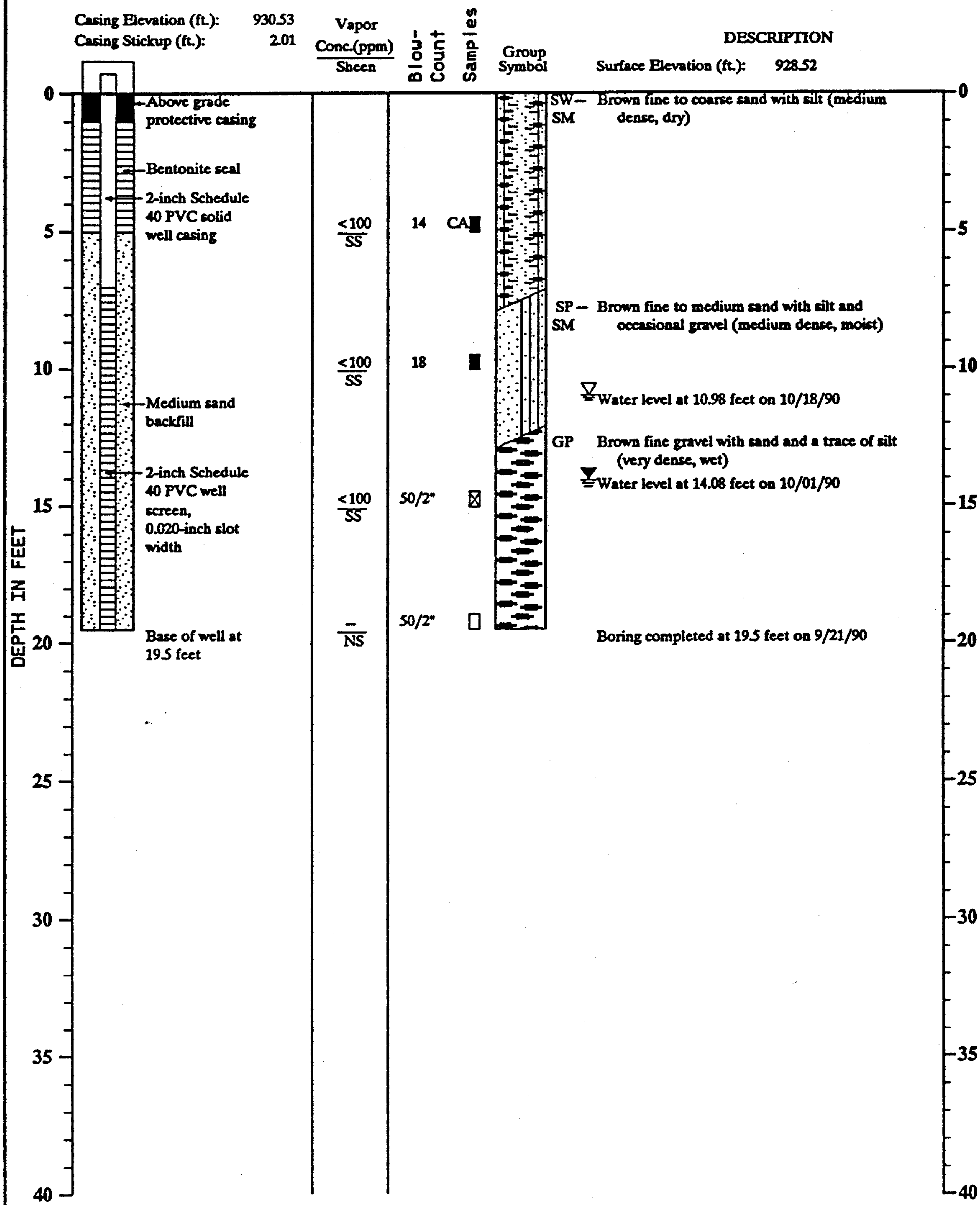
Figure A-17

MONITOR WELL NO. MW-16

WELL SCHEMATIC

Casing Elevation (ft.): 930.53
Casing Stickup (ft.): 2.01

DESCRIPTION
Surface Elevation (ft.): 928.52



Note: See Figure A-2 for explanation of symbols

GeoEngineers

Log of Monitor Well

Figure A-18

0508-018-B14 :CRW:TEP:JHB:KKT 8/8/91

MONITOR WELL NO. MW-17

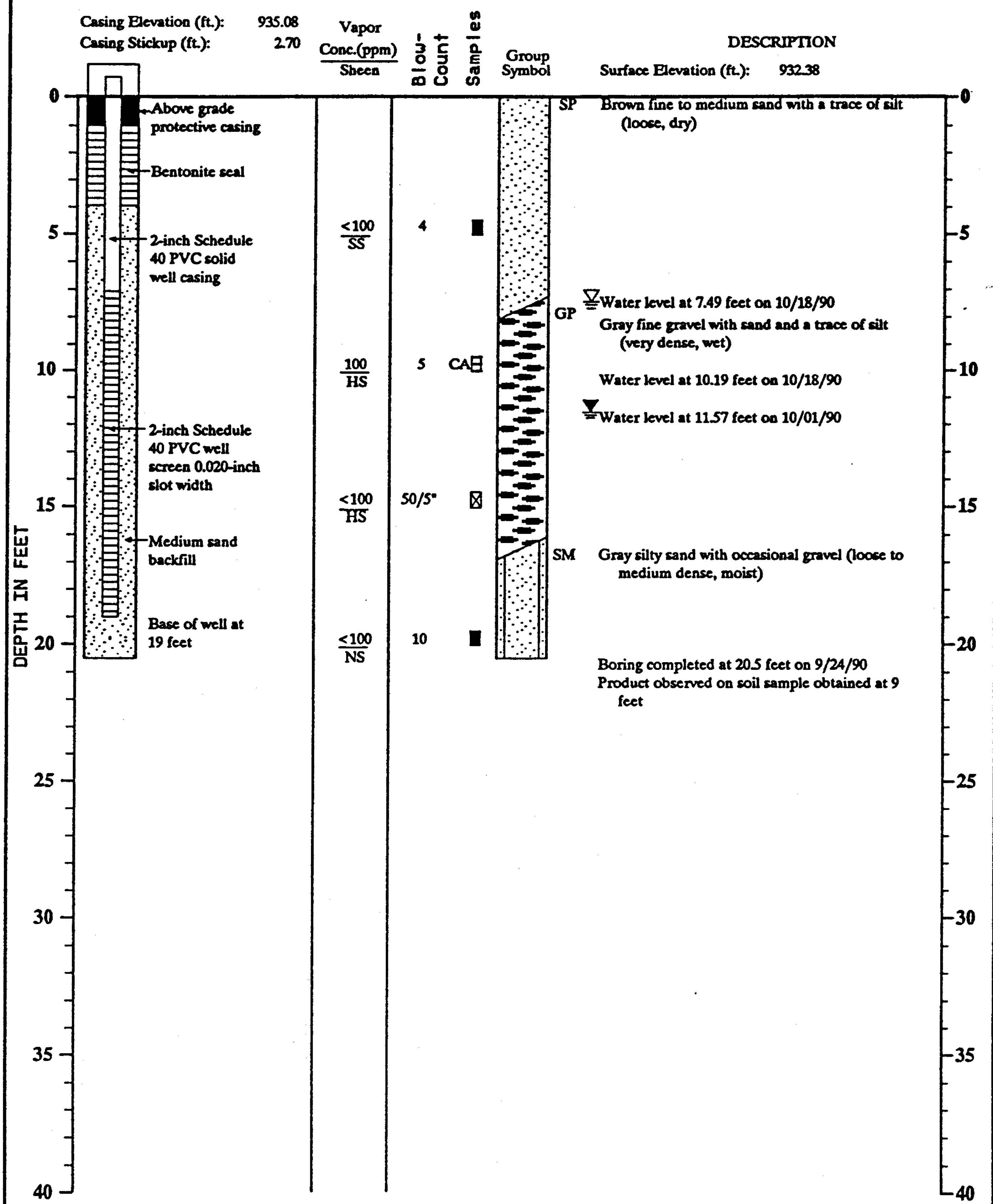
WELL SCHEMATIC

Casing Elevation (ft.): 935.08

Casing Stickup (ft.): 2.70

DESCRIPTION

Surface Elevation (ft.): 932.38



Note: See Figure A-2 for explanation of symbols

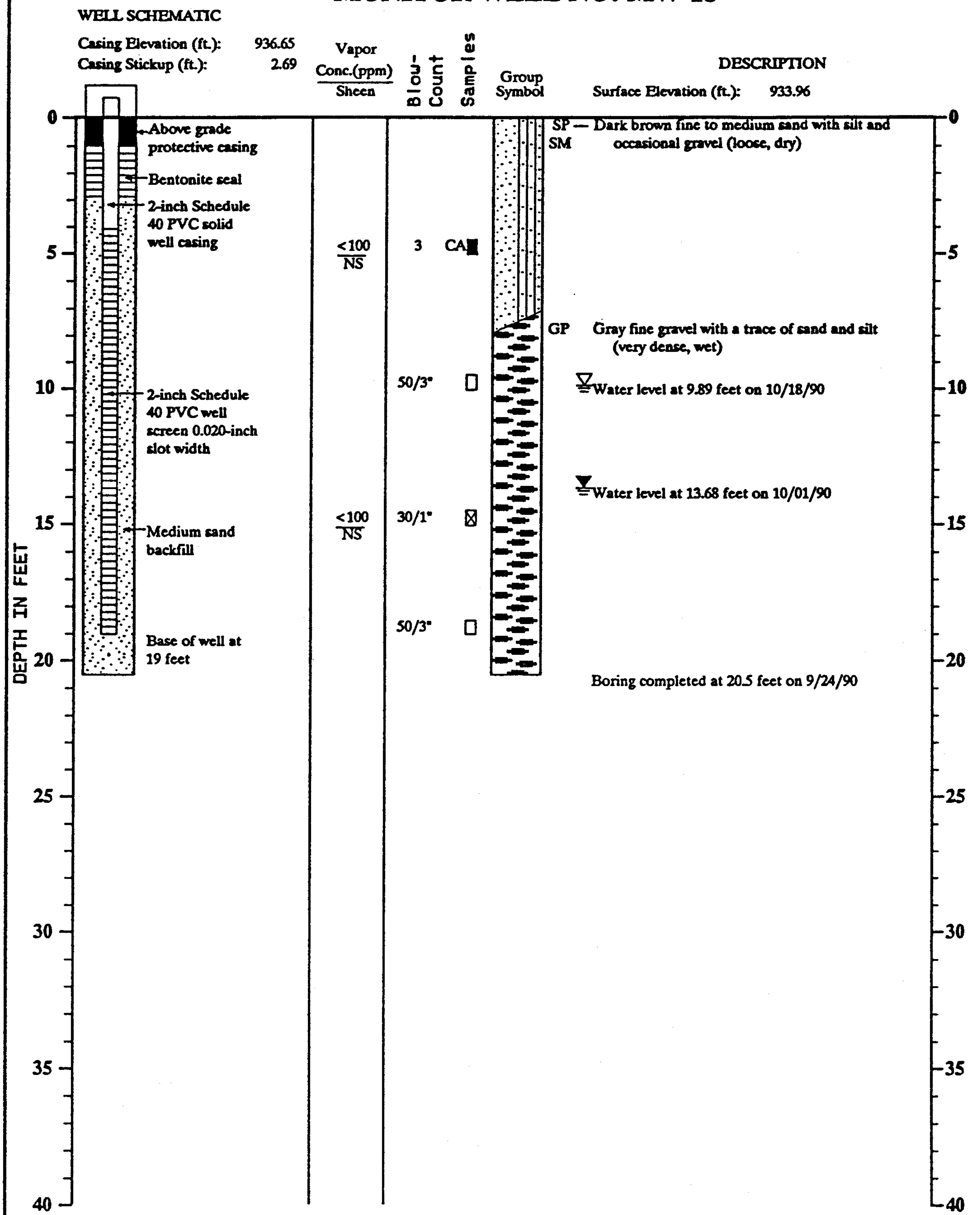
GeoEngineers

Log of Monitor Well

Figure A-19

0506-018-B14 :CRW:TEP:JHB:KKT 8/8/91

MONITOR WELL NO. MW-18



Note: See Figure A-2 for explanation of symbols

GeoEngineers

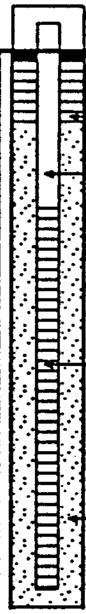
Log of Monitor Well

Figure A-20

MONITOR WELL NO. MW-19

WELL SCHEMATIC

Casing Elevation (ft.): 928.51
Casing Stickup (ft.): 2.56



DESCRIPTION

Surface Elevation (ft.): 925.95

Depth (ft)	Vapor Conc.(ppm) / Sheen	Blow-Count	Samples	Group Symbol	Description
0				SW-SM	Brown fine to coarse sand with silt and occasional cobbles (medium dense, dry)
5	≤100 / MS	22	□		Water level at 5.29 feet on 10/18/90
		21	CA ■		
				GP	Brown gravel with a trace of silt and occasional cobbles (medium dense, moist to wet)
10	≤100 / SS	22	⊠		Water level at 10.51 feet on 10/01/90
15	≤100 / NS	50/5"	□		Boring completed at 14.5 feet on 9/26/90

DEPTH IN FEET: 0, 5, 10, 15, 20, 25, 30, 35, 40

Note: See Figure A-2 for explanation of symbols

GeoEngineers

Log of Monitor Well

Figure A-21

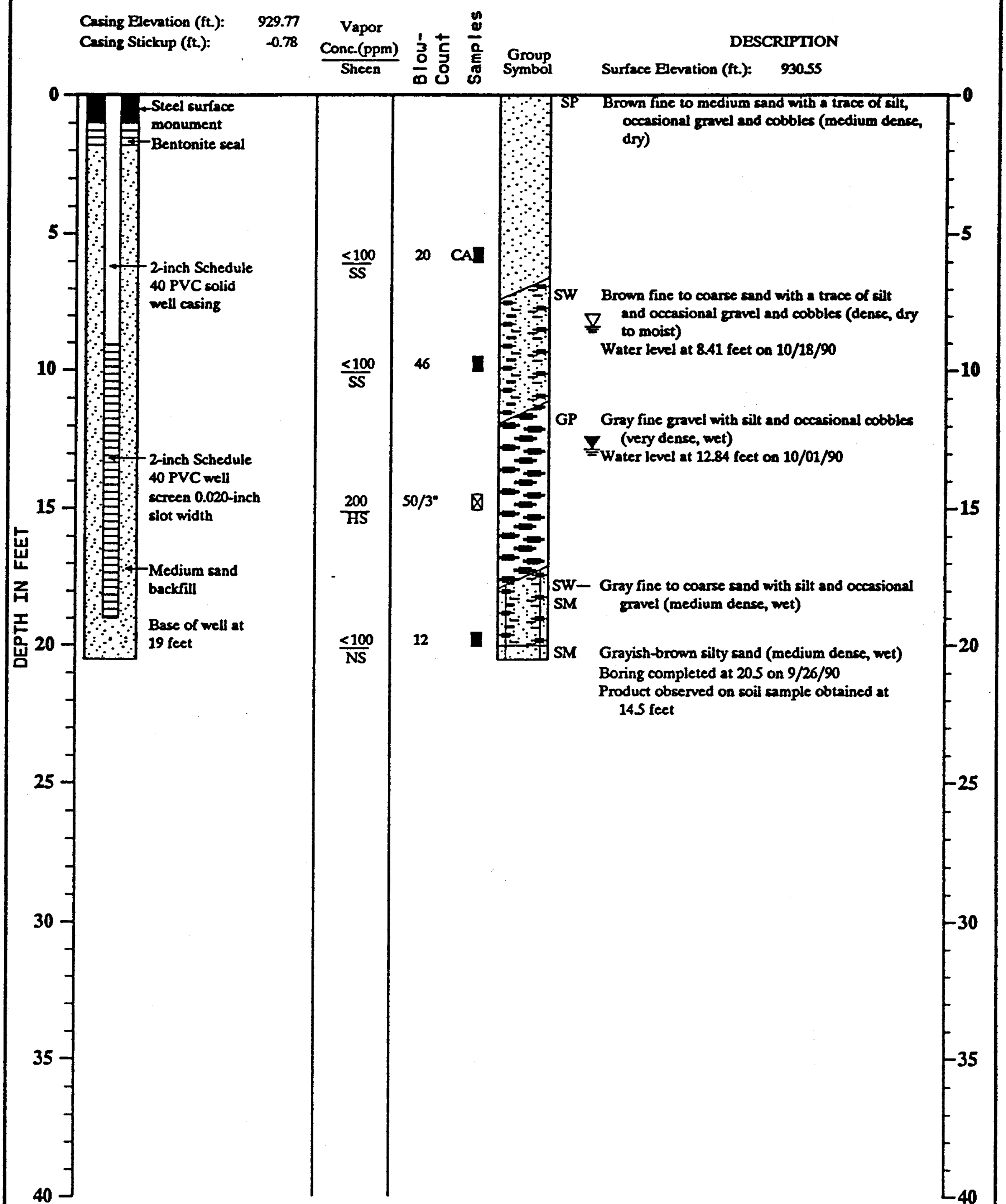
0508-018-B14 :CRW:TEP:JHB:KKT 6/6/91

MONITOR WELL NO. MW-20

WELL SCHEMATIC

Casing Elevation (ft.): 929.77
Casing Stickup (ft.): -0.78

Surface Elevation (ft.): 930.55



Note: See Figure A-2 for explanation of symbols

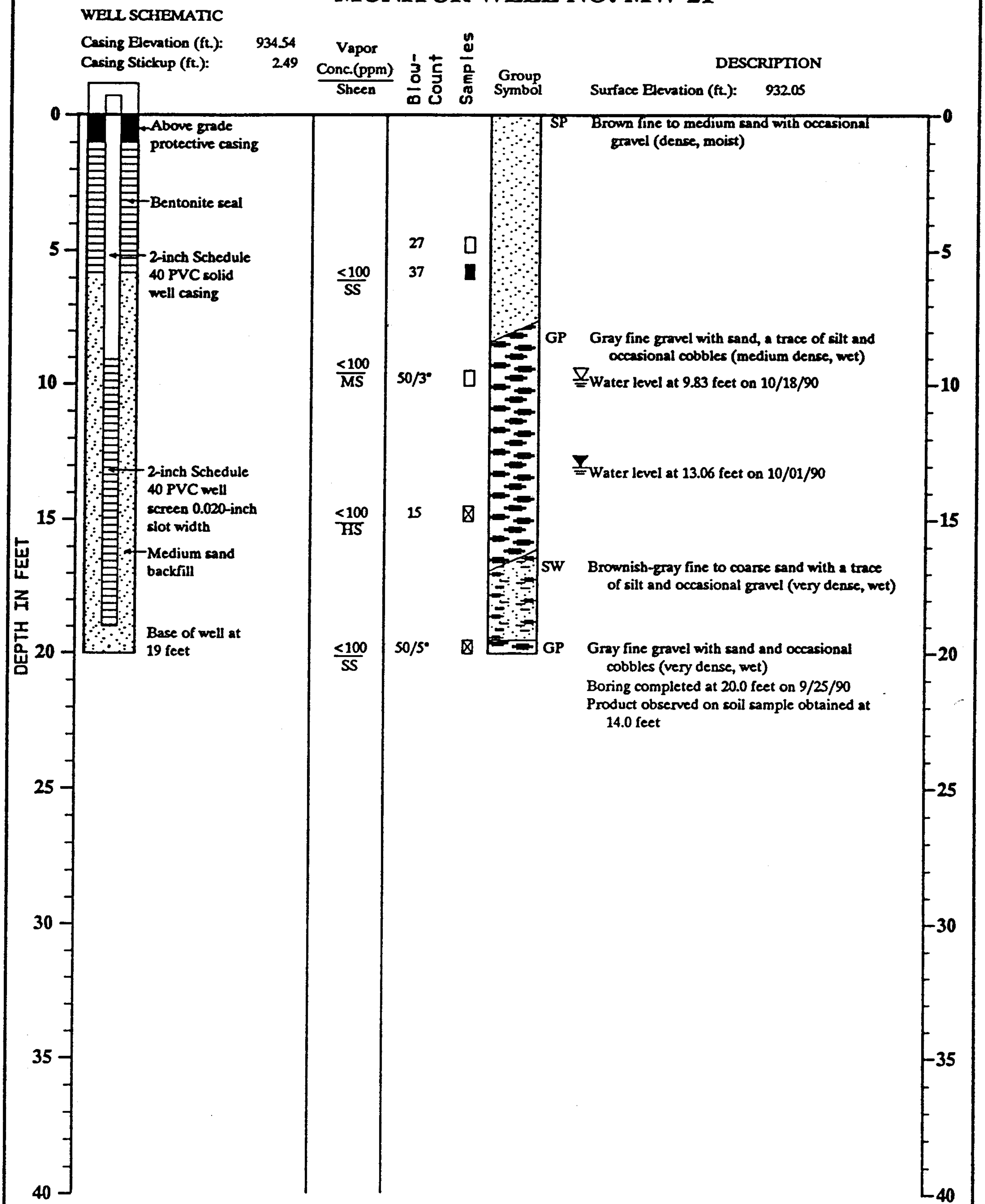
GeoEngineers

Log of Monitor Well

Figure A-22

0508-018-014:CRW:TEP:JHB:KKT 8/7/91

MONITOR WELL NO. MW-21



Note: See Figure A-2 for explanation of symbols

GeoEngineers

Log of Monitor Well

Figure A-23

CRW: TEP: JHB: KKT 6/7/91

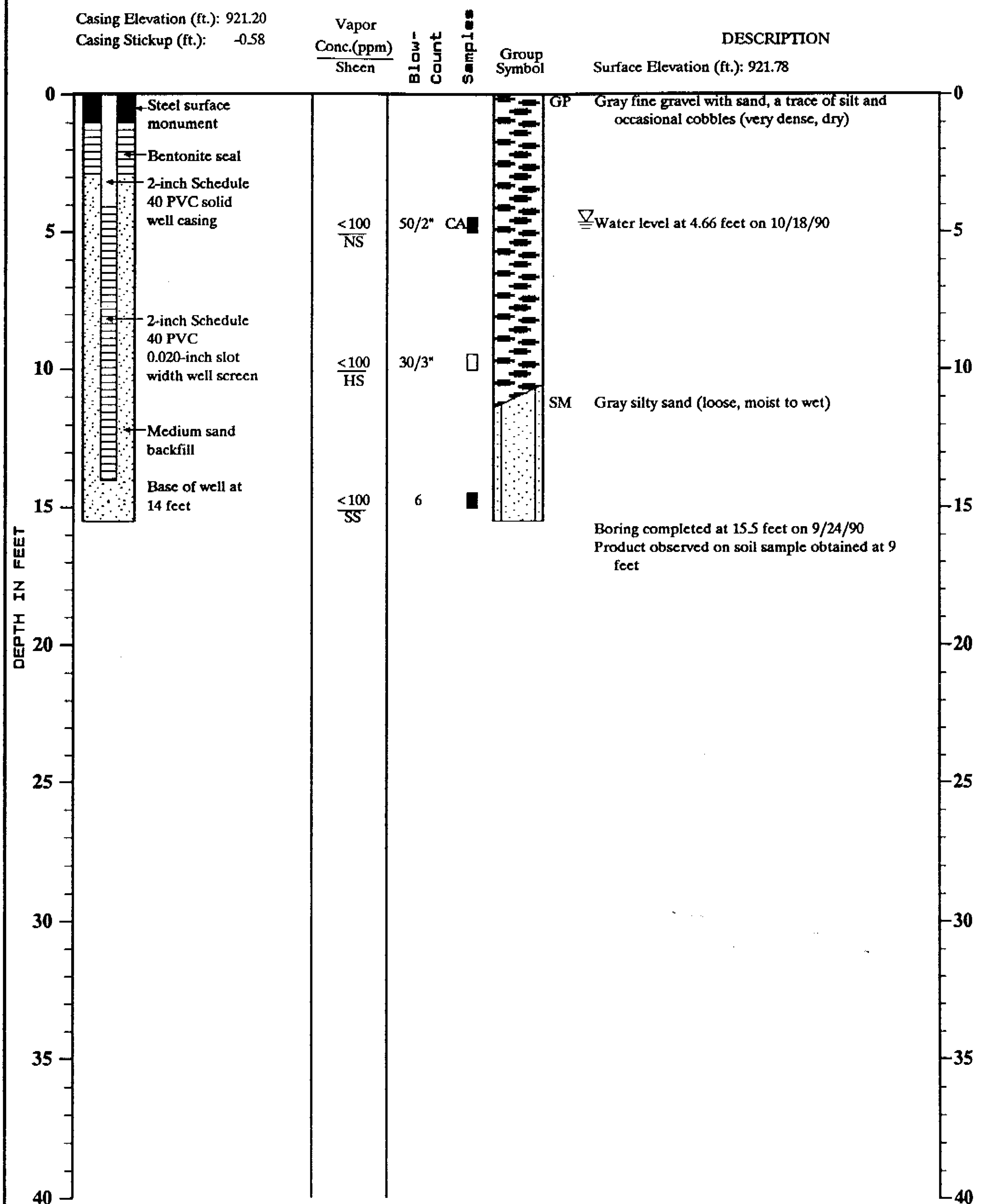
0508-018-B14

MONITOR WELL NO. MW-22

WELL SCHEMATIC

Casing Elevation (ft.): 921.20
Casing Stickup (ft.): -0.58

Surface Elevation (ft.): 921.78



Note: See Figure A-2 for explanation of symbols

GeoEngineers

Log of Monitor Well

Figure A-24

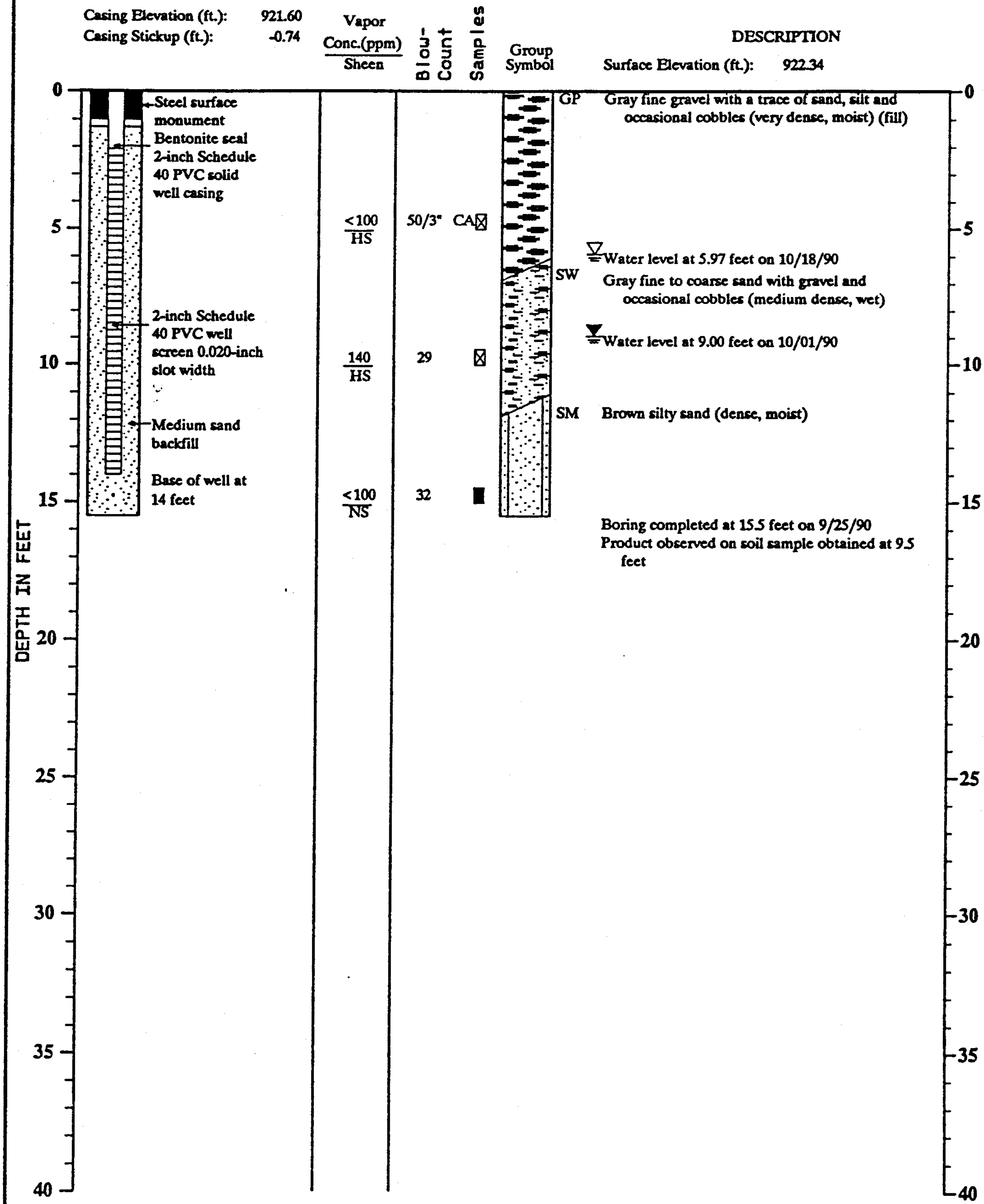
0506-016-B14 11/14/90 :CRW:TEP:JHB:KKT

MONITOR WELL NO. MW-23

WELL SCHEMATIC

Casing Elevation (ft.): 921.60
Casing Stickup (ft.): -0.74

DESCRIPTION
Surface Elevation (ft.): 922.34



Note: See Figure A-2 for explanation of symbols

GeoEngineers

Log of Monitor Well

Figure A-25

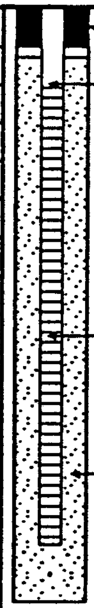
MONITOR WELL NO. MW-24

WELL SCHEMATIC

Casing Elevation (ft.): 921.82
Casing Stickup (ft.): -0.77

DESCRIPTION

Surface Elevation (ft.): 922.59



- Steel surface monument
- Bentonite seal
- 2-inch Schedule 40 PVC solid well casing
- 2-inch Schedule 40 PVC well screen 0.020-inch slot width
- Medium sand backfill
- Base of well at 14 feet

Depth (ft)	Vapor Conc.(ppm) / Sheen	Blow-Count	Samples	Group Symbol	Description
0				SW	Brown fine to coarse sand with a trace of silt, occasional gravel and cobbles (very dense, dry) (fill)
5	<100 / MS	50/3"	CA ☒		
~6.2					Water level at 6.21 feet on 10/18/90
~7				GP-GM	Gray fine gravel with silt and sand (very dense, wet)
~9					Water level at 9.09 feet on 10/01/90
10	<100 / HS	50/3"	☒		
14				SM	Brown silty sand with occasional gravel (medium dense, wet to moist)
15	<100 / NS	15	■		
15.5					Boring completed at 15.5 feet on 9/25/90

DEPTH IN FEET (0–40)

Note: See Figure A-2 for explanation of symbols

GeoEngineers

Log of Monitor Well

Figure A-26

0506-018-B14 :CRW:TEP:JHB:KKT 6/7/91

MONITOR WELL NO. MW-25

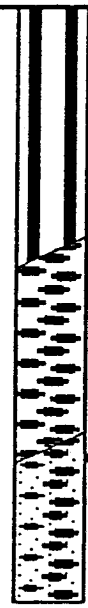
WELL SCHEMATIC

Casing Elevation (ft.): 922.84
Casing Stickup (ft.): -0.24

DESCRIPTION

Surface Elevation (ft.): 923.08

Depth (ft)	Vapor Conc.(ppm) / Sheen	Blow-Count	Samples	Group Symbol	Description
0				MH	Dark brown silt with sand, occasional gravel and wood debris (very loose, moist) (fill)
5	<100 / NS	2	CA		
~6.5				GP	Water level at 9.57 feet on 10/01/90. Gray fine gravel with sand, a trace of silt and occasional cobbles (very dense, wet)
10	140 / HS	50/5"	☒		Water level at 9.57 feet on 10/01/90
~12				GW	Gray fine to coarse gravel with sand (medium dense, wet)
15	<100 / HS	16	☒		



Boring completed at 15.5 feet on 9/25/90
Product observed on soil sample obtained at 9 and 14 feet

DEPTH IN FEET: 0, 5, 10, 15, 20, 25, 30, 35, 40

Note: See Figure A-2 for explanation of symbols

GeoEngineers

Log of Monitor Well

Figure A-27

0508-016-B14 :CRW:TEP:JHB:KKT 8/7/91

MONITOR WELL NO. MW-26

WELL SCHEMATIC

Casing Elevation (ft.): 926.60
Casing Stickup (ft.): -0.40

DESCRIPTION

Surface Elevation (ft.): 927.00

Well schematic:
- Steel surface monument
- Bentonite seal
- 2-inch Schedule 40 PVC solid well casing
- 2-inch Schedule 40 PVC well screen 0.020-inch slot width
- Medium sand backfill
- Base of well at 19 feet

Depth (ft)	Vapor Conc.(ppm) / Sheen	Blow-Count	Samples	Group Symbol	Description
0				GP-GM	Gray fine gravel with silt, sand and occasional cobbles (very dense, dry)
5	<100 / MS	50/4"			
6.39					Water level at 6.39 feet on 10/18/90
10	<100 / SS	50/1"	CA		
10.71					Water level at 10.71 feet on 10/01/90
12				SM	Brown silty fine sand (medium dense, moist)
15	<100 / NS	14			
18				SP-SM	Brown fine to medium sand with silt (medium dense, wet)
20	<100 / NS	17			

Boring completed at 20.5 feet on 9/26/90
Product observed on soil sample obtained at 14 feet

DEPTH IN FEET: 0, 5, 10, 15, 20, 25, 30, 35, 40

Note: See Figure A-2 for explanation of symbols

GeoEngineers

Log of Monitor Well

Figure A-28

0508-016-B14 CRW:TEP:JHB:KKT 8/7/91

MONITOR WELL NO. MW-27

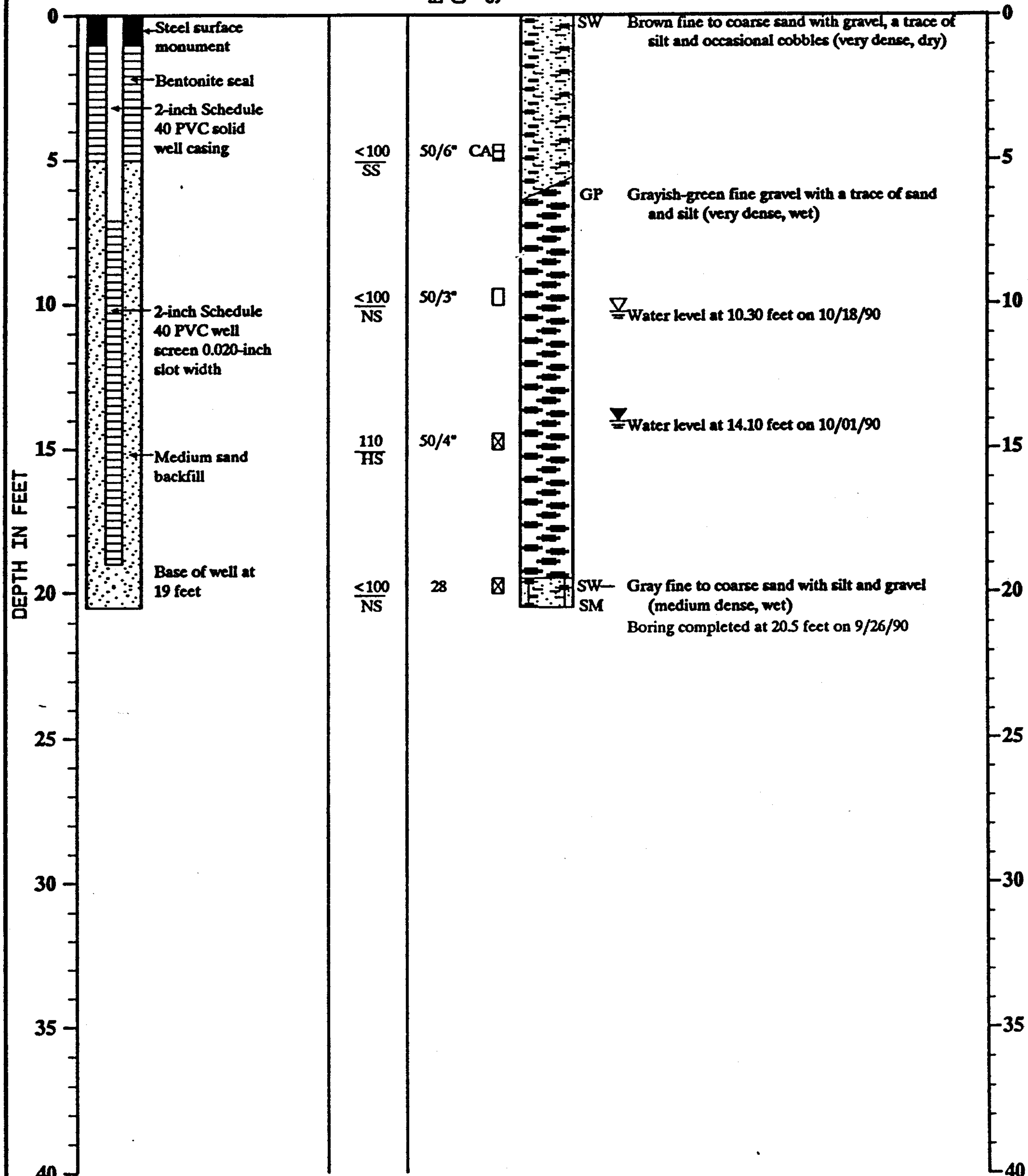
WELL SCHEMATIC

Casing Elevation (ft.): 932.18

Casing Stickup (ft.): -0.25

DESCRIPTION

Surface Elevation (ft.): 932.43



Note: See Figure A-2 for explanation of symbols

GeoEngineers

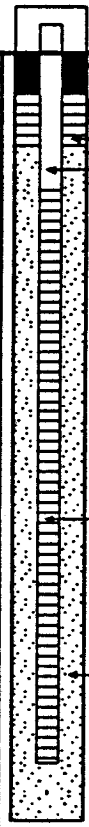
Log of Monitor Well

Figure A-29

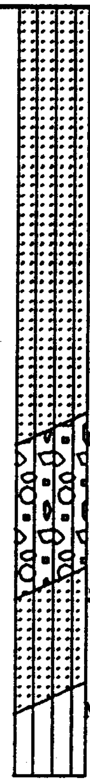
MONITOR WELL NO. MW-28

WELL SCHEMATIC

Casing Elevation (ft.): 936.60
Casing Stickup (ft.): 1.26



Depth (ft)	Well Schematic	Vapor Conc.(ppm) / Sheen	Blow Count	Samples	Group Symbol	DESCRIPTION (Surface Elevation (ft.): 935.34)
0	Above-grade protective casing and concrete; Bentonite Seal; 2-inch Schedule 40 PVC solid pipe				SM	Bluish brown silty sand and occasional gravel (loose, moist)
						Zone of very loose, water-saturated soil from 1 to 2 feet
						Becomes moist
	2-inch Schedule 40 PVC screen, 0.020-inch slot width				GM	Brownish gray silty fine gravel with sand (very dense, moist)
						Water level at 11.94 feet on 12/17/91
		<100 / HS	50/2"	⊠		
	Medium sand backfill				SM	Brown silty fine sand and occasional gravel (medium dense, moist)
		<100 / NS	28	⊠		
					ML	Gray to light brown sandy silt (very stiff, moist)
	Base of well at 18.5 feet	<100 / NS	18	⊠		
20						Boring completed at 20.0 feet on 11/04/91



DEPTH IN FEET: 0, 5, 10, 15, 20, 25, 30, 35, 40

Note: See Figure A-2 for explanation of symbols

GeoEngineers

Log of Monitor Well

Figure A-6

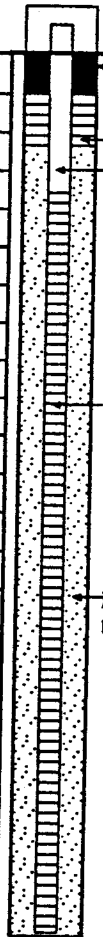
:DEH:KLB:CMS 2/24/92

0506-016-R14

MONITOR WELL NO. MW-29

WELL SCHEMATIC

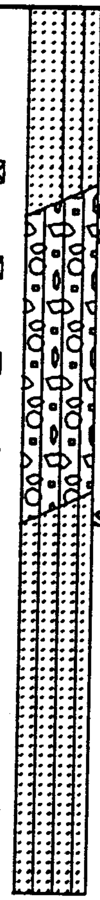
Casing Elevation (ft.): 943.10
Casing Stickup (ft.): 2.28



DEPTH IN FEET (0–40)

Vapor Conc.(ppm) / Sheen	Blow Count	Samples
<100 / SS	6	CA ☒
<100 / SS	50/5"	☒
<100 / SS	50/5"	☒
<100 / SS	50/5"	CA ☒
<100 / SS	50/6"	☒
<100 / SS	50/5"	☒
<100 / NS	50/6"	☒
<100 / NS	50/2"	☒

Group Symbol



DESCRIPTION

Surface Elevation (ft.): 940.82

SP — SM Light brown fine to medium sand with silt (loose, moist)

GW — GM Gray to light brown fine to coarse gravel with sand, silt and occasional cobbles (very dense, moist)

SM Brown silty fine to medium sand with gravel (very dense, moist)

Water level at 16.32 feet on 12/17/91

Becomes wet

Boring completed at 23.0 feet on 11/05/91

Note: See Figure A-2 for explanation of symbols

GeoEngineers

Log of Monitor Well

Figure A-7

MONITOR WELL NO. MW-30

WELL SCHEMATIC

Casing Elevation (ft.): 928.89
Casing Stickup (ft.): 2.30

DESCRIPTION

Surface Elevation (ft.): 926.59

Well schematic:
- Above-grade protective casing and concrete
- Bentonite seal
- 2-inch Schedule 40 PVC solid pipe
- 2-inch Schedule 40 PVC screen, 0.020-inch slot width
- Medium sand backfill
- Base of well at 18.5 feet

Depth (ft)	Vapor Conc. (ppm) / Sheen	Blow Count	Samples	Group Symbol	Description
0				SM	Light brown silty fine to medium sand with occasional gravel (dense, moist)
~4	≤100 / SS	44	CA ⊠		
~6.5	≤100 / SS	12	⊠		Becomes loose
~9	≤100 / NS	8	CA ⊠		Grades to rusty brown
~11.5	≤100 / NS	19	⊠		Grades to medium dense
12.45					▽ Water level at 12.45 feet on 12/17/91
~13				SP-SM	Brown fine to medium sand with silt and occasional gravel (medium dense, wet)
~14	≤100 / NS	14	⊠		
~16.5	≤100 / NS	15	⊠		
~19	≤100 / NS	64	⊠		Grades to very dense
20					Boring completed at 20.0 feet on 11/06/91

DEPTH IN FEET: 0, 5, 10, 15, 20, 25, 30, 35, 40

Note: See Figure A-2 for explanation of symbols

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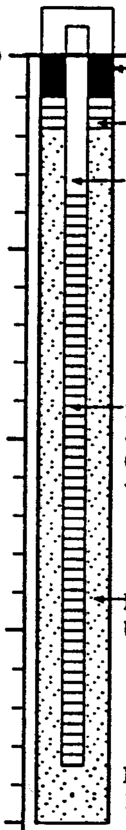
Log of Monitor Well

Figure A-8

MONITOR WELL NO. MW-31

WELL SCHEMATIC

Casing Elevation (ft.): 931.01
Casing Stickup (ft.): 2.51



DESCRIPTION
Surface Elevation (ft.): 928.50

Depth (ft.)	Vapor Conc.(ppm) / Sheen	Blow Count	Samples	Group Symbol	Description
0				SM	Dark brown silty fine to medium sand and occasional gravel (very loose, moist)
4	≤100 / SS	3	CA ☒		
5				SP — SM	Light brown fine to medium sand with silt (dense, moist)
7	≤100 / NS	33	☒		
9	≤100 / NS	2	☒		Becomes very loose
12	≤100 / NS	7	CA ☒		⊻ Grades to loose Water level at 11.79 feet on 12/17/91
14	≤100 / NS	38	CA ☒		Grades to dense with occasional gravel, becomes wet
17	≤100 / NS	44	☒		Grades to gray, gravel increases
19	≤100 / NS	50/6"	☒		Grades to very dense
20					Boring completed at 20.0 feet on 11/06/91

Note: See Figure A-2 for explanation of symbols

GeoEngineers

Log of Monitor Well

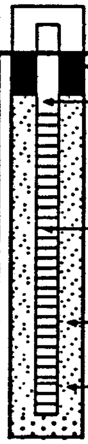
Figure A-9

0506-016-R14 :DEH:KLB:CMS 2/24/92

MONITOR WELL NO. MW-32

WELL SCHEMATIC

Casing Elevation (ft.): 922.86
Casing Stickup (ft.): 2.45



Well schematic labels
Above-grade protective casing and concrete
2-inch Schedule 40 PVC solid pipe
2-inch Schedule 40 PVC screen, 0.020-inch slot width
Medium sand backfill
Natural soil backfill
Base of well at 9.4 feet

Vapor Conc.(ppm) / Sheen	Blow Count	Samples
<100 / SS		CA
<100 / NS		
<100 / NS		
<100 / NS		CA
<100 / NS		

DESCRIPTION

Surface Elevation (ft.): 920.41

Group Symbol	Description
OL	Dark brown sandy organic soil with wood fragments (loose, moist)
SM	Brown silty fine sand with roots and wood fragments (loose, moist)
ML	Gray sandy silt with ground water stain laminations (medium dense, moist)
GW-GM	Water level at 6.45 feet on 12/17/91 Brownish gray fine to coarse gravel with silt, sand and cobbles (dense to very dense, wet)

Test pit completed at 10.0 feet on 11/08/91
MW-32 was installed in this test pit

DEPTH IN FEET: 0, 5, 10, 15, 20, 25, 30, 35, 40

Note: See Figure A-2 for explanation of symbols

GeoEngineers

Log of Monitor Well

Figure A-10

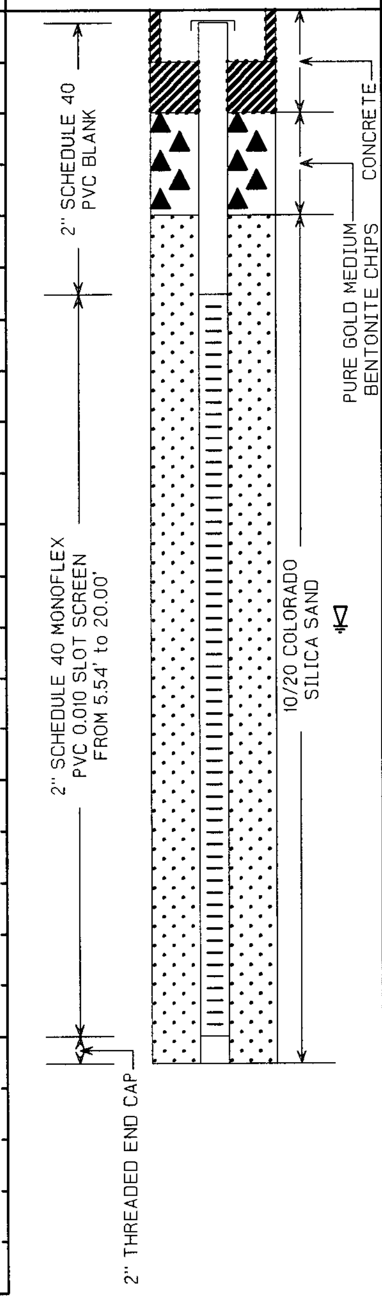
0506-016-R14 :DEH:KLB:CMS 2/24/92

RETEC	BORING/WELL INSTALLATION LOG Monitoring Well MW-33	1011 SW Klickitat Way Suite 207 Seattle, WA 98134 (206) 624-9349

PROJECT NO: 3-1161 BN-Skykomish		CLIENT: Burlington Northern
LOCATION: Railroad Avenue; Skykomish, WA		DRILLING CO.: Cascade Drilling
START DATE: 9/28/93 TIME: 1445	BORING ID: 8"	DRILLER: R. Labrosse/B. Maloy/D. Miner
COMPLETION DATE: 9/28/93 TIME: 1645	TOTAL DEPTH: 20.5 feet	RIG TYPE: CME 75
WATER LEVEL DURING DRILLING: 12'bgs	PVC STICK-UP: -0.34'	METHOD: HSA
SURFACE ELEV.: 934.34	MP ELEV.: 934.00 TOC PVC	LOGGED BY: W. Beebe

DEPTH (in feet): 0, 5, 10, 15, 20, 25

WELL CONSTRUCTION



SOIL DESCRIPTION / SAMPLE DATA

U.S.C.S.	SOIL DESCRIPTION	TYPE	BLOWS /ft	%RECOVERY	PID (ppm)
SW	ASPHALT: GRAVELLY SAND: Gray-brown; coarse gravel; medium grained sand; dense; dry	SS	50/6	11	0
SP	SAND: Light brown; medium grained sand; very dense; damp to moist	SS	22 50/5	28	0
SW	GRAVELLY SAND: Brown; sub-angular gravels to 2-3"; gravels to 6" in cuttings; medium to coarse grained sand; very dense; moist	SS	50/2	11	0
		SS	50/4	0	NR
		SS	50/2	0	NR
ML	SANDY SILT: Gray; very fine sand; hard; rapid dilatency; saturated	SS	15 18 24	89	0
SM	SILTY SAND: Brown to gray; very fine sand; medium dense to dense; saturated	SS	10 10 10	72	0
		SS	12 12 20	44	
SW	GRAVELLY SAND: Gray; gravels to 2"; coarse grained sand; very dense; saturated	SS	50/5	50	0

Refusal at 20.5'

Backfilled with 6 bags sand; 5 bags chips; 4 bags concrete

REMARKS: SS = Split Spoon
■ Analytical Sample
11/10/94 - Well Monument repaired. Casing not damaged.

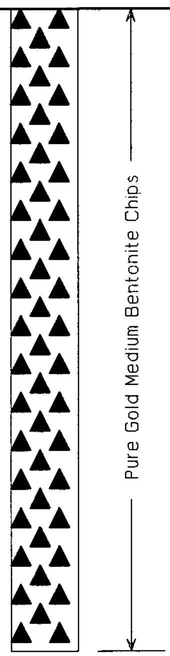
RETEC

BORING/WELL INSTALLATION LOG
Abandoned Deep Well MW-34

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: *3-1161 BN-Skykomish*		CLIENT: *Burlington Northern*
LOCATION: *Railroad Avenue; Skykomish, WA*		DRILLING CO.: *Cascade Drilling*
START DATE: *9/28/93* TIME: *1330*	BORING ID: *8"*	DRILLER: *R. Labrosse/B. Maloy/D. Miner*
COMPLETION DATE: *9/28/93* TIME: *1430*	TOTAL DEPTH: *12.5 feet*	RIG TYPE: *CME 75*
WATER LEVEL DURING DRILLING: *'bgs*	PVC STICK-UP:	METHOD: *HSA*
SURFACE ELEV.: *935.99*	MP ELEV.: *NA*	LOGGED BY: *W. Beebe*

WELL CONSTRUCTION



SOIL DESCRIPTION

DEPTH (in feet)	U.S.C.S.	Description
0		ASPHALT:
	SW	GRAVELLY SAND: Light brown; sub-rounded gravels; medium grained sand; medium dense; dry
		1' – 10" boulder
		2.5' – becomes brown; with minor silt; sub-angular gravels; very dense
5		5' – becomes gray
		7.5' – becomes moist
		12' – gravels in cuttings average 2-3"
12.5		Refusal at 12.5'
		Backfilled with 4 bags Pure Gold Medium Bentonite Chips; 2 bags concrete

SAMPLE DATA

TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)
SS	■	7 8 12	39	0
SS		50/4	33	0
SS		50/3	11	0
SS	■	50/6	11	-
SS	■	50/3	6	0
SS		50/4	0	NR

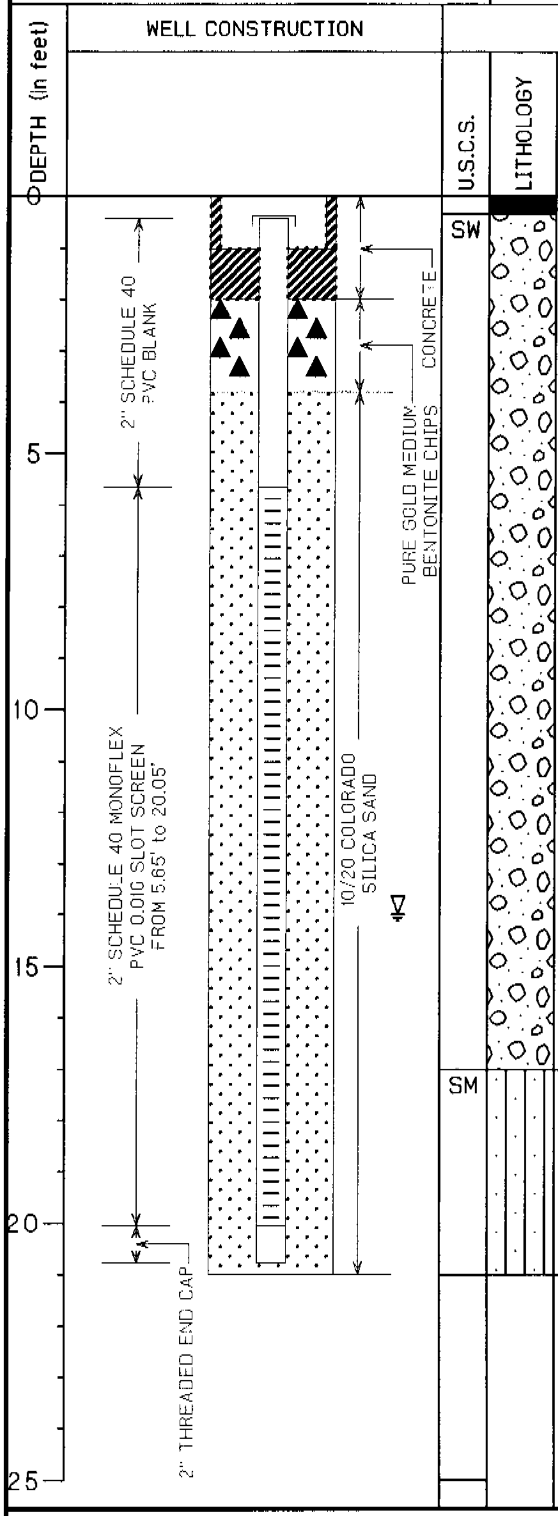
REMARKS: SS = Split Spoon;
■ Analytical Sample

RETEC — BORING/WELL INSTALLATION LOG

Monitoring Well MW-34B

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: 3-1161 BN-Skykomish		CLIENT: Burlington Northern
LOCATION: Railroad Avenue; Skykomish, WA		DRILLING CO.: Cascade Drilling
START DATE: 10/22/93 TIME: 1700	BORING ID: 9 3/4"	DRILLER: S. Butler/M. Sharp/J. Trover
COMPLETION DATE: 10/23/93 TIME: 1050	TOTAL DEPTH: 21 feet	RIG TYPE: Ingersoll-Rand T3W
WATER LEVEL DURING DRILLING: 14'bgs	PVC STICK-UP: -0.47'	METHOD: Air Rotary
SURFACE ELEV.: 935.99	MP ELEV.: 935.52 TOC PVC	LOGGED BY: W. Beebe



U.S.C.S.	SOIL DESCRIPTION	TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)
	ASPHALT:					
SW	GRAVELLY SAND: Light brown; sub angular gravels; medium grained sand; medium dense; damp 2.5' – becomes brown; with minor silt; sub-angular gravels; very dense 5' – becomes gray 8' – slow drilling; coarse gravels 12' – becomes moist 14' – becomes wet 14'-16.5' – large boulder					
SM	SILTY SAND: Brown; fine grained sand; medium dense; wet	SS	■	4 9 18	33	0
	Total depth = 21'					

REMARKS: SS = Split Spoon;
■ Analytical Sample

RETEC

BORING/WELL INSTALLATION LOG

Abandoned Monitoring Well MW-35

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: 3-1161 BN-Skykomish		CLIENT: Burlington Northern
LOCATION: Third Street; Skykomish, WA		DRILLING CO.: Cascade Drilling
START DATE: 9/28/93 TIME: 1650	BORING ID: 8"	DRILLER: R. Labrosse/B. Maloy/D. Miner
COMPLETION DATE: 9/28/93 TIME: 1750	TOTAL DEPTH: 12.5 feet	RIG TYPE: CME 75
WATER LEVEL DURING DRILLING: 'bgs	PVC STICK-UP:	METHOD: HSA
SURFACE ELEV.: 936.48	MP ELEV.: NA	LOGGED BY: W. Beebe

WELL CONSTRUCTION: Pure Gold Medium Bentonite Chips (0 to 12.5 feet)

SOIL DESCRIPTION

DEPTH (in feet)	U.S.C.S.	Description
0		ASPHALT:
0–2	SW	GRAVELLY SAND: Brown; gravels to 2"; medium grained sand; dense; dry
2–4	SP	GRAVELLY SAND: Brown-gray; gravels to 3/8"; coarse grained sand; medium dense; dry
4–12.5	SW	GRAVELLY SAND: Brown; with minor silt; sub-angular gravels to 2"; medium grained sand; very dense; damp
12.5		Refusal at 12.5'
		Backfilled with 6 bags Pure Gold Medium Bentonite Chips; 1 bag concrete

SAMPLE DATA

TYPE	BLOWS /ft	%RECOVERY	PID (ppm)
SS	17 19 24	72	0
SS	7 8 12	67	0
SS	50/4	6	0
SS	50/4	22	0
SS	50/4	17	0

Depth scale: 0, 5, 10, 15, 20, 25

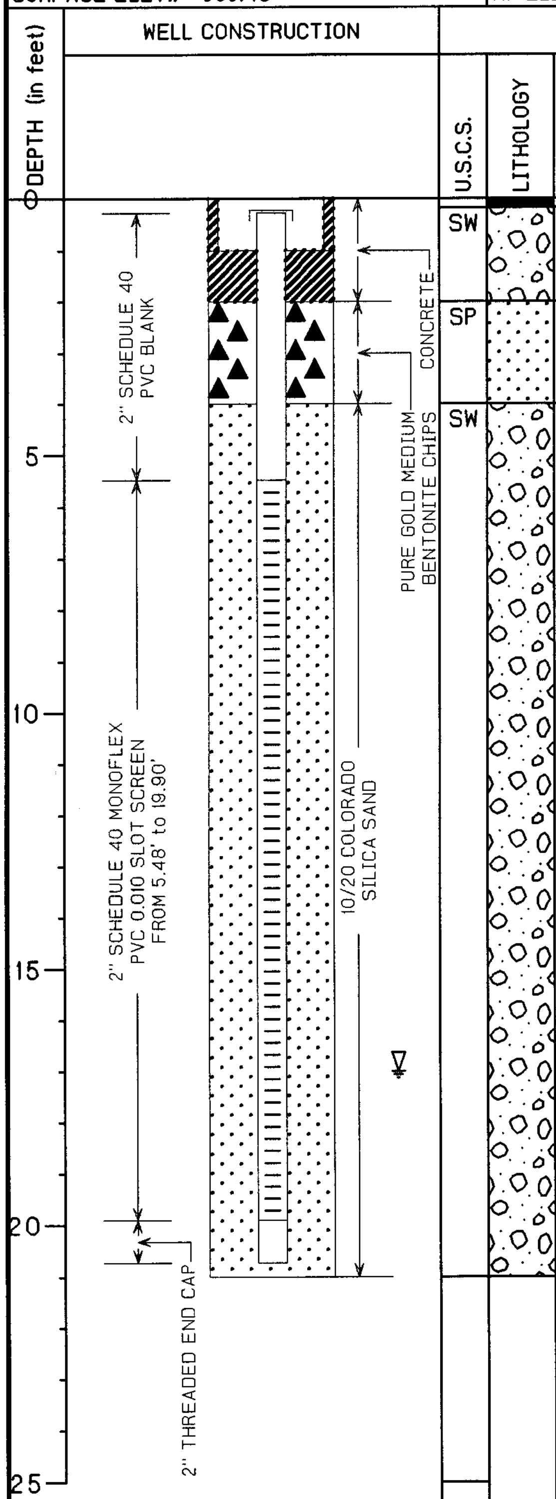
REMARKS: SS = Split Spoon;
■ Analytical Sample

BORING/WELL INSTALLATION LOG
Monitoring Well MW-35B

RETEC

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: 3-1161 BN-Skykomish		CLIENT: Burlington Northern
LOCATION: Third Street; Skykomish, WA		DRILLING CO.: Cascade Drilling
START DATE: 10/19/93 TIME: 1600	BORING ID: 9 3/4"	DRILLER: S. Butler/M. Sharp/J. Trover
COMPLETION DATE: 10/19/93 TIME: 1900	TOTAL DEPTH: 21 feet	RIG TYPE: Ingersoll-Rand T3W
WATER LEVEL DURING DRILLING: 17'bgs	PVC STICK-UP: -0.33'	METHOD: Air Rotary
SURFACE ELEV.: 936.48	MP ELEV.: 936.15 TOC PVC	LOGGED BY: W. Beebe



SOIL DESCRIPTION

U.S.C.S.	Description
	ASPHALT:
SW	GRAVELLY SAND: Brown; gravels to 2"; medium grained sand; dense; dry
SP	GRAVELLY SAND: Brown-gray; gravels to 3/8"; coarse grained sand; medium dense; dry
SW	GRAVELLY SAND: Brown; with minor silt; sub-angular gravels to 2"; medium grained sand; very dense; damp 17' - becomes gravels to 3"; fine to medium grained sand; saturated
	Total depth =21'

SAMPLE DATA

TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)
SS	■ (17'–18.5')	3 6 7	11	0

REMARKS: SS = Split Spoon;
■ Analytical Sample
3/3/94 – Well Monument repaired. Casing not damaged.

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Concord, MA Pittsburgh, PA Fort Collins, CO Austin, TX Chapel Hill, NC
Seattle, WA Billings, MT St. Paul, MN Mandeville, LA Tucson, AZ

RETEC

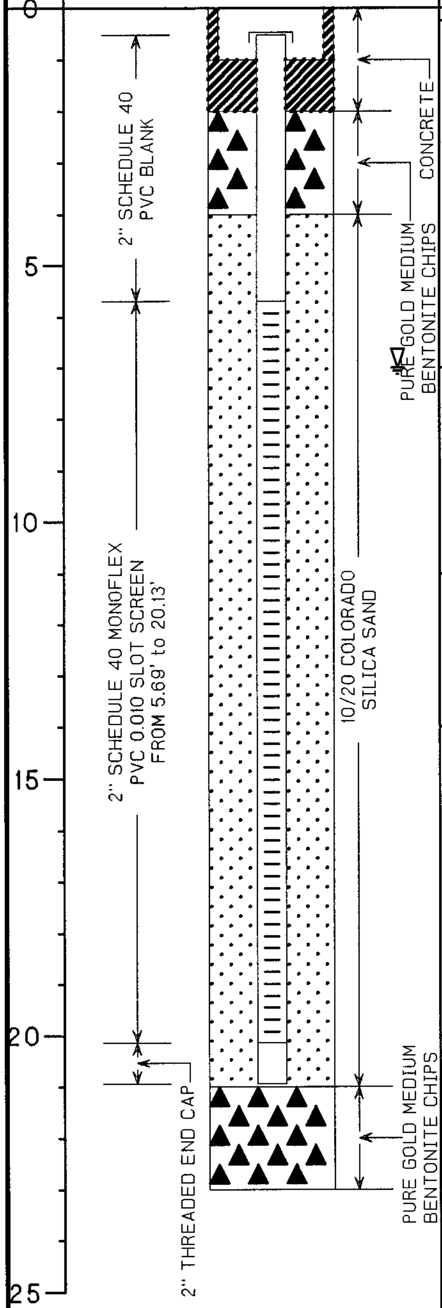
BORING/WELL INSTALLATION LOG

Monitoring Well MW-36

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: *3-1161 BN-Skykomish*		CLIENT: *Burlington Northern*
LOCATION: *River Drive East; Skykomish, WA*		DRILLING CO.: *Cascade Drilling*
START DATE: *10/21/93* TIME: *1430*	BORING ID: *9 3/4"*	DRILLER: *S. Butler/M. Sharp/J. Trover*
COMPLETION DATE: *10/21/93* TIME: *1730*	TOTAL DEPTH: *23 feet*	RIG TYPE: *Ingersoll-Rand T3W*
WATER LEVEL DURING DRILLING: *7'bgs*	PVC STICK-UP: *-0.51'*	METHOD: *Air Rotary*
SURFACE ELEV.: *928.90*	MP ELEV.: *928.39 TOC PVC*	LOGGED BY: *W. Beebe*

WELL CONSTRUCTION



SOIL DESCRIPTION / SAMPLE DATA

U.S.C.S.	SOIL DESCRIPTION	TYPE	BLOWS /ft	%RECOVERY	PID (ppm)
	ASPHALT:				
SW	GRAVELLY SAND: Brown; with minor debris (asphalt, glass); sub-angular gravel to 5"; fine to medium grained sand; loose to medium dense; damp	SS	18 35/5	33	0
	3' - becomes black				
	5' - becomes very dense				
	6' - becomes moist with oil	SS	4 7 10	44	3.7
SP	SAND: Brown; fine grained sand; medium dense; saturated	SS	6 4 5	67	0
SW	GRAVELLY SAND: Brown; saturated				
	13' - no further signs of contamination				
SP	SAND: Brown; with some silt, fine grained sand; saturated	S	5 15 20	83	0
SW	GRAVELLY SAND: Gray; very dense; saturated				
	Total depth = 23'				

REMARKS: SS = Split Spoon;
■ Analytical Sample

RETEC

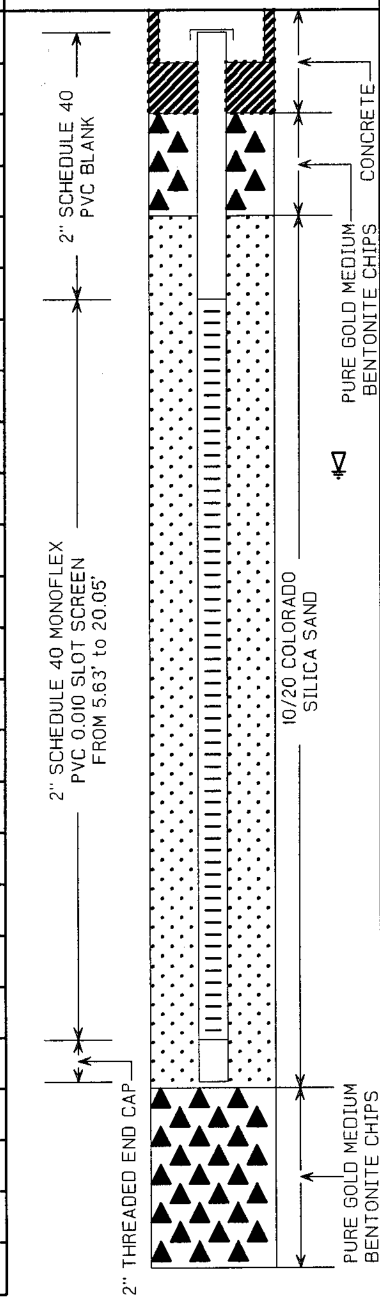
1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

BORING/WELL INSTALLATION LOG

Monitoring Well MW-37

PROJECT NO: *3-1161 BN-Skykomish*		CLIENT: *Burlington Northern*
LOCATION: *Railroad Avenue; Skykomish, WA*		DRILLING CO.: *Cascade Drilling*
START DATE: *10/22/93* TIME: *0800*	BORING ID: *9 3/4"*	DRILLER: *S. Butler/M. Sharp/J. Trover*
COMPLETION DATE: *10/22/93* TIME: *1300*	TOTAL DEPTH: *24.5 feet*	RIG TYPE: *Ingersoll-Rand T3W*
WATER LEVEL DURING DRILLING: *9'bgs*	PVC STICK-UP: *-0.39'*	METHOD: *Air Rotary*
SURFACE ELEV.: *932.71*	MP ELEV.: *932.32 TOC PVC*	LOGGED BY: *W. Beebe*

WELL CONSTRUCTION



SOIL DESCRIPTION

DEPTH (in feet)	U.S.C.S.	SOIL DESCRIPTION
0		ASPHALT OVERLAY:
	SW	ASPHALT BASE:
		GRAVELLY SAND: Black; medium grained gravel; medium grained sand; medium dense to dense; damp
5		5' – becomes brown
12.5		12.5' – oily luster; sheen in water
15		15' – strong hydrocarbon odor
17		17' – hydrocarbon odor; oily water; heavy sheen
20		20' – oily water
20	CL	SILTY CLAY: Gray; medium stiff; wet; no signs of contamination
24.5		Total depth = 24.5'

SAMPLE DATA

TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)
SS	~7.5–9'	2 14 25	33	0
SS	~12.5–14'	8 6 17	17	0
SS	~23–24.5'	3 4 5	67	0

REMARKS: SS = Split Spoon;
■ Analytical Sample

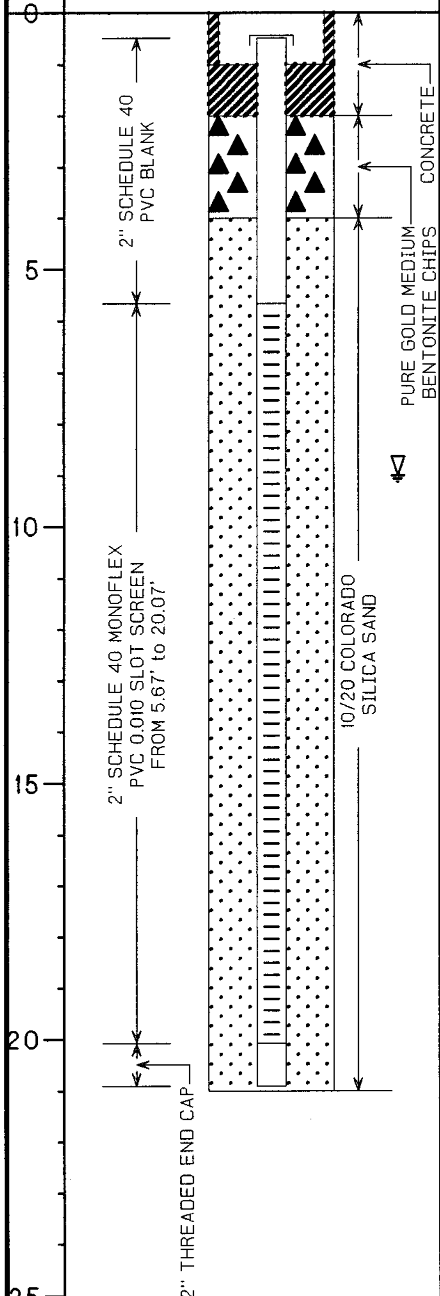
BORING/WELL INSTALLATION LOG
Monitoring Well MW-38

RETEC

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: *3-1161 BN-Skykomish*		CLIENT: *Burlington Northern*
LOCATION: *Railroad Avenue; Skykomish, WA*		DRILLING CO.: *Cascade Drilling*
START DATE: *10/23/93* TIME: *1800*	BORING ID: *9 3/4"*	DRILLER: *S. Butler/M. Sharp/J. Trover*
COMPLETION DATE: *10/24/93* TIME: *1025*	TOTAL DEPTH: *21 feet*	RIG TYPE: *Ingersoll-Rand T3W*
WATER LEVEL DURING DRILLING: *9'bgs*	PVC STICK-UP: *-0.52'*	METHOD: *Air Rotary*
SURFACE ELEV.: *923.08*	MP ELEV.: *922.56 TOC PVC*	LOGGED BY: *W. Beebe*

WELL CONSTRUCTION



SOIL DESCRIPTION / **SAMPLE DATA**

U.S.C.S.	LITHOLOGY	Description	TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)
SW		ASPHALT:					
		GRAVELLY SAND: Brown; with some silt; medium grained sand; dense; moist					
		5' – becomes minor silt					
			SS	■	5 12 21	33	0
		12' – becomes coarse grained sand; trace silt	SS	■	16 25 27	22	0
		Total depth = 21'					

REMARKS: SS = Split Spoon;
■ Analytical Sample

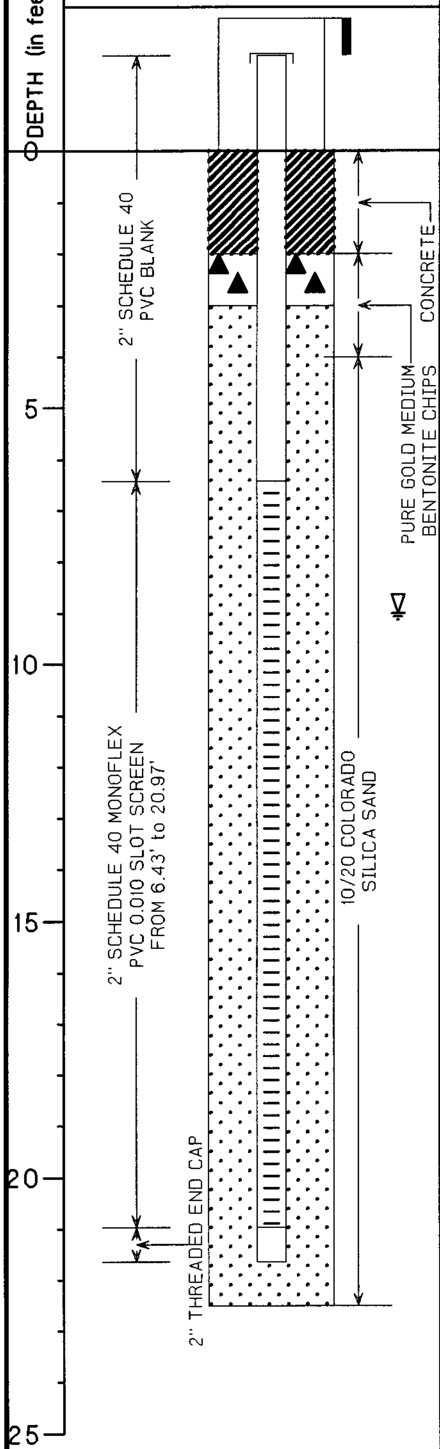
RETEC

BORING/WELL INSTALLATION LOG
Monitoring Well MW-39

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: 3-1161 BN-Skykomish		CLIENT: Burlington Northern
LOCATION: North of Old Cascade Highway @ Thelma St.; Skykomish, WA		DRILLING CO.: Cascade Drilling
START DATE: 10/19/93 TIME: 1130	BORING ID: 9 3/4"	DRILLER: S. Butler/M. Sharp/J. Trover
COMPLETION DATE: 10/19/93 TIME: 1500	TOTAL DEPTH: 22.5 feet	RIG TYPE: Ingersoll-Rand T3W
WATER LEVEL DURING DRILLING: 9'bgs	PVC STICK-UP: +3.01'	METHOD: Air Rotary
SURFACE ELEV.: 933.20	MP ELEV.: 936.21 TOC PVC	LOGGED BY: W. Beebe

WELL CONSTRUCTION



SOIL DESCRIPTION / SAMPLE DATA

U.S.C.S.	SOIL DESCRIPTION	TYPE	BLOWS /ft	%RECOVERY	PID (ppm)
SM	SILTY SAND: Brown; with some gravel; and minor organics (roots, wood); and minor debris (burnt wood chips, brick); loose to medium dense; damp to moist 3' - becomes damp				
SW	GRAVELLY SAND: Brown; coarse grained sand; loose; damp	SS	7 7 2	17	2.2
	9' - becomes saturated				
	10' - minor specks of oil; slight gasoline smell; slight oily luster	SS	2 4 6	44	3.2
	12.5' - out of contamination based on visual evidence				
	15' - becomes medium dense; no sheen or oil in SS sample	SS	6 8 18	44	3.2
	Total depth = 22.5'				

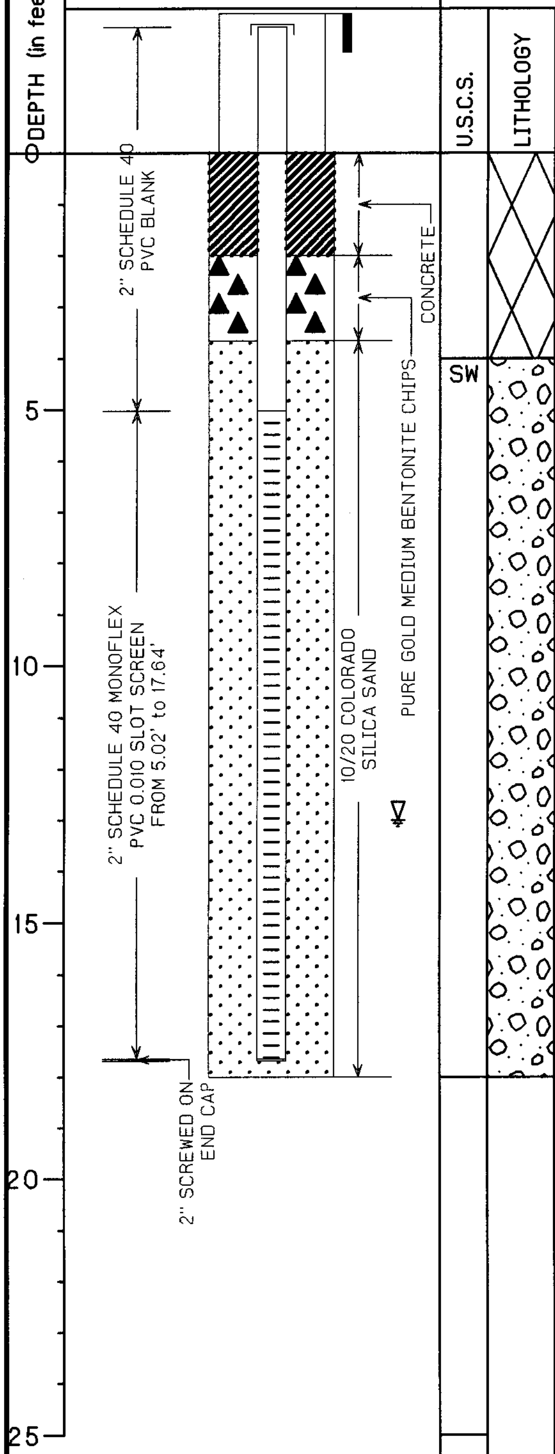
REMARKS: SS = Split Spoon;
■ Analytical Sample

BORING/WELL INSTALLATION LOG
Monitoring Well MW-40

RETEC
1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: *3-1161 BN-Skykomish*		CLIENT: *Burlington Northern*
LOCATION: *Railroad Avenue Skykomish, WA*		DRILLING CO.: *Cascade Drilling*
START DATE: *9/27/93* TIME: *1310*	BORING ID: *8"*	DRILLER: *R. Labrosse/B. Maloy/D. Miner*
COMPLETION DATE: *9/27/93* TIME: *1515*	TOTAL DEPTH: *18 feet*	RIG TYPE: *CME 75*
WATER LEVEL DURING DRILLING: *13'bgs*	PVC STICK-UP: *+3.02'*	METHOD: *HSA*
SURFACE ELEV.: *933.50*	MP ELEV.: *936.52 TOC PVC*	LOGGED BY: *W. Beebe*

DEPTH (in feet) — WELL CONSTRUCTION



SOIL DESCRIPTION

<u>TOPSOIL:</u> Brown; silty sand; with some gravel; with some organics; sub-angular gravel to 1"; medium grained sand; medium dense; damp

SW — <u>GRAVELLY SAND:</u> Brown; with trace silt; sub-angular to sub-rounded gravel to 2"; medium to coarse grained sand; dense; damp

13' - becomes saturated

Refusal at 18'

Backfilled with 8 bags sand; 3 bags chips; and 10 bags concrete

SAMPLE DATA

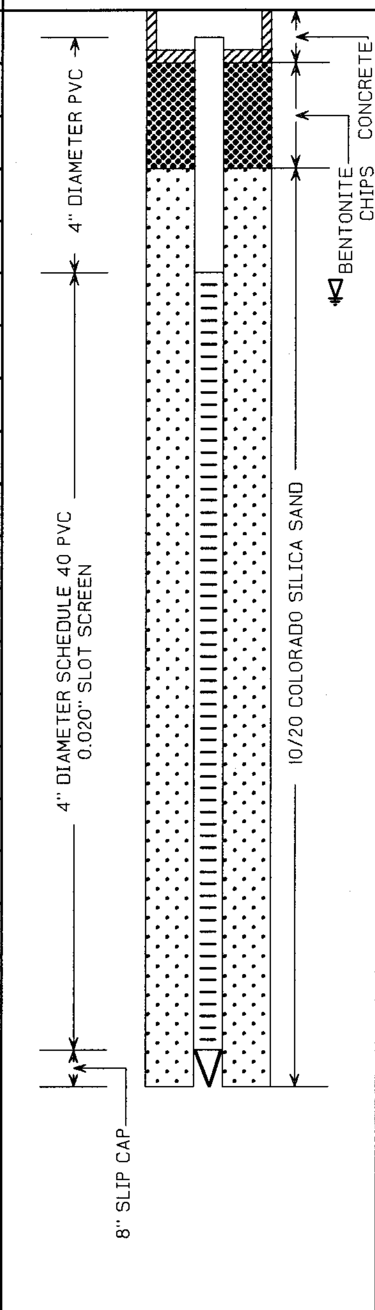
TYPE	BLOWS /ft	%RECOVERY	PID (ppm)
SS	43 23 30	28	0
SS	5 6 10	39	0
SS	13 15 24	33	0
SS	50/3	0	NR
SS	23 28 50/4	39	0
SS	24 50/6	33	0
SS	50/6	33	0
SS	50/4	39	0

REMARKS: SS = Split Spoon;
■ Analytical Sample

BORING/WELL INSTALLATION LOG
Monitoring Well MW-41

RETEC
1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: 3-1161-520 BNRR-Skykomish		CLIENT: Burlington Northern Railroad
LOCATION: Skykomish, Washington		DRILLING CO.: Cascade Drilling
START DATE: 10/26/95 TIME: 15:50	BORING ID: 10"	DRILLER: Bob Bishop
COMPLETION DATE: 10/26/95 TIME: 18:20	TOTAL DEPTH: 20.5 feet	RIG TYPE: IR TW3
WATER LEVEL DURING DRILLING: 5.5'bgs	PVC STICK-UP:	METHOD: Air Rotary
SURFACE ELEV.:	MP ELEV.:	LOGGED BY: S. S. Birch

DEPTH (in feet)	WELL CONSTRUCTION	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION	TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)
0		AC		ASPHALT					
		SP		SAND; Brown; fine to coarse; some silt and some cobbles					
5				5.5' - Odor; sheen					
				7' - Product					
10									
15									
20									
				Total Depth = 20.5 feet					
25									

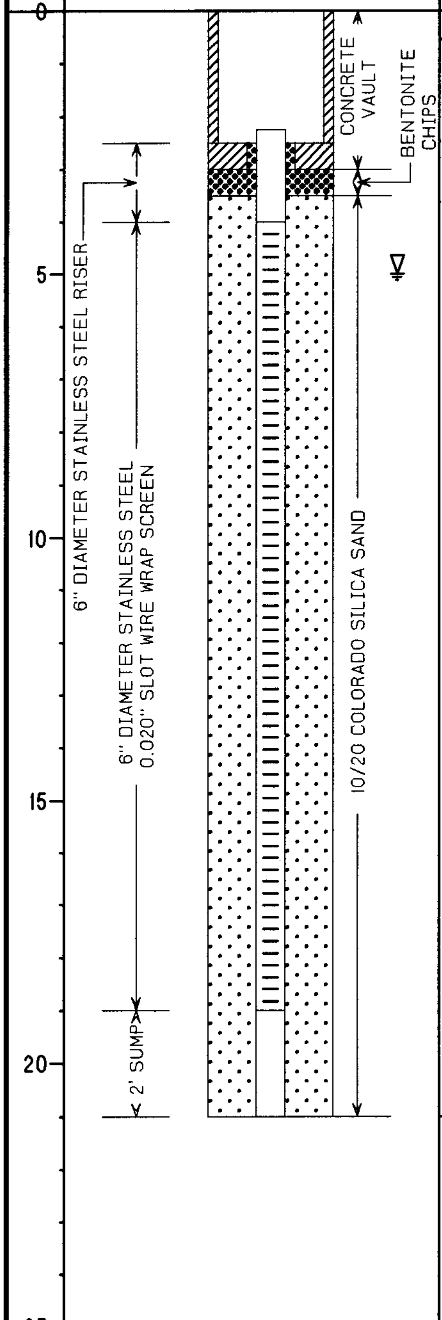
REMARKS:

BORING/WELL INSTALLATION LOG
Recovery Well R-1

RETEC
1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: 3-1161-520 BNRR-Skykomish		CLIENT: Burlington Northern Railroad
LOCATION: Skykomish, Washington		DRILLING CO.: Cascade Drilling
START DATE: 10/27/95 TIME: 11:10	BORING ID: 10"	DRILLER: Bob Bishop
COMPLETION DATE: 10/27/95 TIME: 12:50	TOTAL DEPTH: 21 feet	RIG TYPE: 1R TW3
WATER LEVEL DURING DRILLING: 5'bgs	PVC STICK-UP:	METHOD: Air Rotary
SURFACE ELEV.:	MP ELEV.:	LOGGED BY: S. S. Birch

DEPTH (in feet)	WELL CONSTRUCTION	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION	TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)
0		AC		ASPHALT					
		SP SM		SAND & SILT; Light brown; medium; some cobbles; slightly moist; no evidence of contamination					
5				5' – Sheen; odor					
				6.5' – Product encountered					
				13' – Producing more water than other recovery well locations					
15				15' – Water color changed from light brown to orange; little silt with medium to coarse sand; no evidence of contamination; color change due to iron?					
				18.5' – Water color back to light brown					



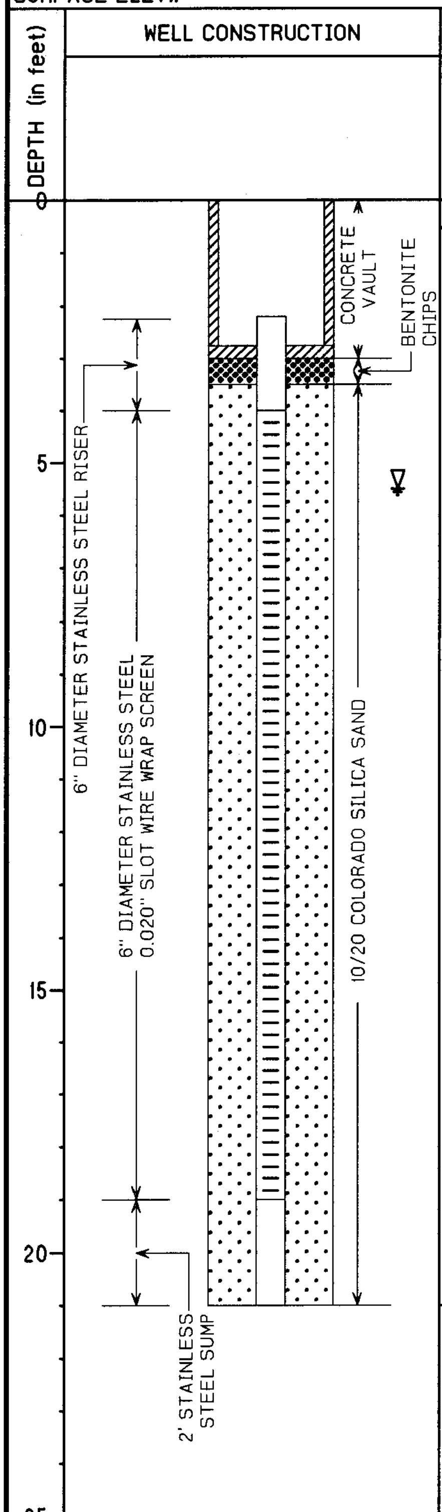
REMARKS:

REMEDIATION TECHNOLOGIES, INC.
OFFICES NATIONWIDE

RETEC
1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

BORING/WELL INSTALLATION LOG
Recovery Well R-2

PROJECT NO: 3-1161-520 BNRR-Skykomish		CLIENT: Burlington Northern Railroad
LOCATION: Skykomish, Washington		DRILLING CO.: Cascade Drilling
START DATE: 10/26/95 TIME: 13:50	BORING ID: 10"	DRILLER: Bob Bishop
COMPLETION DATE: 10/26/95 TIME: 15:30	TOTAL DEPTH: 21 feet	RIG TYPE: 1R TW3
WATER LEVEL DURING DRILLING: 5.5'bgs	PVC STICK-UP:	METHOD: Air Rotary
SURFACE ELEV.:	MP ELEV.:	LOGGED BY: S. S. Birch



SOIL DESCRIPTION

U.S.C.S.	LITHOLOGY	Description
AC		ASPHALT
SP		SAND: Brown; fine to coarse; some silt and cobbles 5.5' – Odor; sheen 7' – Evidence of product

SAMPLE DATA

TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)

REMARKS:

REMEDIATION TECHNOLOGIES, INC.
OFFICES NATIONWIDE

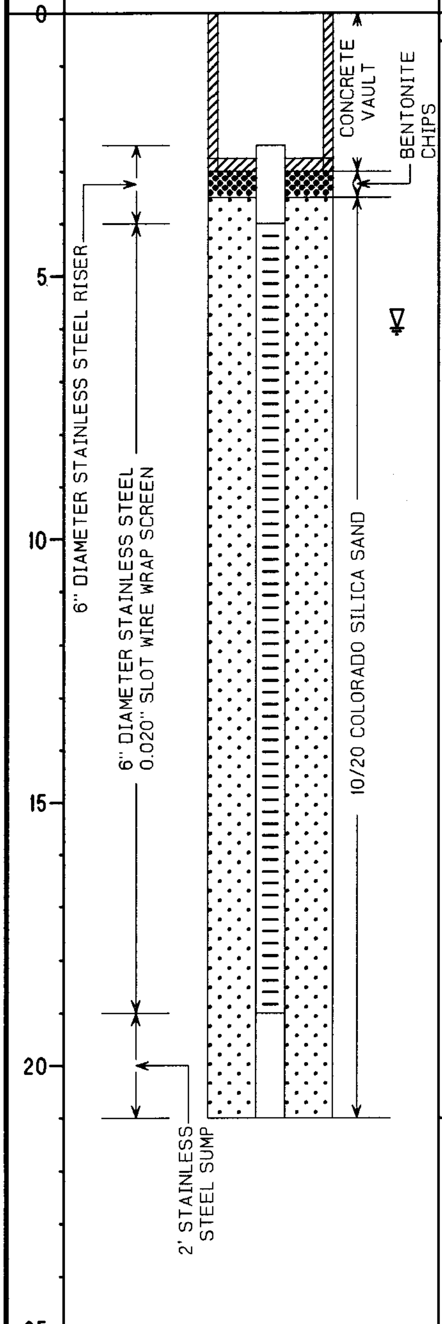
RETEC

BORING/WELL INSTALLATION LOG
Recovery Well R-3

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: *3-1161-520 BNRR-Skykomish*		CLIENT: *Burlington Northern Railroad*
LOCATION: *Skykomish, Washington*		DRILLING CO.: *Cascade Drilling*
START DATE: *10/27/95* TIME: *09:00*	BORING ID: *10"*	DRILLER: *Bob Bishop*
COMPLETION DATE: *10/27/95* TIME: *10:30*	TOTAL DEPTH: *21 feet*	RIG TYPE: *1R TW3*
WATER LEVEL DURING DRILLING: *6'bgs*	PVC STICK-UP:	METHOD: *Air Rotary*
SURFACE ELEV.:	MP ELEV.:	LOGGED BY: *S. S. Birch*

WELL CONSTRUCTION



SOIL DESCRIPTION

U.S.C.S.	LITHOLOGY	DESCRIPTION	TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)
AC		ASPHALT					
SP		SAND WITH SILT; Light brown; medium; some silt and some cobbles; no evidence of contamination					
		6' – Sheen; odor					
		7' – Heavy sheen; some product (R-2 appeared to produce more product)					
		Decrease in silt; increase in sand					

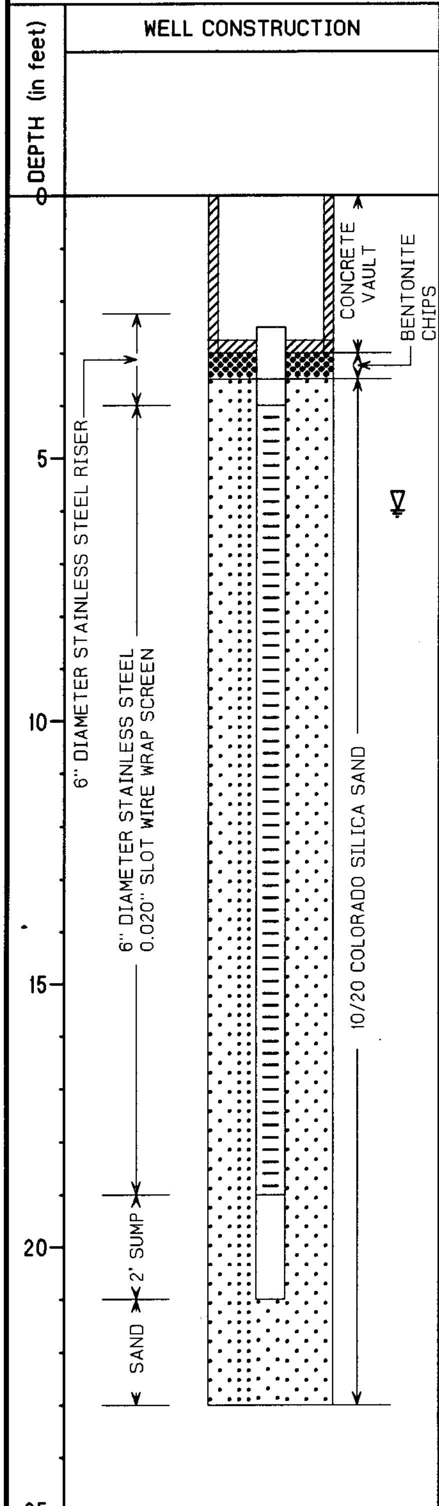
REMARKS:

BORING/WELL INSTALLATION LOG

Recovery Well R-4

RETEC
1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: 3-1161-520 BNRR-Skykomish		CLIENT: Burlington Northern Railroad
LOCATION: Skykomish, Washington		DRILLING CO.: Cascade Drilling
START DATE: 10/26/95 TIME: 09:00	BORING ID: 10"	DRILLER: Bob Bishop
COMPLETION DATE: 10/26/95 TIME: 11:30	TOTAL DEPTH: 23 feet	RIG TYPE: 1R TW3
WATER LEVEL DURING DRILLING: 6'bgs	PVC STICK-UP:	METHOD: Air Rotary
SURFACE ELEV.:	MP ELEV.:	LOGGED BY: S. S. Birch



U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION	TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)
AC		ASPHALT					
SP		SAND; Light brown; fine to coarse sand, some silts 6' – Evidence of petroleum and odor 7' – Occasional cobble and gravels					

REMARKS:

RETEC

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

BORING LOG

SO-1

PROJECT NO: *3-1161-520 BNRR-Skykomish*		CLIENT: *Burlington Northern Railroad*
LOCATION: *Skykomish, Washington; Approximately 50' west of R-1*		DRILLING CO.: *Cascade Drilling*
START DATE: *10/27/95* TIME: *14:30*	BORING ID: *10"*	DRILLER: *Bob Bishop*
COMPLETION DATE: *10/27/95* TIME: *15:30*	BORING DEPTH: *12'*	RIG TYPE: *IR TW3*
WATER LEVEL DURING DRILLING: *5'*	*SURFACE ELEV.: ' (MSL)*	METHOD: *Air Rotary*
DATE MEASURED: *10/27/95*	M. P. ELEVATION:	LOGGED BY: *S. S. Birch*

DEPTH (in feet)	SAMPLE DATA: TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION
0						SM		SILTY SAND; Dark brown; trace gravels
						GW		GRAVELLY SAND; Light brown; some cobbles
5	G				0	∇		5' – Staining; product
10								
15								

REMARKS: Collected grab sample from cyclone because of cobbles.

RETEC

BORING LOG
SO-2

1011 SW Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PROJECT NO: 3-1161-520 BNRR-Skykomish		CLIENT: Burlington Northern Railroad
LOCATION: Skykomish, Washington; Approximately 110' west of R-1		DRILLING CO.: Cascade Drilling
START DATE: 10/27/95 TIME: 15:50	BORING ID: 10"	DRILLER: Bob Bishop
COMPLETION DATE: 10/27/95 TIME: 16:10	BORING DEPTH: 8'	RIG TYPE: 1R TW3
WATER LEVEL DURING DRILLING: 4.5'	SURFACE ELEV.: ' (MSL)	METHOD: Air Rotary
DATE MEASURED: 10/27/95	M. P. ELEVATION:	LOGGED BY: S. S. Birch

DEPTH (in feet)	SAMPLE DATA: TYPE	DEPTH	BLOWS /ft	%RECOVERY	PID (ppm)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION
0						SM		SILTY SAND; Dark brown; trace gravels
						GW		GRAVELLY SAND; Light brown; some silt; no odor or contaminants
5								5' – Slight Sheen
								6' – Stained soils; product observed on split spoon rod
	SS			50	3			SANDY GRAVELS; Light brown; rounded; fine to coarse sand
10								

REMARKS:

REMEDIATION TECHNOLOGIES, INC.
OFFICES NATIONWIDE

SURFACE SAMPLE

SS 28 - 1528 PID - NRB

Dark brown to black silty sand w/ S. gravel, gravel 2", sub & to sub rnd, med - fine grd sand, damp [BG - 2.0, Read - 2.0 MD, ~~mac~~ trace debris (glass, slag) (SM)

1540 - Air Monitor - BG = 2, Read = 2

BGAZ

9/30/93

Barrel Count

Soil		Water	
B-11	9/27	DW-1	9/28
DW-1	9/28		9/27
DW-2/MW-40	9/27		9/29
MW-33	9/28	DW-3/B-10	9/29
DW-3	9/29		
MW-35	9/28		
B-10	9/29		

1 unlabeled.

0910 Calibrate PID - calibrate @ 99 ppm

SS-30 PID = ∅ 0912

Edge of shrubs - scotch broom,

brown sand w/ trace gravel, angular to sub & gravel to 1/2", med. grd sand, w/ trace organics (rootlets), L-MD, damp. (SP)

BG-2 0935 PID = ϕ

BG Air Mon = ϕ

- Topsoil, dark brown silty sand w/some organics (rootlets, wood, burnt wood), and minor gravel. Gravel sub-rnd, to 1", med grnd sand, L-MD, damp.
- In woods - Maple, Cedar forest, minor underbrush of ferns, vine maple, Salmon berry, cascara, many branches on ground, forest litter = leaves, moss, humus.
- E end of city on Old Cascade Hwy

SS-32

- East of RR turnaround
- Edge of tracks - adjacent to shrubs - alder

0953 PID = ϕ Air Mon = ϕ

0-2" dark brown to black, gravel, ∓, to 1¼" (1¼" - crushed rock), dry (GP)

2"-6", Gravelly sand, lt brown to brown, gravel sub ∓ to sub rnd, to 2", med grd sand, L-MD, damp. (SW)

SS-31

inside RR turnaround, clover-grass field, lawn on other side of tracks

1009 PID = ϕ Air Mon = ϕ

0-6" Gravelly sand, brown, w/ minor silt, ∓ to sub ∓ to sub rnd gravel to 4", med grnd sand, MD, damp (pit run ?+ crushed gravel ?) - (SW)

6-7" Sand, darkish reddish brown, med grnd, (SP) MD, damp

1026 - Replace decon water

SS-29
middle of gravel road.
1042 PID = ϕ AM = ϕ
~~B~~ Gray to black silty
sand w/s. gravel (SM)
ʃ to sub ʃ to sub- rnd gravel -
some fracture faces, med
grd sand, VD, dry, to
damp - (crushed pit run)
shovel + digging bar
dup ~~labelled~~ SS92-0 @ 1024

Surface Sampling Procedures
[Decon shovel w/ TSP wash + DI rinse
└ describe surroundings
lay out plastic near sample site, dig w/ shovel
+ place soil on plastic - dig to 6", check PID
BG + soil + hole. Fill sample jars w/ sample
using gloved hand, label jars. Write
soil descriptions. Replace soil,
discard plastic + gloves.

SS27 1102 PID=ϕ AM=0
Disturbed ground
gray ~~gravelly~~ silty sand, w/s. gravel,
sub & gravel to 2", med grd
sand, MD, dry

SS-13
disturbed ground, some
grasses (clover)
1127 PID = ϕ AM = ϕ
Brown-gray gravelly sand,
gravel sub ʃ to sub rnd,
to 4" ϕ, med grd sand (SW)
MD-D, damp w/ tr.
debris (glass, plastic),
w/ tr. organics (roots)

Get more rinse water -
distilled water @ Mountain View
Store in Basin

1250 Replace Decon water

SS 14 gravel road between tracks
1302 PID = ∅ AM = ∅
used digging bar
Gray-brown gravelly sand w/ minor silt, ∡ to sub ∡ to rounded gravel to 4", med grd sand, VD, damp.
(crushed pit run)
duplicate SS41-0 @ 1320

SS 15 - gravel road between ~~RR~~ tracks
1322 PID = ∅ AM = ∅
digging bar
Gray brown gravelly sand w/ minor silt, ∡ to sub ∡ to sub-rnd gravel to 3", med grd sand, VD, damp
(crushed pit run)

SS 16 - has been moved to w/i 3' of tracks - move back to ½ way between tracks.
Gravelled area between tracks - minor grass, ~~[illegible]~~, plantain.
1342 PID = ∅ AM = ∅
Dark brown to black silty sand w/ S gravel, gravel sub ∡ to 2", med grd sand, VD, dry (SM)
used digging bar
- w/ m. organics (roots)

SS 18 in low area adjacent to roadway - dried pond - receive run off from roadway,
1402 PID = ∅ AM = ∅
brown silty sand w/ S g, gravel ∡ to sub ∡ to sub-rnd, to 1", med grd sand, D, damp. Fine layer of dried silt on surface.
(crushed pit run)

SS 17 - Masonic Temple Prop.
in thick ground cover of
clover, buttercup, grasses
~25' from Edge of Road
1433 PID = φ, AM = φ
Topsoil; dark brown to black
~~Sandy~~ organic sand w/
Some silt & minor gravel,
gravel sub ∡ to 1", med
sand, organics (humus,
roots), ∠, damp to moist

SS 19 - in storage area -
between track hardware &
gear boxes? appears to be
leakage from boxes onto
ground.
1451 Brown gray sandy
gravel w/ some silt (GM)
gravel sub ∡ to sub rnd
to 1½", med grnd sand,
UD (used digger, bar),
damp

PLD = φ AM = φ

~18 gear boxes (2' □ x 3' high)
Set on supported concrete
pad (~10' x 20')
outside of boxes looks
oil stained, but (at least)
one has leaked and left
oil stained area on ground
(~6' x 2') grabbed sample
SS 19.1 from oil stained
area. - 19.1 is ~7½' E of 19
SS19.1 @ 1506 PID = φ AM = φ
Dark brown to black
Sandy gravel, w/ m. silt,
gravel sub ∡ to sub rnd,
to 3", med grnd sand,
damp to moist with oil,
MD - D,

Went to Boeing for more distilled water
SS 21 - Storage area - in front of
rail storage.
- decon shovel & bar, replace decon water
Decon shovel & bar again.

SS21 1624 PID=ϕ, AM=ϕ
~~Dark~~ In Black Gravelly sand with ~~some~~ silt, gravels sub ∡, to 2", med. sand, MD, smells of oil, damp. or creosote? (SW)

SS22 in road bed area - at end of depot - in dry mud puddle.
1645 Gray ~~sand~~ gravelly sand w/ some silt, (SW) gravel sub ∡ to sub rnd to 2", med sand, dry to damp, VD (used digging bar), (crushed pit run).

SS23 at edge of gravelled area & edge of alder woods - in side cast fill. - grassy
1705 PID=0, AM=ϕ
- in shade of woods,

Topsoil, dark brown to black silty sand w/ some organics and minor gravel, gravel sub ∡ to sub rnd, to 2", med grnd sand, organics (humus, roots), moist, L-MD.

SS24 - gravelled parking lot in front of private residence & Lake City Elk's Ski School, minor moss & plantain on surface
1721 PID=ϕ AM=0
Gravelly sand w/ some silt, brown-gray, gravel - 5/8" crushed med. sand, MD, damp

10/1/93

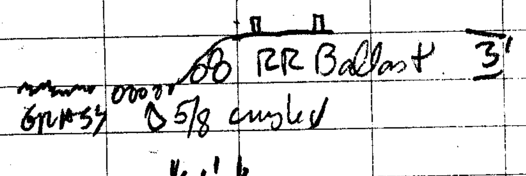
PAEA #36 - Fed Ex

7-11:00 - Package up 3 coolers of samples, phone calls to office, ACZ labs, AABCO
- Replace deion water

BG1 - 2d growth forest -
trees - alder & maple
Shrubs - salmonberry, cascara, thimbleberry,
herbaceous ground cover - bleeding heart,
duff - leaves, humus
1136 PID = Ø AM = Ø
0-2" Topsoil, sandy organics, roots, duff, humus, L, moist w/ [illegible] debris (pipe, RR spikes, bolts,)
2-6" Sandy Gravel, brown gray, gravel sub Ø to 10", med-coarse sand, D-VD, damp - w/ m. organics (roots)

SS 20 – near edge of roadway – in "parking strip" PID=Ø, AM=Ø
1158 Gray gravelly sand w/ minor silt, gravel & to sub-& to sub- and to 2", UD (used digging bar), dry to damp (crushed pit run) (SW)

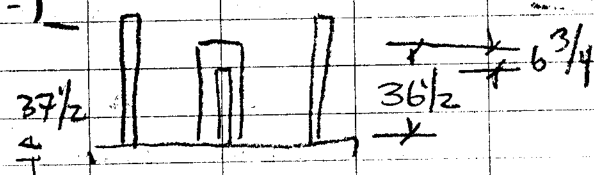
SS 26
~~1219~~ – at edge of RR tracks – in 5/8" crushed rocks at edge of RR ballast
1219 PID=Ø AM=Ø



brown sandy gravel gravel to 5/8", crushed, med-coarse sand, D-VD, damp
(5/8" – crushed)

SS 25 – ~ 1' beyond 5/8" – crushed ~~sam~~ described in SS26, in grass w/ clover, plantain, blackberry vines
1235 Dark brown to black silty sand w/ s. gravel, & ~~trace~~ organics (roots)
contains 5-10% white specks in silt size (tailings, slag??)
organic smell, MD
damp.

DW-1

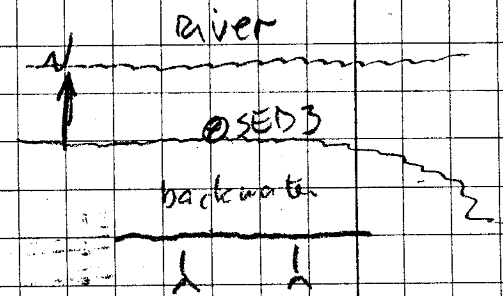


SED-1 - move 10 upstream due to proximity to outfall.
15' from bank - closer to bank is grasses and some moss on rocks. SED-1 is at edge of grass/moss area & edge of bare gravel.
1112 PID ∅ AM = ∅
Gray brown sandy gravel - coarse grd sand sub & gravel, D, wet. to > 6"
~15' from river

SED-2 - from bank out 5' - area appears stained brown-reddish brown - source of staining uncertain. Sample ~ 3' out from bank. Stained area ~ 40' x 10'

slight HC odor in area, although AM = ∅
1146 PID = ∅, AM = ∅
Brown sandy gravel, coarse sand, sub & gravel to > 6" wet, D,
First hit GW @ -1". GW seeps up to -6". GW is lt brown in color, no sheen or product.
Minor leaf litter on top of gravel.

SED-3 - water from bank out to ~50'. Sed sample just beyond back water. 30' to river on other side. Back water has sheen.



1210 PID = ∅ AM = ∅
Brown gravelly sand.
GW @ -2" = med brown,
no sheen or product.
Dup of SED 3 labeled
SED 10 @ 1201

SED 4 — 5' out from bank
in river — up against bank
have ~1' x 1' pool of product.
SED 4 is ~ 3' away
1250 PID$_{max}$ = 6 AM 0.5
Product (thin layer) on
water surface - GW @
-6". Oil stained seds.
Wash shovel — Replace Decon
water - wash shovel again

SED-5 - narrow 2' wide
beach next to river. Minor
sheen in water, lots of
leaf litter.

1325 PID$_{max}$ = 9 AM = 10
Thin layer of product in
WT at SED 5. GW @ -2".
Appears to be less product
than SED 4.

SED-6 Backyard - in swale.
Collects runoff from back yard.
1405 PID = 0 AM = 0
Brown sandy silt w/ s
gravel & minor organics
(roots). moist to wet,
L-MD.
- many fine roots.

SED 7 - in Ravine ~ 10' deep.
Shrubs of devils club &
Cascara
1425 PID = ∅ AM = ∅
organic silt, Brown,
roots, ~~organ~~ humus,
moist, L-MD

Replace Decon water

HA-2 Charlie Brown
lawn adjacent to
Pub ~60' W of sidewalk,
~8' S. of R.

Cut out plug of grass

0-2" Topsoil, dark brown organic
silt w/ tr. gravel, grass roots,
moist
2"-5" Gravelly sand, brown,
w/ m. silt, gravel to 3/8", moist SW
5"-8" Sand, gray med-
coarse grnd. (SP)
8"-16" (SM) silty sand
dark brn to black w/ white
specks, w/ tr. debris (brick
fragments) damp (glass)
16" - Refusal

HA2-1
Sample 12-16" @ 1505
PID = Ø AM = Ø

HA-1 ~80' from sidewalk,
~20' to R w/ P.O.
~30' N. of S. R.
HA1-2
1540 PID = Ø AM = Ø
0-12" Topsoil, dark
brown sandy silt
w/ m. organics + m. gravel,
L-MD, damp
12"-28" Sand w/ s. gravel
(SW), gravel to 1", med-
coarse grnd sand,
MD, damp
w/ tr. debris (pottery?)
(ceramics?)
Dup = HA-10 @ 1504
28" Refusal - due to caving
HA-4 - 11' N. of tennis courts
HA4-0
17' W of R fence
1615 PID = Ø AM = Ø
0-10" Topsoil, dark
brown silt w/ some
sand + m. gravel +
m. organics (roots),
MD, damp (ML)

10-12" - Gravelly sand (~~[illegible]~~ gravel sub + to 2", coarse sand, damp, D

12" - Refusal

HA 3

10' S of R,
20' W of R,

1645 HA-3-1 PID ∅ AM=∅

0-9" Topsoil, sandy silt w/ m. gravel & m. organics, dark brown to black, w/ roots, MD, damp

9-12" Gravelly sand, lt. brown, silt & gravel to 3", med grd sand (SW), MD-D, damp

12" - Refusal due to cobbles,

B-10B

10/18/93 mBarbo

0830 - Meet Cascade & Shelly @ site, review HASP, Bogin @ B-10B

Ingersoll-Rand Drillmaster T3W Air Rotary

1005 Bogin drilling

0-5' Black silty sand, w/ m. organics (wood), gravel to 1", w/s. gravel, damp

5' 1"R PID=∅ 1018

Dk. brown to black silty sand, w/ m. org & s. gravel, damp,

7' - PID = 1
moist w/ oil sl odor

10' - wet w/ oil
PID = 6

APPENDIX D

SOIL AND SEDIMENTS ANALYTICAL RESULTS

RETEC

1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349
FAX (206) 624-2839

DATA VALIDATION REPORT

TO: Shelly Birch
FROM: Kim Lofgren
DATE: March 2, 1994
RE: Review of Analytical Data

1.0 GENERAL

PROJECT:	BNRR Skykomish #3-1161-340
DATE SAMPLED:	09/27-10/29/1993
RECEIVING LAB	ACZ Laboratories, Inc.
ANALYTICAL METHODS:	Volatile Organic Compounds: SW846-8240 Semivolatile Organic Compounds: SW846-8270 Polychlorinated Biphenyl Compounds: SW846-8080 Washington Total Petroleum Hydrocarbons: SW846-8015 (Extended) Washington Total Petroleum Hydrocarbons: EPA 418.1 (Modified) Total Metals: SW846-6010, 7060, 7470 or 7421
NUMBER OF SAMPLES:	130
MATRIX:	soil
DATE(S) EXTRACTED:	all samples were extracted within the holding time limits unless otherwise stated
DATE(S) ANALYZED:	all samples were analyzed within the holding time limits

- Data validation summary tables are given as Attachment 1.
- Laboratory results with qualifiers are given as Attachment 2.
- All the samples and all of the Quality Assurance/Quality Control (QA/QC) in this data set have been reviewed with respect to holding times, method blanks, surrogate recoveries, matrix spikes, sample results, and any other QC measures (lab blank spikes, field duplicates, etc.).

2.0 VALIDITY AND COMMENTS

This section summarizes only those instances where acceptance criteria were not met or a discussion of the data were warranted.

2.1 GENERAL COMMENTS

The objectives of this review were to determine the quality of the analytical data by examining the level of precision, accuracy and completeness. Precision is a measure of the mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is determined through analysis of duplicate samples. Completeness is a determined by assessing the number of samples where valid results are reported versus the number of samples which were submitted to the laboratory for analysis. The accuracy of data is the degree of agreement of a measurement with an accepted reference or true value. The level of accuracy is determined by examination of laboratory matrix spike analyses. The overall measure of completeness will be the ratio of valid analyses received compared to the expected amount of data to be obtained under correct or normal conditions.

Quality Assurance/Quality Control (QA/QC) for this project included specific criteria by which precision, accuracy, and completeness were evaluated. Precision is measured through the evaluation of field QA/QC including duplicate analysis and analysis of field and trip blanks. Evaluation of duplicate samples for precision was done using the relative percent difference (RPD). RPD is defined as the difference between two duplicate samples divided by the mean and expressed as a percent. The criteria for acceptable RPD is 0-50% for field samples and 0-20% for laboratory samples.

Laboratory QC, which evaluates accuracy, involves using a method blank (reagent blank) for approximately 20 actual samples, a matrix spike/matrix spike duplicate (MS/MSD) for approximately one out of every 20 samples, and analysis of surrogate standards for organic analyses. Method blanks are analyzed to identify compounds which are introduced during the laboratory extraction or analysis phase (i.e. laboratory contaminants). MS/MSD percent recoveries and relative percent differences (RPD) reported are compared to published QC limits. Surrogates are compounds that are "like" the compounds requested for analysis, but not structurally the same. They are analyzed to demonstrate that structurally similar compounds can be recovered and quantified by the lab. The completeness goal is set at 90%. The laboratory data showing the raw analytical data, the sample data results and all QA/QC backup data are found in Attachment 2.

All appropriate data were found in the raw data, the forms provided, or the narrative part of the report from ACZ Laboratories. The amount extracted, dilution factor and amount analyzed were included for all of the samples in this data set. Table 1-1 provides a summary of the soil data. Parameters identified in the QA/QC review as outside the control limits are shaded. Not all soil samples were analyzed for each parameter, refer to Table 1-1 for exact analyses of each sample.

2.2 HOLDING TIMES

The times and dates for sampling were taken from RETEC's Chain of Custody (COC). The dates for extraction and analyses were taken from the ACZ organic analysis data sheets.

For the purpose of this review, the holding times stated in SW-846 were used to qualify data. All samples met the holding time requirements for the preparation type requirements unless otherwise stated in the appropriate analysis section of the report.

2.3 VOLATILE ORGANIC COMPOUNDS - ANALYSIS OF SOIL

Thirty soil samples were reviewed for volatile organic compounds (VOC) validity in this data set.

2.3.1 Method Blanks

Method Blanks - Sixteen method blanks were extracted and analyzed with the VOC samples. Methylene chloride and acetone were detected in several of the method blanks. Methylene chloride and acetone are common laboratory contaminants. All positive results for methylene chloride, acetone and chloroform have been qualified with a "U" value, based on the 10X rule for blank contamination (EPA 1988).

2.3.2 Surrogate Recovery

Percent surrogate Recoveries (%R) for dibromofluoromethane, toluene-d8 and bromofluorobenzene were summarized on the Quality Control Data Summary forms. Samples B9-7 1/2, MW39-6, SED-7, HA4-0, B40-10, B40-10MS, B40-10MSD, MW39-6MS and MW39-6MSD had one surrogate recovery above the maximum allowable control limit of 115% for bromofluorobenzene. Samples MW36-6, MW37-7 1/2, B4-10, HA2-1, SED-6 and B4-10MS had two of the three surrogate recoveries above maximum control limits of 155% for dibromofluoromethane, 110% for toluene-d8 and 115% for bromofluorobenzene. Samples MW33-5, HA3-1 and B4-10MSD had all three surrogate recoveries above the maximum allowable control limits of 155% for dibromofluoromethane, 110% for toluene-d8 and 115% for bromofluorobenzene. All positive results for these samples have been qualified weigh a "J" qualifier (the associated numerical value is an estimate quantity), and all non positive results have been qualified with a "UJ" qualifier (the material was analyzed for, but was not detected, and the sample quantitation limit is an estimated quantity), based on high surrogate recoveries.

2.3.3 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Eleven MS/MSD summary reports were submitted with this data set. All MS/MSD recoveries and RPD values were within control limits.

2.3.4 Field and Laboratory Duplicates

Four field duplicates were included in this data set; however, were not labelled as such by RETEC personnel. Sample B40-10 is a field duplicate of B4-10, MW53-7.5 is a field duplicate of MW35-7.5, SED-10 is a field duplicate of SED-3 and HA10-2 is a field duplicate of HA1-2. Table 2-1 summarizes the RPD for these samples and their corresponding duplicates. The RPD values for all the analytes were not calculated because all analytes were below the method detection limit, indicating field sampling techniques are acceptable. No qualifiers were given to the data based on the field duplicates.

Laboratory duplicates were not included in this sample set.

2.3.5 Overall Assessment of Data

The quantity of soil extracted, the amounts analyzed and the dilution factors were included in this data set for all of the samples. All compounds were reviewed based on the surrogate recoveries, the MS/MSD recoveries, the detection limits, the field duplicates and the method blanks. All data were found to be accurate based on the information given.

Field accuracy and precision have been determined acceptable based on the field duplicates. Completeness goal of 90% was achieved for environmental samples and field QA/QC.

Laboratory accuracy and precision have been determined acceptable based on the method blanks, MS/MSD spike recoveries, and the MS/MSD RPD values. Completeness goal of 90% was achieved for laboratory QA/QC.

2.4 SEMIVOLATILE ORGANIC COMPOUNDS - ANALYSIS OF SOIL

Twenty-two soil samples were reviewed for semivolatile organic compound (SVOC) validity in this data set. Sample HA10-2 was extracted 14 days past the recommended holding time of 14 days for SVOC analysis. The results have been qualified with "R" qualifiers (the data are unusable).

2.4.1 Method Blanks

Method Blanks - Seven method blanks were extracted and analyzed with the SVOC samples. No target analytes were detected in the method blank.

2.4.2 Surrogate Recovery

Percent surrogate recoveries (%R) for nitrobenzene-d5, 2-fluorobiphenyl, p-terphenyl-d14, phenol-d5, 2-fluorophenol and 2,4,6-tribromophenol were reported with the Quality Control Data Summary forms. All six surrogate recoveries for sample SED-3 were not recovered. The sample was re-extracted outside the recommended holding time and the results have been qualified with "R" qualifiers. All six surrogate recoveries for sample B4-10 diluted out upon re-analysis. All positive results have been qualified with "J" qualifiers (the numerical value is an estimated quantity), and non positive results have been qualified with "UJ" qualifiers (the sample quantitation limit is an estimated quantity). All other surrogate recoveries were within control limits.

2.4.3 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Six MS/MSD summary reports were submitted with this data set. All MS/MSD recoveries were within control limits. Ten RPD values exceeded acceptable control limits of 20% for laboratory samples.

2.4.4 Field and Laboratory Duplicates

Two field duplicates were included in this data set; however, were not labelled as such by RETEC personnel. Sample HA10-2 is a field duplicate of HA1-2 and SED-10 is a field duplicate of SED-3. Results for samples HA10-2 have been qualified unusable due to holding time violation, and results for SED-3 have been qualified as unusable due to poor surrogate recoveries. Table 2-2 summarizes the Relative Percent Difference (RPD) for these samples and the corresponding duplicates. No analytes were detected in the samples or the corresponding duplicates, indicating field sampling techniques to be acceptable.

Laboratory duplicates were not included in this sample set.

2.4.5 Overall Assessment of Data

The quantity of soil extracted, the amounts analyzed and the dilution factors were included in this data set for all of the samples. All compounds were reviewed based on the surrogate recoveries, the MS/MSD recoveries, the detection limits, the field duplicates, the and the method blanks. All data were found to be accurate based on the information given.

Field accuracy and precision have been determined acceptable based on the field duplicates. A completeness goal of 90% was achieved for environmental samples and field QA/QC.

Laboratory accuracy and precision have been determined acceptable based on the method blanks, MS/MSD spike recoveries and the surrogate recoveries. A completeness goal of 90% was achieved for laboratory QA/QC.

2.5 POLYCHLORINATED BIPHENYLS - ANALYSIS OF SOIL

Forty-seven soil samples were reviewed for polychlorinated biphenyl (PCB) compounds validity in this data set.

2.5.1 Method Blanks

Method Blanks - Nine method blanks were extracted and analyzed with the PCB samples. No target analytes were detected in the method blank.

2.5.2 Surrogate Recovery

Percent surrogate recoveries (%R) for tetrachloro-m-xylene and decachlorobiphenyl were reported on the Quality Control Data Summary forms. Samples SED-7 MS, SED-7 MSD, BG1-0 MS, BG1-0 MSD, SS27-0 MS, SS27-0 MSD, B7-0 MS and B7-0 MSD had one %R outside control limits of 75-125% decachlorobiphenyl. No qualifiers were warranted based on surrogate recoveries for the MS and MSD samples.

2.5.3 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Nine MS/MSD summary reports were submitted with this data set. All MS/MSD recoveries and RPD values were within control limits with the exception of sample DW2-0. The MS recovery for aroclor 1268 was 0% and the MSD recovery for aroclor 1268 was 0%, indicating a spiking error by the laboratory. No qualifiers were warranted based on the poor MS/MSD recoveries for sample DW2-0.

2.5.4 Field and Laboratory Duplicates

Three field duplicates were included in this data set; however, were not labelled as such by RETEC personnel. Sample SED-10 is a field duplicate of SED-3, SS41-0 is a field duplicate of SS14-0 and SS92-0 is a field duplicate of SS29-0. Table 2-3 summarizes the Relative Percent Difference (RPD) for these samples and the corresponding duplicates. No analytes were detected in any of the samples or the corresponding duplicate samples, indicating field sampling techniques were acceptable.

Laboratory duplicates were not included in this sample set.

2.5.5 Overall Assessment of Data

The quantity of soil extracted, the amounts analyzed and the dilution factors were included in this data set for all of the samples. All compounds were reviewed based on the surrogate recoveries, the MS/MSD recoveries, the detection limits, the field duplicates and the method blanks. All data were found to be accurate based on the information given.

Field accuracy and precision have been determined acceptable based on the field blank and field duplicates. A completeness goal of 90% was achieved for environmental samples and field QA/QC.

Laboratory accuracy and precision have been determined acceptable based on the method blanks, MS/MSD spike recoveries and the surrogate recoveries. A completeness goal of 90% was achieved for laboratory QA/QC.

2.6 WASHINGTON TOTAL PETROLEUM HYDROCARBON - ANALYSIS OF SOIL

Forty-five soil samples were reviewed for Washington total petroleum hydrocarbon for diesel (WTPH-D) and five soil samples for Washington total petroleum hydrocarbon for gasoline (WTPH-G) validity in this data set.

2.6.1 Method Blanks

Method Blanks - Fifteen method blank were extracted and analyzed with the fuel hydrocarbon samples. No target analytes were detected in the method blank.

2.6.2 Surrogate Recovery

Percent surrogate recoveries (%R) for nitrobenzene, o-terphenyl for WTPH-D and trifluorotoluene, bromofluorobenzene for WTPH-G were reported on the Quality Control Data Summary forms. Samples B7-11 MS, B7-11 MSD and MW35-10 had one %R outside control limits. Samples B10-10, B10-15, MW36-7 1/2, B7-17, DW4-7 1/2 and B12-7 1/2 MS had two %Rs outside control limits. All positive results were qualified with "J" qualifiers (the associate numerical value is an estimated quantity), and non positive results with 'UJ" qualifiers (the sample quantitation limit is an estimated quantity), based on poor surrogate recoveries.

2.6.3 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Eight MS/MSD summary reports were submitted with this data set. One MS/MSD % recoveries exceeded control limits of 144% for API Diesel Standard. All other % recoveries for fuel hydrocarbons (diesel and gasoline) in the MS/MSD values were within control limits of 68-144%. All RPD values for were below the maximum allowable control limit of 20% for laboratory samples.

2.6.4 Field and Laboratory Duplicates

Three field duplicates were included in this data set; however, were not labelled as such by RETEC personnel. Sample MW53-10 is a field duplicate of MW35-10, B80-17 is a field duplicate of B8-17 and MW93-0 is a field duplicate of MW39-0. Table 2-4 summarizes the Relative Percent Difference (RPD) for these samples and the corresponding duplicates. Two RPD values were calculated for WTPH-D. The RPD value for sample B80-17 and its corresponding duplicate B8-17 was 69% which exceeded the maximum allowable RPD value of 50% field samples. No qualifiers were warranted based on RPD values for the field duplicates.

Six laboratory duplicates were included in this data set. All six RPD values exceeded the maximum control limit of 20% set by the lab for soil samples. No qualifiers were warranted based on poor laboratory RPD values.

2.6.5 Overall Assessment of Data

The quantity of soil extracted, the amounts analyzed and the dilution factors were included in this data set for all of the samples. All compounds were reviewed based on the surrogate recoveries, the MS/MSD recoveries, the detection limits, the field duplicates, the laboratory duplicates and the method blanks. All data were found to be accurate based on the information given.

Field accuracy and precision have been determined acceptable based on the field blank and field duplicates. A completeness goal of 90% was achieved for the field environmental samples and field QA/QC.

Laboratory accuracy and precision have been determined acceptable based on the method blanks, MS/MSD spike recoveries RPD values and laboratory duplicate samples. A completeness goal of 90% was achieved for the laboratory QA/QC.

2.7 TOTAL PETROLEUM HYDROCARBON - ANALYSIS OF SOIL

Eighty soil samples were reviewed for total petroleum hydrocarbon (TPH) validity in this data set.

2.7.1 Method Blanks

Method Blanks - Method blanks were not extracted or analyzed with the TPH samples.

2.7.2 Surrogate Recovery

Percent surrogate recoveries (%R) were not included with this sample set.

2.7.3 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Ten MS/MSD summary reports were submitted with this data set. The percent recoveries for TPH in the MS/MSD were within the control limits. One RPD value exceeded the maximum control limit of 20% set by the laboratory for soil samples.

2.7.4 Field and Laboratory Duplicates

Eleven field duplicates were included in this data set; however, were not labelled as such by RETEC personnel. Sample MW53-10 is a field duplicate of MW35-10, HA10-2 is a field duplicate of HA1-2, SS41-0 is a field duplicate of SS14-0, SS92-0 is a field duplicate of SS14-0, B80-17 is a field duplicate of B8-17, MW93-10 is field dupplicate of MW39-10, B50-17 is a field duplicate of B5-17, MW73-23 is field duplicate of MW37-23, DW10-23 1/2 is a field duplicate of DW1-23 1/2, DW50-17 is a field duplicate of DW5-17 and SED-10 is a field duplicate of SED-3. Table 2-4 summarizes the Relative Percent Difference (RPD) for these samples and the corresponding duplicates. Four RPD values were calculated for the TPH samples. All RPD values were within the control limits of 0-50%, indicating field sampling techniques were acceptable.

Ten laboratory duplicate summary reports were included in this data set. Seven RPD values for TPH were outside the maximum control limit of 20% for laboratory samples.

2.7.5 Overall Assessment of Data

The quantity of soil extracted, the amounts analyzed and the dilution factors were included in this data set for all of the samples. All compounds were reviewed based on the surrogate recoveries, the MS/MSD recoveries, the blank spike recoveries, the detection limits, field duplicates, and the laboratory duplicates. All data were found to be accurate based on the information given.

Field accuracy and precision have been determined acceptable based on the field duplicates. A completeness goal of 90% was achieved for the field environmental samples and QA/QC.

Laboratory accuracy and precision have been determined acceptable based on the method blanks. A completeness goal of 90% was achieved for the laboratory QA/QC.

2.8 METALS - ANALYSIS OF SOIL

Fifty-three soil samples were reviewed for total metals validity in this data set.

2.8.1 Method Blanks

Method Blanks - Three method blanks were extracted and analyzed with antimony, beryllium, cadmium, chromium, copper, lead, mercury, silver and zinc; four method blanks were extracted and analyzed with selenium; and five method blanks were extracted and analyzed with arsenic. No target metals were detected in the method blank.

2.8.2 Initial Calibration Checks

Three initial calibration checks were extracted and analyzed for antimony, beryllium, cadmium, chromium, copper, lead, mercury, nickel and silver; four initial calibration checks were extracted and analyzed for selenium; and six initial calibration checks were extracted and analyzed for arsenic. All initial calibration check recoveries were within control limits for total metals.

2.8.3 Matrix Spike/Matrix Spikes Duplicates (MS/MSD) and Analytical Spikes (AS)

Three MS/MSDs were extracted and analyzed for antimony, beryllium, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc; four MS/MSDs were extracted and analyzed for selenium;and six MS/MSDs were extracted and analyzed for arsenic. All MS/MSD recoveries were within control limits for total metals. One RPD value for chromium exceeded the maximum control limit of 20% for laboratory samples. No qualifiers were warranted based on the three RPD values.

Three analytical spikes (AS) were extracted and analyzed for antimony, beryllium, cadmium, chromium, copper, lead, mercury, nickel, silver and zinc; four analytical spikes were extracted and analyzed for selenium; and six analytical spikes were extracted and analyzed for arsenic. All AS recoveries were within acceptable control limits.

2.8.4 Field and Laboratory Duplicates

Five field duplicates were included in this data set; however, were not labelled as such by RETEC personnel. Sample B110-0 is a field duplicate of B11-0, sample HA10-2 is a field duplicate of HA1-2, SS41-0 is a field duplicate of SS14-0, SS92-0 is a field duplicate of SS29-0 and SED-10 is a field duplicate of SED-3. Table 2-5 summarizes the Relative Percent Difference (RPD) for these samples and the corresponding duplicates. A total of thirty-four RPD values were calculated for field duplicate metal analyses. Five RPD values exceeded the maximum acceptable control limit of 50% for field QA/QC. No qualifiers were warranted based on the RPD values and field sampling techniques are considered to be acceptable.

Three laboratory control checks were performed on arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, silver and zinc; four laboratory control checks were performed on selenium. All % recoveries and RPD values were within control limits of 0-20% for analytical QA/QC for each metal analysis.

2.8.5 Overall Assessment of Data

The quantity of soil extracted, the amounts analyzed and the dilution factors were included in this data set for all of the samples. All compounds were reviewed based on the surrogate recoveries, the MS/MSD recoveries, the analytical spike recoveries, the detection limits, the field duplicates, the method blanks and laboratory control checks. All data were found to be accurate based on the information given.

Field accuracy and precision have been determined acceptable based on the field duplicates. A completeness goal of 90% was achieved for the field environmental samples and QA/QC.

Laboratory accuracy and precision have been determined acceptable based on the method blanks, MS/MSD recoveries and RPD values, analytical spike recoveries and laboratory control check recoveries. A completeness goal of 90% was achieved for the laboratory QA/QC.

Explanation of qualifiers:

"U" = The material was analyzed for, but was not detected. The associated numerical value is the sample quantitation limit.

"J" = The associated numerical value is an estimated quantity.

"R" = The data are unusable (compound may or may not be present). Resampling and reanalysis is necessary for verification.

References

EPA, 1988. laboratory Data Validation Functional Guidelines For Evaluating Organics Analyses, USEPA Data Review Work Group.

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BNRR SKYKOMISH
SOIL DATA VALIDATION
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ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
DW2-10	09/27/93	VOCs (8240)	Surrogates w/in QC limits Methylene Chloride detected 4 "JB" ug/kg - qualified with "U" Acetone detected 23 "B" ug/kg - qualified with "U"
B4-10	09/28/93	VOCs (8240)	2 Surrogates exceeded QC limits, non positive results qualified with "UJ" Dibromofluoromethane %R = 123%, Bromofluorobenzene %R = 163% MS - 2 surrogates exceeded QC limits Dibromofluoromethane %R = 140%, Bromofluorobenzene %R = 160% MSD - 3 surrogates exceeded QC limits, toluene-d8 %R = 160% Dibromofluoromethane %R = 132%, Bromofluorobenzene %R = 183% Methylene Chloride detected 38 "B" ug/kg - qualified with "U" Acetone detected 109 "B" ug/kg - qualified with "U" MS recoveries w/in QC limits MSD recoveries w/in QC limits RPDs w/in QC limits
B40-10 Dup of B4-10	09/28/93	VOCs (8240)	1 Surrogate exceeded QC limits, non positive results qualified with "UJ" Bromofluorobenzene %R = 185% Methylene Chloride detected 37 "B" ug/kg - qualified with "U" Acetone detected 100 "B" ug/kg - qualified with "U" MS recoveries w/in QC limits MS - 1 surrogate exceeded QC limits, Bromofluorobenzene %R = 151% MSD recoveries w/in QC limits MSD - 1 surrogate exceeded QC limits, Bromofluorobenzene %R = 151% RPDs w/in QC limits
MW34-7 1/2	09/28/93	VOCs (8240)	Surrogates w/in QC limits Methylene Chloride detected 4 "JB" ug/kg - qualified with "U" Acetone detected 15 "B" ug/kg - qualified with "U"
MW33-5	09/28/93	VOCs (8240)	3 Surrogates exceeded limits, Dibromofluoromethane %R = 123%, Toluene-d8 %R = 147%, Bromofluorobenzene %R = 150% All positive results qualified with "J", non positive results qualified with "UJ" Methylene Chloride detected 13 "B" ug/kg - qualified with "U" Acetone detected 14 "B" ug/kg - qualified with "U"
MW40-5	09/27/93	VOCs (8240)	Surrogates w/in QC limits Methylene Chloride detected 4 "JB" ug/kg - qualified with "U" Acetone detected 7 "B" ug/kg - qualified with "U"
		SVOCs (8270)	Surrogates w/in QC limits
		PCBs (8080)	Surrogates w/in QC limits
		WTPH-G (8015)	2 surrogates below QC limits, Trifluorotoluene %R = 25%, Bromofluorobenzene %R = 34% non positive result qualified with "UJ"
		WTPH-D (8015)	Surrogates w/in QC limits Lab duplicate RPD value exceeded QC limits
		Metals (6010/7000)	
MW34-10	09/28/93	SVOCs (8270)	Surrogates w/in QC limits
		WTPH-D (8015)	Surrogates w/in QC limits
		TPH (418.1)	

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SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
DW2-5	09/27/93	SVOCs (8270)	Surrogates w/in QC limits
		WTPH-D (8015)	Surrogates w/in QC limits
		TPH (418.1)	
MW33-2 1/2	09/28/93	SVOCs (8270)	Surrogates w/in QC limits MS surrogates w/in QC limits MSD surrogates w/in QC limits MS recoveries win QC limits MSD recoveries win QC limits RPD values w/in QC limits
		WTPH-G (8015)	Surrogates w/in QC limits
		WTPH-D (8015)	Surrogates w/in QC limits MS recoveries win QC limits MSD recoveries win QC limits RPD values w/in QC limits
		TPH (418.1)	
B11-5	09/27/93	WTPH-D (8015)	Surrogates w/in QC limits
		TPH (418.1)	
DW1-5	09/28/93	WTPH-D (8015)	Surrogates w/in QC limits
		TPH (418.1)	
DW4-7 1/2	09/27/93	WTPH-D (8015)	**Surrogates diluted out, Result qualified with a "J"**
		TPH (418.1)	**Lab duplicate RPD value exceeded QC limits**
DW2-12 1/2	09/27/93	TPH (418.1)	Surrogates w/in QC limits
MW40-12 1/2	09/27/93	TPH (418.1)	Surrogates w/in QC limits
B11-10	09/27/93	TPH (418.1)	Surrogates w/in QC limits
B110-0 Dup of B11-0	09/27/93	Metals (6010/7000)	
DW1-0	09/27/93	Metals (6010/7000)	
MW34-0	09/28/93	Metals (6010/7000)	
DW4-0	09/27/93	Metals (6010/7000)	
MW33-0	09/28/93	Metals (6010/7000)	
DW1-22 1/2	09/28/93	TPH (418.1)	Surrogates w/in QC limits
DW10-22 1/2 Dup of DW1-22 1/2	09/28/93	TPH (418.1)	**Lab duplicate RPD value exceeded QC limits**
MW33-12 1/2	09/28/93	TPH (418.1)	Surrogates w/in QC limits

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SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
B4-10	09/28/93	SVOCs (8270)	**All 6 surrogates diluted out** **Positive results qualified with "J", Non-positive results qualified "UJ"**
		PCBs (8080)	Surrogates w/in QC limits
		TPH (418.1)	
DW2-2	09/27/93	PCBs (8080)	Surrogates w/in QC limits
B4-2	09/28/93	PCBs (8080)	Surrogates w/in QC limits
DW2-0	09/27/93	PCBs (8080)	Surrogates w/in QC limits MS surrogates w/in QC limits MSD surrogates w/in QC limits **MS recovery, MSD recovery and RPD value outside QC limits**
		Metals (6010/7000)	
B4-0	09/28/93	PCBs (8080)	Surrogates w/in QC limits
		Metals (6010/7000)	
Method Blank VBLK 10/5	10/05/93	VOCs (8240)	Surrogates w/in QC limits
Method Blank VBLK 10/7	10/07/93	VOCs (8240)	Surrogates w/in QC limits
Method Blank VBLK 10/8	10/08/93	VOCs (8240)	Surrogates w/in QC limits
Method Blank VBLK 10/11	10/11/93	VOCs (8240)	Surrogates w/in QC limits
Method Blank SBLK 10/8	10/08/93	SVOCs (8270)	Surrogates w/in QC limits
Method Blank SBLK 10/8	10/08/93	PCBs (8080)	Surrogates w/in QC limits
Method Blank WBLK-00	NA	WTPH-G	Surrogates w/in QC limits
Method Blank WBLK-01	NA	WTPH-G	Surrogates w/in QC limits
Method Blank WBLK-02	NA	WTPH-G	Surrogates w/in QC limits
MS/MSD	10/21/93	WTPH-G	MS recovery, MSD recovery and RPD value w/in QC limits
Method Blank TBLK 10/9	10/09/93	WTPH-D	Surrogates w/in QC limits
MS/MSD	11/19/93	TPH (418.1)	Surrogates w/in QC limits MS recovery, MSD recovery and RPD value w/in QC limits

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SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
MW35-7 1/2	09/28/93	VOCs (8240)	Surrogates w/in QC limits **Methylene Chloride detected 5 "B" ug/kg, qualified with "U"** **Acetone detected 10 "B" ug/kg, qualified with "U"**
MW35-0	09/28/93	Metals (6010/7000)	
MW53-7 1/2 **Dup of MW35-7 1/2**	09/28/93	VOCs (8240)	Surrogates w/in QC limits **Methylene Chloride detected 12 "B" ug/kg, qualified with "U"** **Acetone detected 12 "B" ug/kg, qualified with "U"**
DW3-17 1/2	09/29/93	TPH (418.1)	
MW35-10	09/28/93	WPTH-D (8015) TPH (418.1)	**1 surrogate below QC limits, Nitrobenzene %R = 12%, Result qualified with "J"** **Lab duplicate RPD value exceeded QC limits**
MW53-10 **Dup of MW35-10**	09/28/93	WPTH-D (8015) TPH (418.1)	Surrogates w/in QC limits
DW3-7 1/2	09/29/93	WPTH-D (8015) TPH (418.1)	
B10-10	09/29/93	WPTH-D (8015) TPH (418.1)	**2 surrogates outside QC limits,** **Nitrobenzene and o-Terphenyl %R diluted out, Result qualified with "J"**
B10-15	09/29/93	WPTH-D (8015) TPH (418.1)	**2 surrogates outside QC limits,** **Nitrobenzene and o-Terphenyl %R diluted out, Result qualified with "J"**
DW3-2	09/29/93	PCBs (8080)	Surrogates w/in QC limits
BG2-0	09/30/93	PCBs (8080) TPH (418.1)	Surrogates w/in QC limits
SS28-0	09/29/93	PCBs (8080) TPH (418.1) Metals (6010/7000)	Surrogates w/in QC limits
SS30-0	09/30/93	PCBs (8080) TPH (418.1) Metals (6010/7000)	Surrogates w/in QC limits
B10-0	09/29/93	Metals (6010/7000)	
DW3-0	09/30/93	PCBs (8080) Metals (6010/7000)	Surrogates w/in QC limits

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SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
SS32-0	09/30/93	PCBs (8080)	Surrogates w/in QC limits
		TPH (418.1)	MS recovery, MSD recovery and RPD value w/in QC limits
		Metals (6010/7000)	
SS31-0	09/30/93	PCBs (8080)	Surrogates w/in QC limits
		TPH (418.1)	
		Metals (6010/7000)	
SS29-0	09/30/93	PCBs (8080)	Surrogates w/in QC limits
		TPH (418.1)	
		Metals (6010/7000)	
SS27-0	09/30/93	PCBs (8080)	Surrogates w/in QC limits **MS and MSD surrogate recovery for Decachlorobiphenyl exceeds QC limits** **MS Decachlorobiphenyl %R = 266%** **MSD Decachlorobiphenyl %R = 289%** MS recovery, MSD recovery and RPD value w/in QC limits
		TPH (418.1)	
		Metals (6010/7000)	
SS92-0 **Dup of SS29-0**	09/30/93	PCBs (8080)	Surrogates w/in QC limits
		TPH (418.1)	
		Metals (6010/7000)	
SS13-0	09/30/93	PCBs (8080)	Surrogates w/in QC limits
		TPH (418.1)	
		Metals (6010/7000)	
SS14-0	09/30/93	PCBs (8080)	Surrogates w/in QC limits
		TPH (418.1)	
		Metals (6010/7000)	
SS41-0 **Dup of SS14-0**	09/30/93	PCBs (8080)	Surrogates w/in QC limits
		TPH (418.1)	
		Metals (6010/7000)	
SS15-0	09/30/93	PCBs (8080)	Surrogates w/in QC limits
		TPH (418.1)	
		Metals (6010/7000)	

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SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
SS16-0	09/30/93	PCBs (8080) TPH (418.1) Metals (6010/7000)	Surrogates w/in QC limits
SS18-0	09/30/93	PCBs (8080) TPH (418.1) Metals (6010/7000)	Surrogates w/in QC limits Lab duplicate RPD exceeded QC limits
SS17-0	09/30/93	PCBs (8080) TPH (418.1) Metals (6010/7000)	Surrogates w/in QC limits
SS19-0	09/30/93	PCBs (8080) TPH (418.1) Metals (6010/7000)	Surrogates w/in QC limits
SS19.1-0	09/30/93	PCBs (8080) TPH (418.1) Metals (6010/7000)	Surrogates w/in QC limits
SS21-0	09/30/93	PCBs (8080) TPH (418.1) Metals (6010/7000)	Surrogates w/in QC limits
SS22-0	09/30/93	PCBs (8080) TPH (418.1) Metals (6010/7000)	Surrogates w/in QC limits
SS23-0	09/30/93	PCBs (8080) TPH (418.1) Metals (6010/7000)	Surrogates w/in QC limits
SS24-0	09/30/93	PCBs (8080) TPH (418.1) Metals (6010/7000)	Surrogates w/in QC limits MS recovery, MSD recovery and RPD value w/in QC limits

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SOIL DATA VALIDATION
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SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
Method Blank VBLK 10/8	10/08/93	VOCs (8240)	Surrogates w/in QC limits
Method Blank VBLK 10/11	10/11/93	VOCs (8240)	Surrogates w/in QC limits
MS/MSD	10/11/93	VOCs (8240)	MS recovery, MSD recovery and RPD value w/in QC limits
Prep Blank PBK1S 10/11	10/11/93	PCBs (8080)	Surrogates w/in QC limits
Prep Blank PBK1S 10/12	10/11/93	PCBs (8080)	Surrogates w/in QC limits
MS/MSD	10/26/93	PCBs (8080)	MS recovery, MSD recovery and RPD value w/in QC limits
MS/MSD	11/04/93	WTPH-D (8015)	MS recovery, MSD recovery and RPD value w/in QC limits

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ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
SED-7	10/07/93	VOCs (8240)	1 Surrogate exceeded QC limits, Bromofluorobenzene %R = 133% All positive results qualified with "J", non positive qualified with "UJ" Methylene Chloride detected 6 "BJ" ug/kg, qualified with "U"
		SVOCs (8270)	Surrogates w/in QC limits
		PCBs (8080)	surrogates w/in QC limits, MS – Surrogate exceeded QC limits, Decachlorobiphenyl %R = 435% MSD – Surrogate exceeded QC limits, Decachlorobiphenyl %R = 451% MS recovery, MSD recovery and RPD value w/in QC limits
		TPH (418.1)	
		Metals (6010/7000)	
SED-6	10/07/93	Metals (6010/7000)	
HA1-2	10/07/93	VOCs (8240)	Surrogates w/in QC limits Methylene Chloride detected 3 "BJ" ug/kg, qualified with "U"
		SVOCs (8270)	Surrogates w/in QC limits
		TPH (418.1)	
		Metals (6010/7000)	
HA2-1	10/07/93	VOCs (8240)	2 Surrogates exceeded QC limits, Bromofluorobenzene %R = 138% Toluene-d8 %R = 161%, non positive results qualified with "UJ" Methylene Chloride detected 12 "B" ug/kg, qualified with "U"
		SVOCs (8270)	Surrogates w/in QC limits
		TPH (418.1)	
		Metals (6010/7000)	
HA3-1	10/07/93	VOCs (8240)	3 Surrogates exceeded QC limits, Bromofluorobenzene %R = 138% Toluene-d8 %R = 175%, Dibromofluoromethane %R = 129 All non-positive results qualified with "UJ" Methylene Chloride detected 11 "B" ug/kg, qualified with "U"
		SVOCs (8270)	Surrogates w/in QC limits
		TPH (418.1)	
		Metals (6010/7000)	
HA4-0	10/07/93	VOCs (8240)	1 Surrogate exceeded QC limits, Bromofluorobenzene %R = 132% All non-positive results qualified with "UJ" Methylene Chloride detected 3 "BJ", qualified with "U" Acetone detected 14 "B" ug/kg, qualified with "U"
		SVOCs (8270)	Surrogates w/in QC limits
		TPH (418.1)	MS recovery, MSD recovery and RPD value w/in QC limits
		Metals (6010/7000)	

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BNRR SKYKOMISH
SOIL DATA VALIDATION
SEPTEMBER - OCTOBER 1993
ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
HA10-2 Dup of HA1-2	10/07/93	VOCs (8240)	Surrogates w/in QC limits Methylene Chloride detected 3 "BJ", qualified with "U"
		SVOCs (8270)	Sample extracted 28 days past recommended holding time, qualified with "R" Sample extract lost, re-extracted outside holding time
		TPH (418.1)	
		Metals (6010/7000)	
Method Blank VBLK 10/20	10/20/93	VOCs (8240)	Surrogates w/in QC limits
Method Blank VBLK 10/21	10/21/93	VOCs (8240)	Surrogates w/in QC limits
MS/MSD	10/11/93	VOCs (8240)	MS recovery, MSD recovery and RPD value w/in QC limits
MS/MSD	10/31/93	VOCs (8240)	MS recovery, MSD recovery and RPD value w/in QC limits
Method Blank SBLK 10/19	10/19/93	SVOCs (8270)	Surrogates w/in QC limits
Method Blank SBLK 10/18	10/21/93	SVOCs (8270)	Surrogates w/in QC limits
MS/MSD	11/17/93	SVOCs (8270)	MS recoveries, MSD recoveries w/in QC limits 1 RPD value exceeds QC limits
Prep Blank PBK1S 10/14	10/14/93	PCBs (8080)	Surrogates w/in QC limits
Lab Control Sample	10/14/93	TPH (418.1)	Lab duplicate RPD value exceeded QC limits

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BNRR SKYKOMISH
SOIL DATA VALIDATION
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ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
B10B-27	10/18/93	TPH (418.1)	
B9-12 1/2	10/18/93	TPH (418.1)	
B6-23	10/19/93	TPH (418.1)	
MW39-10	10/19/93	WTPH-D (8015)	Surrogates w/in QC limits
		TPH (418.1)	
B9-7 1/2	10/18/93	VOCs (8240)	**1 surrogate exceeded QC limits, Bromofluorobenzene %R = 129%** **All positive results qualified with "J", non positive qualified with "UJ"** **Methylene Chloride detected 10 "B" ug/kg, qualified with "U"** **Acetone detected 86 "B" ug/kg, qualified with "J"**
		SVOCs (8270)	Surrogates w/in QC limits
		WTPH-D (8015)	Surrogates w/in QC limits
		TPH (418.1)	**Lab duplicate RPD value exceeded QC limits** MS recovery, MSD recovery and RPD value w/in QC limits
B6-8	10/19/93	VOCs (8240)	Surrogates w/in QC limits **Methylene Chloride detected 10 "B" ug/kg, qualified with "U"** **Acetone detected 48 "B" ug/kg, qualified with "U"**
		SVOCs (8270)	Surrogates w/in QC limits
		WTPH-D (8015)	Surrogates w/in QC limits
		TPH (418.1)	
MW39-6	10/19/93	VOCs (8240)	**1 surrogate exceeded QC limits, Bromofluorobenzene %R = 144%** **All positive results qualified with "J", non positive qualified with "UJ"** **MS - 1 surrogate exceeded QC limits, Bromofluorobenzene %R = 131%** **MSD - 1 surrogate exceeded QC limits, Bomofluorobenzene %R = 132%** MS recoveries, MSD recoveries and RPD values w/in QC limits **Methylene Chloride detected 14 "B" ug/kg, qualified with "U"** **Acetone detected 17 "B" ug/kg, qualified with "U"**
		SVOCs (8270)	Surrogates w/in QC limits
		WTPH-G (8015)	Surrogates w/in QC limits MS recovery, MSD recovery and RPD value w/in QC limits
		WTPH-D (8015)	Surrogates w/in QC limits
		TPH (418.1)	
B6-10 1/2	10/19/93	VOCs (8240)	Surrogates w/in QC limits **Methylene Chloride detected 39 "B" ug/kg, qualified with "U"** **Acetone detected 43 "B" ug/kg, qualified with "U"**
		SVOCs (8270)	Surrogates w/in QC limits
		PCBs (8080)	Surrogates w/in QC limits
		WTPH-D (8015)	Surrogates w/in QC limits
		TPH (418.1)	
		Metals (6010/7000)	

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SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
B9-0	10/18/93	PCBs (8080) Metals (6010/7000)	Surrogates w/in QC limits
B6-0	10/18/93	PCBs (8080) Metals (6010/7000)	Surrogates w/in QC limits
MW39-0	11/19/93	Metals (6010/7000)	
Method Blank VBLK 10/30	10/30/93	VOCs (8240)	Surrogates w/in QC limits
Method Blank VBLK 10/31	10/31/93	VOCs (8240)	Surrogates w/in QC limits
Method Blank SBLK 10/8	10/22/93	SVOCs (8270)	Surrogates w/in QC limits
MS/MSD	11/17/93	SVOCs (8270)	MS recoveries, MSD recoveries and RPD values w/in QC limits
Prep Blank	10/27/93	PCBs (8080)	Surrogates w/in QC limits
MS/MSD	10/27/93	PCBs (8080)	MS recovery, MSD recovery and RPD value w/in QC limits
MS/MSD	11/03/93	PCBs (8080)	MS recovery, MSD recovery and RPD value w/in QC limits
Method Blank WBLK-02	10/21/93	WTPH-G (8015)	Surrogates w/in QC limits
MS/MSD	11/03/93	WTPH-D (8015)	**MS and MSD exceeded QC limits.** RPD value w/in QC limits
Lab Control Sample	10/29/93	WTPH-D (8015)	**Lab duplicate RPD value exceeded QC limits**
Method Blank TBLK1 10/29	10/29/93	WTPH-D (8015)	Surrogates w/in QC limits
Method Blank TBLK2 10/29	10/29/93	WTPH-D (8015)	Surrogates w/in QC limits

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ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
BG1-0	10/01/93	PCBs (8080)	Surrogates w/in QC limits **MS - 1 surrogate exceeded QC limits, Decachlorobiphenyl %R = 464%** **MSD - 1 surrogate exceeded QC limits, Decachlorobiphenyl %R = 375%** MS recovery, MSD recovery and RPD value w/in QC limits
		TPH (418.1)	
		Metals (6010/7000)	
SS20-0	10/01/93	PCBs (8080)	Surrogates w/in QC limits
		TPH (418.1)	
		Metals (6010/7000)	
SS26-0	10/01/93	PCBs (8080)	Surrogates w/in QC limits
		TPH (418.1)	
		Metals (6010/7000)	
SS25-0	10/01/93	PCBs (8080)	Surrogates w/in QC limits
		TPH (418.1)	
		Metals (6010/7000)	
Prep Blank PBK1S 10/19	10/19/93	PCBs (8080)	Surrogates w/in QC limits
Lab Control Sample	10/10/93	TPH (418.1)	**Lab duplicate RPD value exceeded QC limits**
Lab Control Sample	10/14/93	TPH (418.1)	Lab duplicate RPD value w/ins QC limits
MS/MSD	11/19/93	TPH (418.1)	MS, MSD, and RPD values w/in QC limits

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ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
B12-7 1/2	10/29/93	VOCs (8240)	Surrogates w/in QC limits **Methylene Chloride detected 5 "B" ug/kg, qualified with "U"**
		SVOCs (8270)	Surrogates w/in QC limits
		WTPH-G (8015)	Surrogates w/in QC limits
		WTPH-D (8015)	Surrogates w/in QC limits Lab duplicate RPD value w/in QC limits **MS - 2 surrogates outside QC limits** MSD surrogates w/in QC limits **MS - %R outside QC limits** MSD - %R w/in QC limits **RPD value outside QC limits**
		TPH (418.1)	Lab duplicate RPD value w/in QC limits
B12-0	10/29/93	Metals (6010/7000)	
B12-12 1/2	10/29/93	TPH (418.1)	
Method Blank VBLK3 11/4		VOCs (8240)	Surrogates w/in QC limits
MS/MSD	10/31/93	VOCs (8240)	MS recoveries, MSD recoveries and RPD values w/in QC limits
Method Blank SBLK 11/12	11/05/93	SVOCs (8270)	Surrogates w/in QC limits
MS/MSD	11/18/93	SVOCs (8270)	MS and MSD recoveries w/in QC limits **4 RPD values exceeds QC limits**
Method Blank TBLK1 11/12	11/12/93	WTPH-D (8015)	Surrogates w/in QC limits
Method Blank WBLK-02	10/21/93	WTPH-G (8015)	Surrogates w/in QC limits
MS/MSD	10/21/93	WTPH-G (8015)	MS recovery, MSD recovery and RPD value w/in QC limits
MS/MSD	11/04/93	TPH (418.1)	MS recovery, MSD recovery and RPD value w/in QC limits

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BNRR SKYKOMISH
SOIL DATA VALIDATION
SEPTEMBER - OCTOBER 1993
ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
MW39-15 1/2	10/19/93	TPH (418.1)	
MW35B-17 1/2	10/19/93	TPH (418.1)	
B8-22	10/20/93	TPH (418.1)	
DW4B-17 1/2	10/20/93	TPH (418.1)	
MW36-17	10/21/93	TPH (418.1)	
MW93-10 Dup of MW39-10	10/19/93	TPH (418.1)	
		WTPH-D (8015)	2 surrogates outside QC limits - Nitrobenzene %R = NR o-Terphenyl %R = NR Positive result qualified with "J"
B8-12	10/20/93	TPH (418.1)	
		WTPH-D (8015)	Surrogates w/in QC limits
B8-17	10/20/93	TPH (418.1)	
		WTPH-D (8015)	Surrogates w/in QC limits
B80-17 Dup of B8-17	10/20/93	TPH (418.1)	
		WTPH-D (8015)	Surrogates w/in QC limits
MW36-7 1/2	10/21/93	TPH (418.1)	Lab duplicate RPD value exceeded QC limits
		WTPH-D (8015)	2 surrogates outside QC limits - Nitrobenzene %R = DO o-Terphenyl %R = DO Positive result qualified with "J"
MW36-6	10/21/93	VOCs (8240)	2 surrogates exceeds QC limits - Dibromofluoromethane %R = 121% Bromofluorobenzene %R = 117% Non-positive results qualified with "UJ" Methylene Chloride detected 56 "B", qualified with "U" Acetone detected 88 "B", qualified with "U"
		WTPH-D (8015)	Surrogates w/in QC limits
		TPH (418.1)	
B8-0	10/20/93	PCBs (8080)	Surrogates w/in QC limits
		Metals (6010/7000)	
MW36-0	10/21/93	Metals (6010/7000)	

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SOIL DATA VALIDATION
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ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
Method Blank VBLK 10/31	10/31/93	VOCs (8240)	Surrogates w/in QC limits
MS/MSD	10/31/93	VOCs (8240)	MS recoveries, MSD recoveries and RPD values w/in QC limits
Prep Blank PBK1S	10/27/93	PCBs (8080)	Surrogates w/in QC limits
MS/MSD	10/27/93	PCBs (8080)	MS recovery, MSD recovery and RPD value w/in QC limits
MS/MSD	11/03/93	PCBs (8080)	MS recovery, MSD recovery and RPD value w/in QC limits
Prep Blank TBLK1 10/29	10/29/93	WTPH-D (8015)	Surrogates w/in QC limits
Prep Blank TBLK2 10/29	10/29/93	WTPH-D (8015)	Surrogates w/in QC limits
Lab Control Sample	10/29/93	WTPH-D (8015)	**Lab duplicate RPD value exceeded QC limits**
MS/MSD	11/03/93	WTPH-D (8015)	**MS - %R exceeded QC limits** **MSD - %R exceeded QC limits** RPD value w/in QC limits
MS/MSD	11/04/93	TPH (418.1)	MS recovery, MSD recovery and RPD values w/in QC limits

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BNRR SKYKOMISH
SOIL DATA VALIDATION
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ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
MW37-7 1/2	10/23/93	VOCs (8240)	2 surrogates exceeds QC limits – Dibromofluoromethane %R = 138%, bromofluorobenzene %R = 169% All non-detects qualified with "UJ", all positive results qualified with "J" Methylene Chloride detected 17 "B" ug/kg, qualified with "U" Acetone detected 37 "B" ug/kg, qualified with "U"
		WTPH-G (8015)	Surrogates w/in QC limits
		WTPH-D (8015)	Surrogates w/in QC limits
		TPH (418.1)	
B5-7	10/24/93	VOCs (8240)	Surrogates w/in QC limits Methylene Chloride detected 10 "B" ug/kg, qualified with "U"
		SVOCs (8270)	Surrogates w/in QC limits MS and MSD surrogates w/in QC limits MS recoveries, MSD recoveries w/in QC limits 4 RPD values exceeded QC limits
		WTPH-D (8015)	Surrogates w/in QC limits
		TPH (418.1)	
MW38-7 1/2	10/24/93	VOCs (8240)	Surrogates w/in QC limits Methylene Chloride detected 14 "B" ug/kg, qualified with "U" Acetone detected 19 "B" ug/kg, qualified with "U"
		WTPH-D (8015)	Surrogates w/in QC limits
		TPH (418.1)	
MW37-12 1/2	10/22/93	WTPH-D (8015)	Surrogates w/in QC limits
B7-11	10/22/93	WTPH-D (8015)	Surrogates w/in QC limits MS surrogates and MSD surrogates w/in QC limits MS recovery and MSD recovery exceeds QC limits MS/MSD RPD value w/in QC limits
		TPH (418.1)	
B7-17	10/22/93	WTPH-D (8015)	2 surrogates outside QC limits – Nitrobenzene %R = DO, 0-Terphenyl %R = DO Positive result qualified with a "J"
		TPH (418.1)	
DW5-12	10/23/93	WTPH-D (8015)	Lab duplicate RPD exceeded QC limits
		TPH (418.1)	
MW37-23	10/22/93	TPH (418.1)	
MW73-23 Dup of MW37-23	10/22/93	TPH (418.1)	
B7-22	10/22/93	TPH (418.1)	
MW34B-17	10/23/93	TPH (418.1)	Lab duplicate RPD value w/in QC limits

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SOIL DATA VALIDATION
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ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
DW5-17	10/23/93	TPH (418.1)	
DW50-17 Dup of DW5-17	10/23/93	TPH (418.1)	
MW38-12	10/24/93	TPH (418.1)	
B4B-17	10/24/93	TPH (418.1)	
B5-17	10/24/93	TPH (418.1)	Lab duplicate w/in QC limits MS recovery, MSD recovery and RPD value w/in QC limits
B50-17 Dup of B5-17	10/24/93	TPH (418.1)	
B7-0	10/22/93	PCBs (8080) Metals (6010/7000)	Surrogates w/in QC limits **MS - 1 surrogate outside QC limits, Decachlorobiphenyl %R = NR** **MSD - 1 surrogate outside QC limits, Decachlorobiphenyl %R = NR** MS recovery, MSD recovery and RPD value w/in QC limits
DW5-0	10/23/93	Metals (6010/7000)	
MW38-0	10/23/93	Metals (6010/7000)	
B5-0	10/24/93	PCBs (8080) Metals (6010/7000)	Surrogates w/in QC limits
Method Blank VBLK 10/05	10/31/93	VOCs (8240)	Surrogates w/in QC limits
MS/MSD	10/31/93	VOCs (8240)	MS recoveries, MSD recoveries and RPD values w/in QC limits
Method Blank SBLK 10/08	11/05/93	SVOCs (8270)	Surrogates w/in QC limits
Prep Blank PBK1S 10/27	10/27/93	PCBs (8080)	Surrogates w/in QC limits
Method Blank WBLK-02	10/21/93	WTPH-G (8015)	Surrogates w/in QC limits
MS/MSD	10/21/93	WTPH-G (8015)	MS recoveries, MSD recoveries and RPD values w/in QC limits
Prep Blank TBLK1 10/29	10/29/93	WTPH-D (8015)	Surrogates w/in QC limits
Prep Blank TBLK2 10/29	10/29/93	WTPH-D (8015)	Surrogates w/in QC limits

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SOIL DATA VALIDATION
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ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
SED-1	10/07/93	VOCs (8240)	Surrogates w/in QC limits **Methylene Chloride detected 3 "BJ" ug/kg, qualified with "U"**
		SVOCs (8270)	Surrogates w/in QC limits
		PCBs (8080)	Surrogates w/in QC limits
		TPH (418.1)	
		Metals (6010/7000)	
SED-2	10/07/93	VOCs (8240)	Surrogates w/in QC limits **Methylene Chloride detected 3 "BJ" ug/kg, qualified with "U"**
		SVOCs (8270)	Surrogates w/in QC limits
		PCBs (8080)	Surrogates w/in QC limits
		TPH (418.1)	
		Metals (6010/7000)	
SED-10 **Dup of SED-3**	10/07/93	VOCs (8240)	Surrogates w/in QC limits **Methylene Chloride detected 3 "BJ" ug/kg, qualified with "U"**
		SVOCs (8270)	Surrogates w/in QC limits
		PCBs (8080)	Surrogates w/in QC limits
		TPH (418.1)	
		Metals (6010/7000)	
SED-3	10/07/93	VOCs (8240)	Surrogates w/in QC limits
		SVOCs (8270)	**Surrogates were not recovered** **Re-extracted outside recommended holding time, qualified with "R"** Re-extract surrogates w/in QC limits
		PCBs (8080)	Surrogates w/in QC limits
		TPH (418.1)	Lab duplicate RPD value w/in QC limits
		Metals (6010/7000)	
SED-4	10/07/93	VOCs (8240)	Surrogates w/in QC limits
		SVOCs (8270)	Surrogates w/in QC limits
		PCBs (8080)	Surrogates w/in QC limits
		TPH (418.1)	
		Metals (6010/7000)	

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SOIL DATA VALIDATION
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ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
SED-5	10/07/93	VOCs (8240)	Surrogates w/in QC limits
		SVOCs (8270)	Surrogates w/in QC limits
		PCBs (8080)	Surrogates w/in QC limits
		TPH (418.1)	MS recovery and MSD recovery w/in QC limits **RPD value exceeded QC limits**
		Metals (6010/7000)	
SED-6	10/07/93	VOCs (8240)	**2 surrogates exceeded QC limits - toluene-d8 %R = 128% bromofluorobenzene %R = 133%, all non positive results qualified with "UJ"**
		SVOCs (8270)	Surrogates w/in QC limits MS surrogates and MSD surrogates w/in QC limits MS recoveries and MSD recoveries w/in QC limits **1 RPD value exceeded QC limits**
		PCBs (8080)	Surrogates w/in QC limits
		TPH (418.1)	
Method Blank VBLK 10/19	10/19/93	VOCs (8240)	Surrogates w/in QC limits
Method Blank VBLK 10/20	10/20/93	VOCs (8240)	Surrogates w/in QC limits
Method Blank VBLK 10/21	10/21/93	VOCs (8240)	Surrogates w/in QC limits
MS/MSD	10/11/93	VOCs (8240)	MS recoveries, MSD recoveries and RPD values w/in QC limits
MS/MSD	10/31/93	VOCs (8240)	MS recoveries, MSD recoveries and RPD values w/in QC limits
Method Blank SBLK 10/18	10/18/93	SVOCs (8270)	Surrogates w/in QC limits
Method Blank SBLK 10/17	10/17/93	SVOCs (8270)	Surrogates w/in QC limits
Prep Blank PBK1S 10/14	10/14/93	PCBs (8080)	Surrogates w/in QC limits
MS/MSD	10/27/93	PCBs (8080)	MS recovery, MSD recovery and RPD value w/in QC limits

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SOIL DATA VALIDATION
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ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
DW4-2 1/2	09/27/93	WTPH-D (8015) TPH (418.1)	Surrogates w/in QC limits Lab duplicate RPD w/in QC limits
DW2-0	09/27/93	WTPH-D	Surrogates w/in QC limits Duplicate RPD w/in QC limits
Method Blank TBLK 10/9	10/09/93	WTPH-D	Surrogates w/in QC limits
MS/MSD	11/04/93	TPH (418.1)	MS, MSD and RPD values w/in QC limits

MS - Matrix Spike
MSD - Matrix Spike Duplicate
%R - Percent Recovery
"U" - The material was analyzed for, but was not detected. The associate numerical value is the sample quantitation limit.
"J" - The associated numerical value is an estimated quantity.
"R" - The data are unusable (compound may or may not be present). Resampling and reanalysis is necessary for verification.
"UJ" - The material was analyzed for, but was not detected. The sample quantitation limit is an estimated quantity.
NR - Not Recovered
DO - Diluted Out
VOC - Volatile Organic Compound
SVOC - Semivolatile Organic Compounds
PCB - Polychlorobiphenyls
WTPH-D - Washington Total Petroluem Hydrocarbon-Diesel
WTPH-G - Washington Total Petroluem Hydrocarbon-Gasoline
TPH - Total Petroluem Hydrocarbons

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SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
Initail Calibration	10/12/93	Antimony (7041)	%R within QC limits
Check	10/28/93	Antimony (7041)	%R within QC limits
	11/08/93	Antimony (7041)	%R within QC limits
	10/13/93	Arsenic (7060)	%R within QC limits
	10/27/93	Arsenic (7060)	%R within QC limits
	10/28/93	Arsenic (7060)	%R within QC limits
	11/03/93	Arsenic (7060)	%R within QC limits
	11/04/93	Arsenic (7060)	%R within QC limits
	11/11/93	Arsenic (7060)	%R within QC limits
	10/13/93	Beryllium (6010)	%R within QC limits
	10/27/93	Beryllium (6010)	%R within QC limits
	10/26/93	Beryllium (6010)	%R within QC limits
	10/13/93	Cadmium (6010)	%R within QC limits
	10/27/93	Cadmium (6010)	%R within QC limits
	10/26/93	Cadmium (6010)	%R within QC limits
	10/11/93	Chromium (6010)	%R within QC limits
	10/27/93	Chromium (6010)	%R within QC limits
	10/26/93	Chromium (6010)	%R within QC limits
	10/11/93	Copper (6010)	%R within QC limits
	10/27/93	Copper (6010)	%R within QC limits
	10/26/93	Copper (6010)	%R within QC limits
	10/13/93	Lead (6010)	%R within QC limits
	10/27/93	Lead (6010)	%R within QC limits
	10/26/93	Lead (6010)	%R within QC limits
	10/14/93	Mercury (7470)	%R within QC limits
	10/29/93	Mercury (7470)	%R within QC limits
	10/26/93	Mercury (7470)	%R within QC limits
	10/13/93	Nickel (6010)	%R within QC limits
	10/27/93	Nickel (6010)	%R within QC limits
	10/26/93	Nickel (6010)	%R within QC limits
	10/12/93	Selenium (7741)	%R within QC limits
	10/28/93	Selenium (7741)	%R within QC limits
	11/02/93	Selenium (7741)	%R within QC limits
	11/15/93	Selenium (7741)	%R within QC limits
	10/13/93	Silver (6010)	%R within QC limits
	10/27/93	Silver (6010)	%R within QC limits
	10/26/93	Silver (6010)	%R within QC limits
	10/13/93	Zinc (6010)	%R within QC limits
	10/27/93	Zinc (6010)	%R within QC limits
	10/26/93	Zinc (6010)	%R within QC limits

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BNRR SKYKOMISH
SOIL DATA VALIDATION
SEPTEMBER - OCTOBER 1993
ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
Spikes	10/12/93	Antimony (7041)	%R within QC limits
	10/28/93	Antimony (7041)	%R within QC limits
	11/08/93	Antimony (7041)	%R within QC limits
	10/13/93	Arsenic (7060)	%R within QC limits
	10/27/93	Arsenic (7060)	%R within QC limits
	10/28/93	Arsenic (7060)	%R within QC limits
	11/03/93	Arsenic (7060)	%R within QC limits
	11/04/93	Arsenic (7060)	%R within QC limits
	11/11/93	Arsenic (7060)	%R within QC limits
	10/13/93	Beryllium (6010)	%R within QC limits
	10/27/93	Beryllium (6010)	%R within QC limits
	10/26/93	Beryllium (6010)	%R within QC limits
	10/13/93	Cadmium (6010)	%R within QC limits
	10/27/93	Cadmium (6010)	%R within QC limits
	10/26/93	Cadmium (6010)	%R within QC limits
	10/11/93	Chromium (6010)	%R within QC limits
	10/27/93	Chromium (6010)	%R within QC limits
	10/26/93	Chromium (6010)	%R within QC limits
	10/11/93	Copper (6010)	%R within QC limits
	10/27/93	Copper (6010)	%R within QC limits
	10/26/93	Copper (6010)	%R within QC limits
	10/13/93	Lead (6010)	%R within QC limits
	10/27/93	Lead (6010)	%R within QC limits
	10/26/93	Lead (6010)	%R within QC limits
	10/14/93	Mercury (7470)	%R within QC limits
	10/29/93	Mercury (7470)	%R within QC limits
	10/26/93	Mercury (7470)	%R within QC limits
	10/13/93	Nickel (6010)	%R within QC limits
	10/27/93	Nickel (6010)	%R within QC limits
	10/26/93	Nickel (6010)	%R within QC limits
	10/12/93	Selenium (7741)	%R within QC limits
	10/28/93	Selenium (7741)	%R within QC limits
	11/02/93	Selenium (7741)	%R within QC limits
	11/15/93	Selenium (7741)	%R within QC limits
	10/13/93	Silver (6010)	%R within QC limits
	10/27/93	Silver (6010)	%R within QC limits
	10/26/93	Silver (6010)	%R within QC limits
	10/13/93	Zinc (6010)	%R within QC limits
	10/27/93	Zinc (6010)	%R within QC limits
	10/26/93	Zinc (6010)	%R within QC limits

TABLE 1-1

BNRR SKYKOMISH
SOIL DATA VALIDATION
SEPTEMBER - OCTOBER 1993
ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
MS/MSD	10/12/93	Antimony (7041)	%R within QC limits
	10/28/93	Antimony (7041)	%R within QC limits
	11/08/93	Antimony (7041)	%R within QC limits
	10/13/93	Arsenic (7060)	%R within QC limits
	10/27/93	Arsenic (7060)	%R within QC limits
	10/28/93	Arsenic (7060)	%R within QC limits
	11/03/93	Arsenic (7060)	%R within QC limits
	11/04/93	Arsenic (7060)	%R within QC limits
	11/11/93	Arsenic (7060)	%R within QC limits
	10/13/93	Beryllium (6010)	%R within QC limits
	10/27/93	Beryllium (6010)	%R within QC limits
	10/26/93	Beryllium (6010)	%R within QC limits
	10/13/93	Cadmium (6010)	%R within QC limits
	10/27/93	Cadmium (6010)	%R within QC limits
	10/26/93	Cadmium (6010)	%R within QC limits
	10/11/93	Chromium (6010)	%RPD exceeds QC limits of 50%, (%RPD = 50%)
	10/27/93	Chromium (6010)	%R within QC limits
	10/26/93	Chromium (6010)	%R within QC limits
	10/11/93	Copper (6010)	%R within QC limits
	10/27/93	Copper (6010)	%R within QC limits
	10/26/93	Copper (6010)	%R within QC limits
	10/13/93	Lead (6010)	%R within QC limits
	10/27/93	Lead (6010)	%R within QC limits
	10/26/93	Lead (6010)	%R within QC limits
	10/14/93	Mercury (7470)	%R within QC limits
	10/29/93	Mercury (7470)	%R within QC limits
	10/26/93	Mercury (7470)	%R within QC limits
	10/13/93	Nickel (6010)	%R within QC limits
	10/27/93	Nickel (6010)	%R within QC limits
	10/26/93	Nickel (6010)	%R within QC limits
	10/12/93	Selenium (7741)	%R within QC limits
	10/28/93	Selenium (7741)	%R within QC limits
	11/02/93	Selenium (7741)	%R within QC limits
	11/15/93	Selenium (7741)	%R within QC limits
	10/13/93	Silver (6010)	%R within QC limits
	10/27/93	Silver (6010)	%R within QC limits
	10/26/93	Silver (6010)	%R within QC limits
	10/13/93	Zinc (6010)	%R within QC limits
	10/27/93	Zinc (6010)	%R within QC limits
	10/26/93	Zinc (6010)	%R within QC limits

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BNRR SKYKOMISH
SOIL DATA VALIDATION
SEPTEMBER - OCTOBER 1993
ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
Prep Blanks	10/12/93	Antimony (7041)	
	10/28/93	Antimony (7041)	
	11/08/93	Antimony (7041)	
	10/13/93	Arsenic (7060)	
	10/27/93	Arsenic (7060)	
	10/28/93	Arsenic (7060)	
	11/03/93	Arsenic (7060)	
	11/04/93	Arsenic (7060)	
	11/11/93	Arsenic (7060)	
	10/13/93	Beryllium (6010)	
	10/27/93	Beryllium (6010)	
	10/26/93	Beryllium (6010)	
	10/13/93	Cadmium (6010)	
	10/27/93	Cadmium (6010)	
	10/26/93	Cadmium (6010)	
	10/11/93	Chromium (6010)	
	10/27/93	Chromium (6010)	
	10/26/93	Chromium (6010)	
	10/11/93	Copper (6010)	
	10/27/93	Copper (6010)	
	10/26/93	Copper (6010)	
	10/13/93	Lead (6010)	
	10/27/93	Lead (6010)	
	10/26/93	Lead (6010)	
	10/14/93	Mercury (7470)	
	10/29/93	Mercury (7470)	
	10/26/93	Mercury (7470)	
	10/13/93	Nickel (6010)	
	10/27/93	Nickel (6010)	
	10/26/93	Nickel (6010)	
	10/12/93	Selenium (7741)	
	10/28/93	Selenium (7741)	
	11/02/93	Selenium (7741)	
	11/15/93	Selenium (7741)	
	10/13/93	Silver (6010)	
	10/27/93	Silver (6010)	
	10/26/93	Silver (6010)	
	10/13/93	Zinc (6010)	
	10/27/93	Zinc (6010)	
	10/26/93	Zinc (6010)	

TABLE 1–1

BNRR SKYKOMISH
SOIL DATA VALIDATION
SEPTEMBER – OCTOBER 1993
ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
Laboratory Control Checks	10/13/93	Arsenic (7060)	%Rs within QC limits, RPD value w/in QC limits
	10/27/93	Arsenic (7060)	%Rs within QC limits, RPD value w/in QC limits
	11/03/93	Arsenic (7060)	%Rs within QC limits, RPD value w/in QC limits
	10/13/93	Beryllium (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/27/93	Beryllium (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/26/93	Beryllium (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/13/93	Cadmium (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/27/93	Cadmium (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/26/93	Cadmium (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/11/93	Chromium (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/27/93	Chromium (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/26/93	Chromium (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/11/93	Copper (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/27/93	Copper (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/26/93	Copper (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/13/93	Lead (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/27/93	Lead (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/26/93	Lead (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/14/93	Mercury (7470)	%Rs within QC limits, RPD value w/in QC limits
	10/29/93	Mercury (7470)	%Rs within QC limits, RPD value w/in QC limits
	10/26/93	Mercury (7470)	%Rs within QC limits, RPD value w/in QC limits
	10/13/93	Nickel (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/27/93	Nickel (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/26/93	Nickel (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/12/93	Selenium (7741)	%Rs within QC limits, RPD value w/in QC limits
	10/28/93	Selenium (7741)	%Rs within QC limits, RPD value w/in QC limits
	11/02/93	Selenium (7741)	%Rs within QC limits, RPD value w/in QC limits
	11/15/93	Selenium (7741)	%Rs within QC limits, RPD value w/in QC limits
	10/13/93	Silver (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/27/93	Silver (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/26/93	Silver (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/13/93	Zinc (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/27/93	Zinc (6010)	%Rs within QC limits, RPD value w/in QC limits
	10/26/93	Zinc (6010)	%Rs within QC limits, RPD value w/in QC limits

TABLE 2-1

VOLATILE ORGANIC COMPOUNDS
QA/QC SUMMARY
DUPLICATE SAMPLES

Sample ID:	B4-10		B40-10 (B4-10 Dup)		RPD B4-10 B40-10	MW35-7.5		MW53-7.5 (W35-7.5 Dup)		RPD MW35-7.5 MW53-7.5
Lab Sample ID:	559-2768		559-2769			573-2845		573-2846		
Sample Date:	9/28/93		9/28/93			9/28/93		9/28/93		
COMPOUND		MDL Q		MDL Q			MDL Q		MDL Q	
VOCs (EPA 8240)										
GC/MS (ug/kg)										
Chloromethane		53 U		53 U	NC		10 U		10 U	NC
Bromomethane		53 U		53 U	NC		10 U		10 U	NC
Vinyl Chloride		53 U		53 U	NC		10 U		10 U	NC
Chloroethane		53 U		53 U	NC		10 U		10 U	NC
Methylene Chloride	38	27 U	37	27 U	NC	5	5 U	12	5 U	NC
Acrolein		53 U		53 U	NC		10 U		10 U	NC
Acrylonitrile		53 U		53 U	NC		10 U		10 U	NC
Acetone	109	27 U	100	27 U	NC	10	5 U	12	5 U	NC
Carbon Disulfide		27 U		27 U	NC		5 U		5 U	NC
1,1-Dichloroethene		27 U		27 U	NC		5 U		5 U	NC
1,1-Dichloroethane		27 U		27 U	NC		5 U		5 U	NC
Total-1,2-Dichloroethene		27 U		27 U	NC		5 U		5 U	NC
Chloroform		27 U		27 U	NC		5 U		5 U	NC
1,2-Dichloroethane		27 U		27 U	NC		5 U		5 U	NC
2-Butanone		53 U		53 U	NC		10 U		10 U	NC
1,1,1-Trichloroethane		27 U		27 U	NC		5 U		5 U	NC
Carbon Tetrachloride		27 U		27 U	NC		5 U		5 U	NC
Vinyl Acetate		53 U		53 U	NC		10 U		10 U	NC
Bromodichloromethane		27 U		27 U	NC		5 U		5 U	NC
1,2-Dichloropropane		27 U		27 U	NC		5 U		5 U	NC
cis-1,3-Dichloropropene		27 U		27 U	NC		5 U		5 U	NC
Trichloroethene		27 U		27 U	NC		5 U		5 U	NC
Dibromochloromethane		27 U		27 U	NC		5 U		5 U	NC
1,1,2-Trichloroethane		27 U		27 U	NC		5 U		5 U	NC
Benzene		27 U		27 U	NC		5 U		5 U	NC
trans-1,3-dichloropropene		27 U		27 U	NC		5 U		5 U	NC
2-chloroethylvinylether		27 U		27 U	NC		5 U		5 U	NC
Bromoform		27 U		27 U	NC		5 U		5 U	NC
4-Methyl-2-Pentanone		53 U		53 U	NC		10 U		10 U	NC
2-Hexanone		53 U		53 U	NC		10 U		10 U	NC
Tetrachloroethene		27 U		27 U	NC		5 U		5 U	NC
1,1,2,2-Tetrachloroethane		27 U		27 U	NC		5 U		5 U	NC
Toluene		27 U		27 U	NC		5 U		5 U	NC
Chlorobenzene		27 U		27 U	NC		5 U		5 U	NC
Ethylbenzene		27 U		27 U	NC		5 U		5 U	NC
Styrene		27 U		27 U	NC		5 U		5 U	NC
Xylene (total)		27 U		27 U	NC		5 U		5 U	NC

NOTES:
RPD - Relative Percent Difference
RPD = absolute value of $((S_1-S_2)/((S_1+S_2)*1/2))*100$, where
S_1 is the orginal sample and S_2 is the duplicate sample.
"U" indicates compound was not detected.
"J" indicates the detected value is an estimated quantity.
"B" indicates compound was found in daily calibration blank.
NC - Not Calculated

TABLE 2-1

VOLATILE ORGANIC COMPOUNDS
QA/QC SUMMARY
DUPLICATE SAMPLES

Sample ID: Lab Sample ID: Sample Date:	HA1-2 590-2937 10/7/93	HA10-2 (HA1-2 Dup) 590-2941 10/7/93	RPD HA1-2 HA10-2	SED-3 588-2930 10/7/93	SED-10 (SED-3 Dup) 588-2929 10/7/93	RPD SED-3 SED-10
COMPOUND	MDL Q	MDL Q		MDL Q	MDL Q	
VOCs (EPA 8240) **GC/MS (ug/kg)**						
Chloromethane	10 U	10 U	NC	11 U	11 U	NC
Bromomethane	10 U	10 U	NC	11 U	11 U	NC
Vinyl Chloride	10 U	10 U	NC	11 U	11 U	NC
Chloroethane	10 U	10 U	NC	11 U	11 U	NC
Methylene Chloride	3 5 U	3 5 U	NC	5 6 U	3 6 U	NC
Acrolein	10 U	10 U	NC	11 U	11 U	NC
Acrylonitrile	10 U	10 U	NC	11 U	11 U	NC
Acetone	5 U	5 U	NC	5 6 U	5 6 U	NC
Carbon Disulfide	5 U	5 U	NC	6 U	6 U	NC
1,1-Dichloroethene	5 U	5 U	NC	6 U	6 U	NC
1,1-Dichloroethane	5 U	5 U	NC	6 U	6 U	NC
Total-1,2-Dichloroethene	5 U	5 U	NC	6 U	6 U	NC
Chloroform	5 U	5 U	NC	6 U	6 U	NC
1,2-Dichloroethane	5 U	5 U	NC	6 U	6 U	NC
2-Butanone	10 U	10 U	NC	11 U	11 U	NC
1,1,1-Trichloroethane	5 U	5 U	NC	6 U	6 U	NC
Carbon Tetrachloride	5 U	5 U	NC	6 U	6 U	NC
Vinyl Acetate	10 U	10 U	NC	11 U	11 U	NC
Bromodichloromethane	5 U	5 U	NC	6 U	6 U	NC
1,2-Dichloropropane	5 U	5 U	NC	6 U	6 U	NC
cis-1,3-Dichloropropene	5 U	5 U	NC	6 U	6 U	NC
Trichloroethene	5 U	5 U	NC	6 U	6 U	NC
Dibromochloromethane	5 U	5 U	NC	6 U	6 U	NC
1,1,2-Trichloroethane	5 U	5 U	NC	6 U	6 U	NC
Benzene	5 U	5 U	NC	6 U	6 U	NC
trans-1,3-dichloropropene	5 U	5 U	NC	6 U	6 U	NC
2-chloroethylvinylether	5 U	5 U	NC	6 U	6 U	NC
Bromoform	5 U	5 U	NC	6 U	6 U	NC
4-Methyl-2-Pentanone	10 U	10 U	NC	11 U	11 U	NC
2-Hexanone	10 U	10 U	NC	11 U	11 U	NC
Tetrachloroethene	5 U	5 U	NC	6 U	6 U	NC
1,1,2,2-Tetrachloroethane	5 U	5 U	NC	6 U	6 U	NC
Toluene	5 U	5 U	NC	6 U	6 U	NC
Chlorobenzene	5 U	5 U	NC	6 U	6 U	NC
Ethylbenzene	5 U	5 U	NC	6 U	6 U	NC
Styrene	5 U	5 U	NC	6 U	6 U	NC
Xylene (total)	5 U	5 U	NC	6 U	6 U	NC

NOTES:
RPD – Relative Percent Difference
RPD = absolute value of $((S_1-S_2)/((S_1+S_2)*1/2))*100$, where
S_1 is the orginal sample and S_2 is the duplicate sample.
"U" indicates compound was not detected.
"J" indicates the detected value is an estimated quantity.
"B" indicates compound was found in daily calibration blank.
NC – Not Calculated

TABLE 2-2

SEMIVOLATILE ORGANIC COMPOUNDS
QA/QC SUMMARY
DUPLICATE SAMPLES

Sample ID: Lab Sample ID: Sample Date:	HA1-2 590-2937 10/7/93	HA10-2 (HA1-2 Dup) 590-2941 10/7/93	RPD HA1-2 HA10-2	HA3-1 590-2939 10/7/93	SED-3 588-2930 10/7/93	SED-10 (SED-3 Dup) 588-2929 10/7/93	RPD SED-3 SED-10
COMPOUND	MDL Q	MDL Q		MDL Q	MDL Q	MDL Q	
SVOC (EPA 8270) **GC/MS (ug/kg)**							
Phenol	346 U	344 R	NC	1575 U	365 R	736 U	NC
bis-(2-Chloroethyl)ether	346 U	344 R	NC	1575 U	365 R	736 U	NC
2-Chlorophenol	346 U	344 R	NC	1575 U	365 R	736 U	NC
1,3-Dichlorobenzene	346 U	344 R	NC	1575 U	365 R	736 U	NC
1,4-Dichlorobenzene	346 U	344 R	NC	1575 U	365 R	736 U	NC
Benzyl Alcohol	346 U	344 R	NC	1575 U	365 R	736 U	NC
1,2-Dichlorobenzene	346 U	344 R	NC	1575 U	365 R	736 U	NC
2-Methylphenol	346 U	344 R	NC	1575 U	365 R	736 U	NC
bis(2-Chloroisopropyl)ether	346 U	344 R	NC	1575 U	365 R	736 U	NC
4-Methylphenol	346 U	344 R	NC	1575 U	365 R	736 U	NC
N-Nitroso-di-n-propylamine	346 U	344 R	NC	1575 U	365 R	736 U	NC
Hexachloroethane	346 U	344 R	NC	1575 U	365 R	736 U	NC
Nitrobenzene	346 U	344 R	NC	1575 U	365 R	736 U	NC
Isophorone	346 U	344 R	NC	1575 U	365 R	736 U	NC
2-Nitrophenol	346 U	344 R	NC	1575 U	365 R	736 U	NC
2,4-Dimethylphenol	1730 U	1721 R	NC	7876 U	1827 R	3679 U	NC
Benzoic Acid	346 U	344 R	NC	1575 U	365 R	736 U	NC
bis(2-Chloroethoxy)methane	346 U	344 R	NC	1575 U	365 R	736 U	NC
2,4-Dichlorophenol	346 U	344 R	NC	1575 U	365 R	736 U	NC
1,2,4-Trichlorobenzene	346 U	344 R	NC	1575 U	365 R	736 U	NC
Naphthalene	346 U	344 R	NC	1575 U	365 R	736 U	NC
4-Chloroaniline	346 U	344 R	NC	1575 U	365 R	736 U	NC
Hexachlorobutadiene	346 U	344 R	NC	1575 U	365 R	736 U	NC
4-Chloro-3-methylphenol	346 U	344 R	NC	1575 U	365 R	736 U	NC
2-Methylnaphthalene	346 U	344 R	NC	1575 U	365 R	736 U	NC
Hexachlorocylopentadiene	346 U	344 R	NC	1575 U	365 R	736 U	NC
2,4,6-Trichlorophenol	346 U	344 R	NC	1575 U	365 R	736 U	NC
2,4,5-Trichlorophenol	1730 U	1721 R	NC	7876 U	1827 R	3679 U	NC
2,Chloronaphthalene	346 U	344 R	NC	1575 U	365 R	736 U	NC
2-Nitroaniline	1730 U	1721 R	NC	7876 U	1827 R	3679 U	NC
Dimethyl phthalate	346 U	344 R	NC	1575 U	365 R	736 U	NC
Acenaphthylene	346 U	344 R	NC	1575 U	365 R	736 U	NC
2,6-Dinitrotoluene	1730 U	1721 R	NC	7876 U	1827 R	3679 U	NC
3-Nitroaniline	1730 U	1721 R	NC	7876 U	1827 R	3679 U	NC
2-Methyl-4,6-dinitrophenol	1730 U	1721 R	NC	7876 U	1827 R	3679 U	NC
N-nitrosodimethylamine	346 U	344 R	NC	1575 U	365 R	736 U	NC
Azobenzene	1730 U	1721 R	NC	7876 U	1827 R	3679 U	NC

TABLE 2-2

SEMIVOLATILE ORGANIC COMPOUNDS
QA/QC SUMMARY
DUPLICATE SAMPLES

Sample ID: Lab Sample ID: Sample Date:	HA1-2 590-2937 10/7/93	HA10-2 (HA1-2 Dup) 590-2941 10/7/93	RPD HA1-2 HA10-2	HA3-1 590-2939 10/7/93	SED-3 588-2930 10/7/93	SED-10 (SED-3 Dup) 588-2929 10/7/93	RPD SED-3 SED-10
COMPOUND	MDL Q	MDL Q		MDL Q	MDL Q	MDL Q	
SVOC (EPA 8270) **GC/MS (ug/kg)**							
Acenaphthene	346 U	344 R	NC	1575 U	365 R	736 U	NC
2,4-Dinitrophenol	1730 U	1721 R	NC	7876 U	1827 R	3679 U	NC
4-Nitrophenol	1730 U	1721 R	NC	7876 U	1827 R	3679 U	NC
Dibenzofuran	346 U	344 R	NC	1575 U	365 R	736 U	NC
2,4-Dinitrotoluene	346 U	344 R	NC	1575 U	365 R	736 U	NC
Diethylphthalate	346 U	344 R	NC	1575 U	365 R	736 U	NC
4,Chlorophenyl-phenylether	346 U	344 R	NC	1575 U	365 R	736 U	NC
Fluorene	346 U	344 R	NC	1575 U	365 R	736 U	NC
4-Nitroaniline	1730 U	1721 R	NC	7876 U	1827 R	3679 U	NC
N-Nitrosodiphenylamine(1)	346 U	344 R	NC	1575 U	365 R	736 U	NC
4-Bromophenyl-phenylether	346 U	344 R	NC	1575 U	365 R	736 U	NC
Hexachlorobenzene	346 U	344 R	NC	1575 U	365 R	736 U	NC
Pentachlorophenol	1730 U	1721 R	NC	7876 U	1827 R	3679 U	NC
Phenanthrene	346 U	344 R	NC	1575 U	365 R	736 U	NC
Anthracene	346 U	344 R	NC	1575 U	365 R	736 U	NC
Di-n-butylphthalate	346 U	55 344 R	NC	1575 U	365 R	736 U	NC
Fluoranthene	346 U	344 R	NC	1575 U	365 R	736 U	NC
Pyrene	346 U	344 R	NC	1575 U	365 R	736 U	NC
Butylbenzylphthalate	346 U	344 R	NC	1575 U	365 R	736 U	NC
3,3'-Dichlorobenzidine	692 U	688 R	NC	3150 U	731 R	1472 U	NC
Benzo(a)anthracene	346 U	344 R	NC	1575 U	365 R	736 U	NC
Bis(2-ethylhexyl)phthalate	346 U	344 R	NC	1575 U	365 R	736 U	NC
Chrysene	346 U	344 R	NC	1575 U	365 R	736 U	NC
Di-n-octyl phthalate	346 U	344 R	NC	1575 U	365 R	736 U	NC
Benzo(b)fluoranthene	346 U	344 R	NC	1575 U	365 R	736 U	NC
Benzo(k)fluoranthene	346 U	344 R	NC	1575 U	365 R	736 U	NC
Benzo(a)pyrene	346 U	344 R	NC	1575 U	365 R	736 U	NC
Indeno(1,2,3-cd)pyrene	346 U	344 R	NC	1575 U	365 R	736 U	NC
Dibenz(a,h)anthracene	346 U	344 R	NC	1575 U	365 R	736 U	NC
Benzo(g,h,i)perylene	346 U	344 R	NC	1575 U	365 R	736 U	NC

NOTES:
RPD – Relative Percent Difference
RPD = absolute value of $((S_1-S_2)/((S_1+S_2)*1/2))*100$, where
S_1 is the orginal sample and S_2 is the duplicate sample.
"U" indicates compound was not detected.
"J" indicates the detected value is an estimated quantity.
"B" indicates compound was found in daily calibration blank.
R" indicates the data are unusable (compound may or may not be present). Resampling and reanalysis is necessary for verfication.
NC – Not Calculated

TABLE 2–3

POLYCHLORINATED BIPHENYL COMPOUNDS
QA/QC SUMMARY
DUPLICATE SAMPLES

COMPOUND:			PCBs (EPA Method 8080)																				
			Aroclor 1016			Aroclor 1221			Aroclor 1232			Aroclor 1242			Aroclor 1248			Aroclor 1254			Aroclor 1260		
Sample ID:	Laboratory Sample ID:	Sample Date:	Conc. (μg/kg)	MDL	Q	Conc. (μg/kg)	MDL	Q	Conc. (μg/kg)	MDL	Q	Conc. (μg/kg)	MDL	Q	Conc. (μg/kg)	MDL	Q	Conc. (μg/kg)	MDL	Q	Conc. (μg/kg)	MDL	Q
Sediments																							
SED–3	588–2930	10/7/93		89	U		89	U		89	U		89	U		89	U		177	U		177	U
SED–10 (SED–3 Dup)	588–2929	10/7/93		89	U		89	U		89	U		89	U		89	U		178	U		178	U
RPD	**SED–3**	**SED–10**		NC			NC			NC			NC			NC			NC			NC	
Vadose Zone																							
SS14–0	573–2864	9/30/93		82	U		82	U		82	U		82	U		82	U		163	U		163	U
SS41–0 (SS14–0 Dup)	573–2865	9/30/93		82	U		82	U		82	U		82	U		82	U		163	U		163	U
RPD	**SS14–0**	**SS41–0**		NC			NC			NC			NC			NC			NC			NC	
SS29–0	573–2860	9/30/93		84	U		84	U		84	U		84	U		84	U		168	U		168	U
SS92–0 (SS29–0 Dup)	573–2862	9/30/93		84	U		84	U		84	U		84	U		84	U		168	U		168	U
RPD	**SS29–0**	**SS92–0**		NC			NC			NC			NC			NC			NC			NC	

NOTES:
RPD – Relative Percent Difference
RPD = absolute value of $((S_1-S_2)/((S_1+S_2)*1/2))*100$, where
S_1 is the orginal sample and S_2 is the duplicate sample.
"U" indicates compound was not detected.
"J" indicates the detected value is an estimated quantity.
"B" indicates compound was found in daily calibration blank.
NC – Not Calculated

TABLE 2-4

TOTAL PETROLUEM HYDROCARBON COMPOUNDS
QA/QC SUMMARY
DUPLICATE SAMPLES

ANALYSIS:				WTPH by 418.1 IR (C8 - C30+)			WTPH as Diesel GC/FID (>C10-C28)		
Sample ID:	Lab Sample ID:	Sample Date:	Sample Depth: (feet bgs)	Conc.: (mg/kg)	MDL	Q	Conc.: (mg/kg)	MDL	Q
Vadose Zone									
MW35-10	573-2848	09/28/93	10		103	U	17	26	J
MW53-10	573-2849	09/28/93	10		103	U		26	U
(MW35-10 Dup)									
RPD	**MW35-10**	**MW53-10**			NC			NC	
HA1-2	590-2937	10/07/93	2		105	U			
HA10-2	590-2941	10/07/93	2		104	U			
(HA1-2 Dup)									
RPD	**HA1-2**	**HA10-2**			NC				
SS14-0	573-2864	09/30/93	0	190	102				
SS41-0	573-2865	09/30/93	0	200	102				
(SS14-0 Dup)									
RPD	**SS14-0**	**SS41-0**		**5**					
SS29-0	573-2860	09/30/93	0	880	105				
SS92-0	573-2862	09/30/93	0	950	105				
(SS29-0 Dup)									
RPD	**SS29-0**	**SS92-0**		**8**					
B8-17	621-3142	10/20/93	17	200	105		59	26	
B80-17	621-3143	10/20/93	17	280	136		120	34	
(B8-17 Dup)									
RPD	**B8-17**	**B80-17**		**33**			**69**		
MW39-10	618-3094	10/18/93	10	3200	200		1560	30	
MW93-10	621-3140	10/19/93	10	3500	236		1800	30	
(MW39-10 Dup)									
RPD	**MW39-10**	**MW93-10**		**9**			**14**		
Saturated-Clean Zone									
B5-17	626-3174	10/24/93	17		136	U			
B50-17	626-3175	10/24/93	17		137	U			
(B5-17 Dup)									
RPD	**B5-17**	**B50-17**			NC				
MW37-23	626-3166	10/22/93	23		123	U			
MW73-23	626-3167	10/22/93	23		136	U			
(MW37-23 Dup)									
RPD	**MW37-23**	**MW73-23**			NC				

TABLE 2-4

TOTAL PETROLUEM HYDROCARBON COMPOUNDS
QA/QC SUMMARY
DUPLICATE SAMPLES

ANALYSIS:				WTPH by 418.1 IR (C8 – C30+)			WTPH as Diesel GC/FID (>C10–C28)		
Sample ID:	Lab Sample ID:	Sample Date:	Sample Depth: (feet bgs)	Conc.: (mg/kg)	MDL	Q	Conc.: (mg/kg)	MDL	Q
DW1-22 1/2	559-2782	09/28/93	22.5		132	U			
DW10-22 1/2 (DW1-22 1/2 Dup)	559-2783	09/28/93	22.5		132	U			
RPD	**DW1-22 1/2**	**DW10-22 1/2**			NC				
DW5-17	626-3170	10/23/93	17		136	U			
DW50-17 (DW5-17 Dup)	626-3171	10/23/93	17		130	U			
RPD	**DW5-17**	**DW50-17**			NC				
Sediments									
SED-3	588-2930	10/07/93	0		111	U			
SED-10 (SED-3 Dup)	588-2929	10/07/93	0		111	U			
RPD	**SED-3**	**SED-10**			NC				

NOTES:
RPD – Relative Percent Difference
RPD = absolute value of $((S_1-S_2)/((S_1+S_2)*1/2))*100$, where
S_1 is the orginal sample and S_2 is the duplicate sample.
"U" indicates compound was not detected.
"J" indicates the detected value is an estimated quantity.
"B" indicates compound was found in daily calibration blank.
NC – Not Calculated

TABLE 2–5

METAL COMPOUNDS
QA/QC SUMMARY
DUPLICATE SAMPLES

COMPOUND:			METALS												
Sample ID	Laboratory Sample ID	Sample Date	Silver (mg/kg)	Arsenic (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Lead (mg/kg)	Antimony (mg/kg)	Selenium (mg/kg)	Thallium (mg/kg)	Zinc (mg/kg)
Vadose Zone															
B11–0	/01837	9/27/93	<1	11.2	<0.5	<0.5	43	36	0.16	37	1897	0.1	0.3	<0.2	187
B110–0	/01838	9/27/93	<1	10.9	<0.5	<0.5	41	33	0.13	36	967	<0.1	<0.2	<0.2	147
(B11–0 Dup)															
RPD	**B11–0**	**B110–0**	NC	3	NC	NC	5	9	21	3	65	NC	NC	NC	24
HA1–2	/01994	10/7/93	<1	9	<0.5	<0.6	29.7	18.7	0.02	26.1	20.9	<0.2	<0.1	<0.2	46.9
HA10–2	/01998	10/7/93	<1	4	<0.5	<0.6	27.9	14.6	<0.02	21.7	11.4	<0.2	<0.1	<0.2	37.5
(HA1–2 Dup)															
RPD	**HA1–2**	**HA10–2**	NC	77	NC	NC	6	25	NC	18	59	NC	NC	NC	22
Vadose Zone															
SS14–0	/01928	9/30/93	<1	12	<0.5	<0.6	17.5	39.5	0.02	17.5	67.4	<0.3	<0.1	<0.2	60
SS41–0	/01929	9/30/93	<1	11	<0.5	<0.6	18.9	40	<0.02	18.7	73.3	<0.3	<0.1	<0.2	62.5
(SS14–0 Dup)															
RPD	**SS14–0**	**SS41–0**	NC	9	NC	NC	8	1	NC	7	8	NC	NC	NC	4
SS29–0	/01924	9/30/93	<2.1	21	<1.1	<1.1	18.1	323	0.05	71.9	402	2.6	0.2	<0.2	264
SS92–0	/01926	9/30/93	<1	17	<0.5	<0.6	22.3	350	0.06	72.2	440	1.6	0.5	<0.2	262
(SS29–0 Dup)															
RPD	**SS29–0**	**SS92–0**	NC	21	NC	NC	21	8	18	0	9	48	86	NC	1
Sediments															
SED–3	/01989	10/7/93	<1	3	<0.5	<0.6	19.7	10.9	<0.02	17.6	2.8	<0.2	<0.1	<0.2	30.2
SED–10	/01988	10/7/93	<1.1	10	<0.5	<0.6	25.2	15.7	<0.02	25.6	4.4	<0.2	<0.1	<0.2	32.4
(SED–3 Dup)															
RPD	**SED–3**	**SED–10**	NC	108	NC	NC	24	36	NC	37	44	NC	NC	NC	7

NOTES:
RPD – Relative Percent Difference
RPD = absolute value of $((S_1 - S_2)/((S_1 + S_2)*1/2))*100$, where
S_1 is the original sample and S_2 is the duplicate sample.
"U" indicates compound was not detected.
"J" indicates the detected value is an estimated quantity.
"B" indicates compound was found in daily calibration blank.
NC – Not Calculated

ATTACHMENT 1

ORGANIC DATA ASSESSMENT

LABORATORY: ACE
SITE: BN SKYKOMISH
NO. OF SAMPLE/MATRIX: 30 soils
REVIEWER'S NAME: Kim Lofgren

DATA ASSESSMENT SUMMARY

	OTHER WTPH-G 8020	OTHER WTPH-D 8015	OTHER PCB/8080
HOLDING TIMES	O	O	O
CALIBRATIONS	NA	NA	NA
BLANKS	NA	NA	NA
SURROGATES	O	O	NA
MATRIX SPIKE/DUP	NA	NA	NA
OTHER QC	NA	NA	NA
INTERNAL STANDARDS	NA	NA	NA
COMPOUND IDENTIFICATION	O	O	O
SYSTEM PERFORMANCE	NA	NA	NA
OVERALL ASSESSMENT	O	O	O

O=DATA HAD NO PROBLEMS/OR QUALIFIED DUE TO MINOR PROBLEMS.
M=DATA QUALIFIED DUE TO MAJOR PROBLEMS.
Z=DATA UNACCEPTABLE.
X=PROBLEMS, BUT DO NOT AFFECT DATA.

ACTION ITEMS:

AREAS OF CONCERN: WTPH-D 8015 - Sample OW 4-7½ qualified w/ "J" due to ~~sample~~ surrogate diluting out.

NOTABLE PERFORMANCE:

ORGANIC DATA ASSESSMENT

LABORATORY: ACZ
SITE: BN SKYKOMISH
NO. OF SAMPLE/MATRIX: 90 Soils
REVIEWER'S NAME: Kim Lofgren

DATA ASSESSMENT SUMMARY

	VOC/8240	SVOC/8270	TPH/ 418.1	METALS/ 6000 - 7000
HOLDING TIMES	O	O	O	O
CALIBRATIONS	NA	NA	NA	NA
BLANKS	NA	NA	NA	NA
SURROGATES	NA	NA	NA	NA
MATRIX SPIKE/DUP	NA	NA	NA	NA
OTHER QC	NA	NA	NA	NA
INTERNAL STANDARDS	NA	NA	NA	NA
COMPOUND IDENTIFICATION	O	O	O	O
SYSTEM PERFORMANCE	NA	NA	NA	NA
OVERALL ASSESSMENT	O	O	O	O

O=DATA HAD NO PROBLEMS/OR QUALIFIED DUE TO MINOR PROBLEMS.
M=DATA QUALIFIED DUE TO MAJOR PROBLEMS.
Z=DATA UNACCEPTABLE.
X=PROBLEMS, BUT DO NOT AFFECT DATA.

ACTION ITEMS: 8240 - no supporting QA/QC, no surrogate recoveries, method blanks Sample B4-10, OW2-10, B40-10, MW34-7 1/2, MW33-5, MW40-5, methylene chloride, Acetone in samples

AREAS OF CONCERN: 418.1 → no supporting QA/QC
8020 → Surrogate recoveries only, no QA/QC
8015 - Surrogate recoveries only, no QA/QC, sample OW1-5 nitrobenzene %R = 33 seems low

NOTABLE PERFORMANCE:

8270 - no surrogate recoveries, no QA/QC, method blanks
8080 - no supporting QA/QC, no surrogate recoveries, no method blanks
metals - no supporting QA/QC

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

ANALYSIS AND EXTRACTION DATE/HOLDIG TIMES

PROJECT: BN Skykomish
PROJECT #: 3-1761
SAMPLE MATRIX: 30 Soils
PAGE 1 **of** 2

ANALYSIS			WTPH - 418.1		WTPH-G 8020		WTPH-D -8015		VOC / 8240			
Sample Number	Lab Number	Sample Date	Extract	Analyze	Extract	Analyze	Extract	Analyze	Extract	Analyze	Analyze	Analyze
DW4-7½	559-2778	9/27/93	10/9/93	10/19/93			10/9/93	11/4/93		~~10/8/93~~		
DW2-0												
DW2-2												
DW2-22½	559-2782	9/28/93	10/9/93	10/19/93								
B4-0												
DW10-22½	559-2783		10/9/93	10/19/93								
B4-2												
B4-10	559-2768									10/11/93		
B4-10	559-2785		10/18/93	10/19/93						~~10/11/93~~		
B40-10	559-2769									10/11/93		
mw34-0												
MW34-7½	559-2770									10/7/93		
mw38-10	559-2773		10/9/93	10/19/93			10/9/93	11/3/93				
mw33-0												
mw33-2½	559-2775		10/9/93	10/19/93	10/11/93	10/18/93	10/9/93	11/4/93				
mw33-5	559-2771									10/7/93		
mw33-12½	559-2784		10/10/93	10/19/93								
DW-2-5	559-2774	9/27/93	10/9/93	10/19/93			10/9/93	11/3/93				
DW-2-10	559-2767									10/8/93		
DW-2-12½	559-2779		10/9/93	10/19/93								
mw-40-0												
mw-40-12½	559-2780		10/9/93	10/19/93								
B11-0												
B11-5	559-2776		10/9/93	10/19/93			10/9/93	11/4/93				
B11-10	559-2781		10/9/93	10/19/93								
B110-0												
DW4-0												
DW1-0		9/28/93										
DW1-5	559-2777		10/9/93	10/9/93								
MW40-5	559-2772	9/27/93			10/11/93	11/10/93	10/9/93	11/3/93		10/7/93		

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

ANALYSIS AND EXTRACTION DATE/HOLDIG TIMES

PROJECT: BN Skykomish
PROJECT #: 3-1161
SAMPLE MATRIX: 30 Soils
PAGE 2 **of** 2

ANALYSIS			SVOC - 8270		PCB - 8080		Metals 6010/7000					
Sample Number	Lab Number	Sample Date	Extract	Analyze	Extract	Analyze	Extract	Analyze	Extract	Analyze	Analyze	Analyze
DW4-7½	559-2778	9/27/93						✓				
DW2-0/559-2788	~~93-51/01834~~	✓			10/8/93	10/16/93		10/19/93				
DW1-22½	559-2782	2/28/93										
B4-0	93-51/01835							10/19/93 ✓				
DW10-22½	559-2783											
B4-2	559-2787				10/8/93	10/16/93						
B4-10	559-2768							✓				
B4-10	559-2785		10/8/93	11/15/93	10/8/93	10/16/93						
B4-10	559-2769							✓				
MW-34-0	559-2773		10/8/93	11/13/93				10/19/93				
MW34-7½	559-2770							✓				
MW34-10	559-2773							✓				
MW33-0	93-51/01842							10/19/93				
MW33-2½	559-2775		10/8/93	11/13/93								
MW33-5	559-2771											
MW33-12½	559-2784	✓										
DW2-5	559-2774	9/27/93	10/8/93	11/13/93								
DW2-10	559-2767											
DW2-2½	559-2779											
MW40-0	93-51/01836							10/19/93				
MW40-12½	559-2780											
B11-0	93-51/01837							10/19/93				
B11-5	559-2776											
B11-10	559-2781											
B110-0	93-51/01838							10/19/93				
DW4-0/559-2789	~~93-51/01839~~	✓			10/8/93	10/16/93		10/19/93				
DW1-0	93-51/01840	9/28/93						10/19/93				
DW1-5	559-2777	9/27/93										
MW40-5	559-2772		10/8/93	11/13/93	10/8/93	10/16/93						
DW2-2	559-2786	✓			10/8/93	10/16/93						

ORGANIC DATA ASSESSMENT

LABORATORY: ACZ
SITE: BN SKYKOMISH
NO. OF SAMPLE/MATRIX: 4 SOILS
REVIEWER'S NAME: K. Lofgren

DATA ASSESSMENT SUMMARY

	OTHER WTPH-418.1	OTHER PCB-8080	OTHER metals
HOLDING TIMES	O	O	O
CALIBRATIONS	NA	NA	NA
BLANKS	NA	NA	NA
SURROGATES	NA	NA	NA
MATRIX SPIKE/DUP	NA	NA	NA
OTHER QC	NA	NA	NA
INTERNAL STANDARDS	NA	NA	NA
COMPOUND IDENTIFICATION	O	O	O
SYSTEM PERFORMANCE	NA	NA	NA
OVERALL ASSESSMENT	O	O	O

O=DATA HAD NO PROBLEMS/OR QUALIFIED DUE TO MINOR PROBLEMS.
M=DATA QUALIFIED DUE TO MAJOR PROBLEMS.
Z=DATA UNACCEPTABLE.
X=PROBLEMS, BUT DO NOT AFFECT DATA.

ACTION ITEMS:

AREAS OF CONCERN: NO supporting QA/QC documentation

NOTABLE PERFORMANCE:

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

ANALYSIS AND EXTRACTION DATE/HOLDIG TIMES

PROJECT: BN SKYKOMISH
PROJECT #: 3-1161
SAMPLE MATRIX: 4 soils
PAGE 1 of 1

ANALYSIS			WTPH - 418.1		PCB - 8080		METALS 6010/7000					
Sample Number	Lab Number	Sample Date	Extract	Analyze	Extract	Analyze	Extract	Analyze	Extract	Analyze	Analyze	Analyze
BG1-0	578-2895	10/02/93	10/14/93	10/19/93	10/12/93	10/26/93		10/30/93				
SS80-0	578-2896	↓	↓	↓	10/12/93	10/26/93		10/30/93				
SS26-0	578-2897	↓	↓	↓	10/12/93	10/26/93		10/30/93				
SS25-0	578-2898	↓	↓	↓	10/12/93	10/26/93		10/30/93				

ORGANIC DATA ASSESSMENT

LABORATORY: ACZ
SITE: BN SKYKOMISH
NO. OF SAMPLE/MATRIX: 34 soil
REVIEWER'S NAME: K. Lofgren

DATA ASSESSMENT SUMMARY

	OTHER WTPH 418.1	OTHER WTPH-D/8015	OTHER VOC/8240
HOLDING TIMES	O	O	O
CALIBRATIONS	NA	NA	NA
BLANKS	NA	NA	NA
SURROGATES	NA	O	NA
MATRIX SPIKE/DUP	NA	NA	NA
OTHER QC	NA	NA	NA
INTERNAL STANDARDS	NA	NA	NA
COMPOUND IDENTIFICATION	O	NA	NA
SYSTEM PERFORMANCE	NA	NA	NA
OVERALL ASSESSMENT	O	[illegible]	[illegible]

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Z=DATA UNACCEPTABLE.
X=PROBLEMS, BUT DO NOT AFFECT DATA.

ACTION ITEMS: 8240 → MW35-7½ + MW53-7½ Acetone and methylene chloride in samples, qualified with a "U"

AREAS OF CONCERN: WTPH-418.1 – no supporting QA/QC,
WTPH-D/8015 – MW35-10 – nitrobenzene 12% low, B10-10 surrogates diluted out qualified w/ a "J", B10-15 surrogates diluted out – "J"

NOTABLE PERFORMANCE:

ORGANIC DATA ASSESSMENT

LABORATORY: ACZ
SITE: BN SKyKomish
NO. OF SAMPLE/MATRIX: 34 Soils
REVIEWER'S NAME: K. Wagner

DATA ASSESSMENT SUMMARY

	OTHER PCB/8080	OTHER metals 6010/7000	OTHER
HOLDING TIMES	0	0	
CALIBRATIONS	NA	NA	
BLANKS	NA	NA	
SURROGATES	NA	NA	
MATRIX SPIKE/DUP	NA	NA	
OTHER QC	NA	NA	
INTERNAL STANDARDS	NA	NA	
COMPOUND IDENTIFICATION	NA	NA	
SYSTEM PERFORMANCE	NA	NA	
OVERALL ASSESSMENT	0	0	

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Z=DATA UNACCEPTABLE.
X=PROBLEMS, BUT DO NOT AFFECT DATA.

ACTION ITEMS:

AREAS OF CONCERN:

NOTABLE PERFORMANCE:

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

ANALYSIS AND EXTRACTION DATE/HOLDIG TIMES

PROJECT: BN-Skykomish
PROJECT #: 3-F161
SAMPLE MATRIX: 34 Soils
PAGE 1 **of** 2

ANALYSIS			WTPH-418.1		WTPH-D/8015		VOC/8240		PCB/8080		metals	
Sample Number	Lab Number	Sample Date	Extract	Analyze	Extract	Analyze	Extract	Analyze	Extract	Analyze	Analyze	Analyze
MW35-0		9/28/93			10/9/93	11/4/93					10/30/93	
MW35-7½	573-2845				~~10/2/93~~	~~10/11/93~~	10/2/93	10/11/93				
MW35-10	573-2848		10/10/93	10/19/93								
MW53-7½	573-2846				~~10/2/93~~	~~10/8/93~~	10/2/93	10/11/93				
MW63-10	573-2849	↓	10/10/93	10/19/93	10/9/93	11/5/93						
DW3-0	573-2857	9/29/93							10/11/93	10/18/93	10/30/93	
DW3-2	573-2853								10/11/93	10/18/93		
DW3-7½	573-2850		10/10/93	10/19/93	10/9/93	11/5/93						
DW3-17½	573-2847		10/10/93	10/19/93								
B10-0	-										10/30/93	
B10-10	573-2851		10/10/93	10/19/93	10/9/93	11/5/93						
B10-15	573-2852		10/10/93	10/19/93								
SS28-0	573-2855	↓							10/11/93	10/18/93		
SS30-0	573-2856	9/30/93	10/10/93	10/19/93					10/11/93	10/18/93	10/30/93	
BG2-0	573-2854	↓	10/10/93	10/19/93					10/11/93	10/18/93		
BG2-0	-		~~10/10/93~~								10/30/93	
SS32-0	573-2858		10/10/93	10/19/93					10/11/93	10/18/93		
SS31-0	573-2859		10/10/93	10/19/93					10/11/93	10/18/93	10/30/93	
SS29-0	573-2860		10/10/93	10/19/93					10/11/93	10/18/93	10/30/93	
SS27-0	573-2861		10/10/93	10/19/93					10/11/93	10/18/93	10/30/93	
SS92-0	573-2862		10/10/93	10/19/93					10/11/93	10/18/93	10/30/93	
SS13-0	573-2863		10/10/93	10/19/93					10/11/93	10/18/93	10/30/93	
SS14-0	573-2864		10/10/93	10/19/93					10/11/93	10/18/93	10/30/93	
SS41-0	573-2865		10/10/93	10/19/93					10/11/93	10/18/93	10/30/93	
SS15-0	573-2866		10/10/93	10/19/93					10/11/93	10/18/93	10/30/93	
SS16-0	573-2867		10/10/93	10/19/93					10/11/93	10/24/93	10/30/93	
SS18-0	573-2868		10/10/93	10/19/93					10/11/93	10/24/93	10/30/93	
SS17-0	573-2869		10/10/93	10/19/93					10/11/93	10/24/93	10/30/93	
SS19-0	573-2870		10/10/93	10/19/93					10/11/93	10/24/93	10/30/93	
SS19.1-0	573-2871		10/10/93	10/19/93					10/12/93	10/26/93	10/30/93	
SS21-0	573-2872	↓	10/10/93	10/19/93					10/12/93	10/27/93	10/30/93	

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

ANALYSIS AND EXTRACTION DATE/HOLDIG TIMES

PROJECT: BN-SKYKOMISH
PROJECT #: 3-1161
SAMPLE MATRIX: 34 Soils
PAGE 2 **of** 2

ANALYSIS			WTPH-418.1		WTPH-D/8015		VOC/8270		PCB/8080		Metals	
Sample Number	Lab Number	Sample Date	Extract	Analyze	Extract	Analyze	Extract	Analyze	Extract	Analyze	Analyze	Analyze
SS22-0	573-2873	9/30/93	10/10/93	10/19/93			10/12/93	10/27/93			10/30/93	
SS23-0	573-2874	↓	10/10/93	10/19/93			10/12/93	10/27/93			10/30/93	
SS24-0	573-2875	↓	10/10/93	10/19/93							10/30/93	

ORGANIC DATA ASSESSMENT

LABORATORY: ACZ
SITE: BN SKYKOMISH
NO. OF SAMPLE/MATRIX: 3/ Soils
REVIEWER'S NAME: K. Lofgren

DATA ASSESSMENT SUMMARY

	VOC/8240	SVOC/ 8270	TPH/ 418.1	METALS/ 6010/7000
HOLDING TIMES	O	M	O	O
CALIBRATIONS	NA	NA	NA	NA
BLANKS	NA	NA	NA	NA
SURROGATES	NA	NA	NA	NA
MATRIX SPIKE/DUP	NA	NA	NA	NA
OTHER QC	NA	NA	NA	NA
INTERNAL STANDARDS	NA	NA	NA	NA
COMPOUND IDENTIFICATION	NA	NA	NA	NA
SYSTEM PERFORMANCE	NA	NA	NA	NA
OVERALL ASSESSMENT	O	O	O	O

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ACTION ITEMS: B7-17 in BD15-m surrogates diluted out - qualified w "J"
MW37-7 1/2, MW38-7 1/2, qualified with "U" for acetone and methylene chloride in blank
B5-7 methylene chloride in blank

AREAS OF CONCERN: 8270 holding time violations in sample B5-7 all positive results qualified w "J"

NOTABLE PERFORMANCE:

ORGANIC DATA ASSESSMENT

LABORATORY: ACZ

SITE: BN-SKYKOMISH

NO. OF SAMPLE/MATRIX: 21 Soils

REVIEWER'S NAME: K. Wolfgren

DATA ASSESSMENT SUMMARY

	OTHER WTPH-G 8015-m	OTHER WTPH-D 8015-m	OTHER PCB/8080
HOLDING TIMES	O	O	O
CALIBRATIONS	NA	NA	NA
BLANKS	NA	NA	NA
SURROGATES	NA	O -	NA
MATRIX SPIKE/DUP	NA	NA	NA
OTHER QC	NA	NA	NA
INTERNAL STANDARDS	NA	NA	NA
COMPOUND IDENTIFICATION	NA	NA	NA
SYSTEM PERFORMANCE	NA	NA	NA
OVERALL ASSESSMENT	O	O	O

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X=PROBLEMS, BUT DO NOT AFFECT DATA.

ACTION ITEMS:

AREAS OF CONCERN:

NOTABLE PERFORMANCE:

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

ANALYSIS AND EXTRACTION DATE/HOLDIG TIMES

PROJECT: BN-SKyKomish
PROJECT #: 3-1161
SAMPLE MATRIX: 21 Soils
PAGE____ of ______

ANALYSIS			SVOC/8270		PCB/8080		metals 6010/7000					
Sample Number	Lab Number	Sample Date	Extract	Analyze	Extract	Analyze	Extract	Analyze	Extract	Analyze	Analyze	Analyze
mw37-7½	626-3159	10/22/93										
mw37-12½												
mw37-23	626-3166											
mw33-23	626-3167											
B7-0	626-3176				10/27/93	11/3/93		11/17/93				
B7-11	626-3163											
B7-17	626-3164											
B7-22	626-3168											
mw34B-17	626-3169	10/23/93										
DW6-0	626-3178				10/27/93	11/3/93		11/17/93				
DW5-17	626-3170											
DW50-17	626-3171											
mw38-0								11/17/93				
mw38-7½	626-3161	10/24/93										
mw38-12	626-3172											
B4B-17	626-3173											
B5-0								11/17/93				
B5-7	626-3160		NA	NA								
B5-17	626-3174											
B50-17	626-3178											
DW5-12	626-3165	10/23/93										

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

ANALYSIS AND EXTRACTION DATE/HOLDIG TIMES

PROJECT: BN SKYKomish
PROJECT #: 3-1161
SAMPLE MATRIX: 21 Soils
PAGE____ of ______

ANALYSIS			WTPH-418.1		WTPH-G / 8015m		WTPH-D/8015M		Voc/8240			
Sample Number	Lab Number	Sample Date	Extract	Analyze	Extract	Analyze	Extract	Analyze	Extract	Analyze	Analyze	Analyze
MW37-7½	626-3159	10/22/93	10/28/93	11/4/93	10/27/93	10/28/93	10/29/93	11/3/93				
MW37-12½							10/29/93	11/3/93		10/31/93		
MW37-23	626-3166		10/28/93	11/4/93								
MW73-23	626-3167		10/28/93	11/4/93								
B7-0												
B7-11	626-3163		10/28/93	11/4/93			10/29/93	11/3/93				
B7-17	626-3164		10/28/93	11/4/93			10/29/93	11/3/93				
B7-22	626-3168	↓	10/28/93	11/4/93								
MW34B-17	626-3169	10/23/93	10/28/93	11/4/93								
DW5-0												
DW5-17	626-3170		10/28/93	11/4/93								
DW50-17	626-3171		10/28/93	11/4/93								
MW38-0		↓										
MW38-7½	626-3161	10/24/93	10/28/93	11/4/93			10/29/93	11/3/93		10/31/93		
MW38-12	626-3172		10/28/93	11/4/93								
B4B-17	626-3173		10/28/93	11/4/93								
B5-0												
B5-7	626-3160		10/28/93	11/4/93	~~10/27/93~~		10/29/93	11/3/93		10/31/93		
B5-17	626-3174		10/28/93	11/4/93								
B50-17	626-3175	↓	10/28/93	11/4/93								
DW5-12	626-3165	10/23/93	10/28/93	11/4/93			10/29/93	11/05/93				

ORGANIC DATA ASSESSMENT

LABORATORY: ACZ
SITE: BN SKYKOMISH
NO. OF SAMPLE/MATRIX: 11 Soils
REVIEWER'S NAME: Kim Lofgren

DATA ASSESSMENT SUMMARY

	VOC/8240	SVOC/8270	TPH/418.1	METALS/ 6010-7000
HOLDING TIMES	O	O	O	O
CALIBRATIONS	NA	NA	NA	NA
BLANKS	NA	NA	NA	NA
SURROGATES	NA	NA	NA	NA
MATRIX SPIKE/DUP	NA	NA	NA	NA
OTHER QC	NA	NA	NA	NA
INTERNAL STANDARDS	NA	NA	NA	NA
COMPOUND IDENTIFICATION	O	O	O	O
SYSTEM PERFORMANCE	NA	NA	NA	NA
OVERALL ASSESSMENT	O	O	O	O

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ACTION ITEMS: B9-7 1/2, B6-8, MW39-6

AREAS OF CONCERN:

NOTABLE PERFORMANCE:

ORGANIC DATA ASSESSMENT

LABORATORY: ACZ
SITE: BN Skykomish
NO. OF SAMPLE/MATRIX: 11 Soils
REVIEWER'S NAME: K. Lofgren

DATA ASSESSMENT SUMMARY

	OTHER WTPH-G 8015m	OTHER WTPH-D 8015m	OTHER PCB/8080
HOLDING TIMES	O	O	
CALIBRATIONS	NA	NA	
BLANKS	NA	NA	
SURROGATES	O	O	
MATRIX SPIKE/DUP	NA	NA	
OTHER QC	NA	NA	
INTERNAL STANDARDS	NA	NA	
COMPOUND IDENTIFICATION	O	O	
SYSTEM PERFORMANCE	NA	NA	
OVERALL ASSESSMENT	O	O	

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X=PROBLEMS, BUT DO NOT AFFECT DATA.

ACTION ITEMS:

AREAS OF CONCERN:

NOTABLE PERFORMANCE:

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

ANALYSIS AND EXTRACTION DATE/HOLDIG TIMES

PROJECT: BN Skykomish
PROJECT #: 3-1161
SAMPLE MATRIX: 11 Soils
PAGE 1 **of** 2

ANALYSIS			WTPH - 418.1		WTPH-G 8015m		WTPH-D 8015m		VOC 8240			
Sample Number	Lab Number	Sample Date	Extract	Analyze	Extract	Analyze	Extract	Analyze	Extract	Analyze	Analyze	Analyze
B10B-27	618-3091	10/18/93	10/26/93	11/4/93								
B9-0												
B9-7½	618-3095		10/25/93	11/4/93	~~10/29/93~~	~~11/5/93~~	10/29/93	11/5/93		10/30/93		
B9-12½	618-3092		10/25/93	11/4/93								
B6-0												
B6-8	618-3096	10/19/93	10/25/93	11/4/93	~~10/29/93~~	~~11/5/93~~	10/29/93	11/5/93		10/30/93		
B6-10½	618-3098		10/25/93	11/4/93			10/29/93	11/5/93		10/30/93		
B6-23	618-3093		10/25/93	11/4/93								
MW39-0												
MW39-6	618-3097		10/25/93	11/4/93	10/27/93	10/27/93	10/29/93	4/5/93		10/30/93		
MW39-10	618-3094		10/25/93	11/4/93	~~11/29/93~~	~~11/5/93~~	10/29/93	11/5/93				

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

ANALYSIS AND EXTRACTION DATE/HOLDIG TIMES

PROJECT: BN Skykomish
PROJECT #: 3-1961
SAMPLE MATRIX: 11 Soils
PAGE 2 **of** 2

ANALYSIS			SVOC 8270		PCB 8080		metals 6010/7000					
Sample Number	Lab Number	Sample Date	Extract	Analyze	Extract	Analyze	Extract	Analyze	Extract	Analyze	Analyze	Analyze
B10B-27	618-3091	10/18/93										
B9-0					10/27/93	11/3/93		11/01/93				
B9-7½	618-3095		10/22/93	11/22/93								
B9-12½	618-3092											
B6-0					10/27/93	11/3/93		11/01/93				
B6-8	618-3096	10/19/93	10/22/93	11/23/93								
B6-10½	618-3098		10/22/93	11/23/93	10/27/93	11/3/93		11/01/93				
B6-23	618-3093											
mw 39-6	618-3097		10/22/93	11/23/93								
mw 39-10	618-3094											
mw 39-0								11/01/93				

ORGANIC DATA ASSESSMENT

LABORATORY: ACZ
SITE: BN SKYKOMISH
NO. OF SAMPLE/MATRIX: 7 Soils
REVIEWER'S NAME: Kim Lofgren

DATA ASSESSMENT SUMMARY

	OTHER WTPH-418.1	OTHER VOC/8240	OTHER PCB/8080
HOLDING TIMES	O	O	O
CALIBRATIONS	NA	NA	NA
BLANKS	NA	NA	NA
SURROGATES	NA	NA	NA
MATRIX SPIKE/DUP	NA	NA	NA
OTHER QC	NA	NA	NA
INTERNAL STANDARDS	NA	NA	NA
COMPOUND IDENTIFICATION	O	O	O
SYSTEM PERFORMANCE	NA	NA	NA
OVERALL ASSESSMENT	O	O	O

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ACTION ITEMS: 8270 - methylene chloride found in method blank, all positive results qualified w/ a "U" according to 10X rule, acetone detected in sample 590-2940

AREAS OF CONCERN: NO QA/QC for data - no ms/msD, Blank Spikes, method blanks, raw data, surrogates -

VOC - cannot tell what method blank goes w/ what sample - no method blanks included

NOTABLE PERFORMANCE:

WTPH-418.1 - dilution factors, % solids, units included on organic Analysis Report
VOC - 8240 " " " " " "

ORGANIC DATA ASSESSMENT

LABORATORY: ACZ
SITE: BN SKYKOMISH
NO. OF SAMPLE/MATRIX: 7 Soils
REVIEWER'S NAME: K. Lofgren

DATA ASSESSMENT SUMMARY

	OTHER PAH 8270	OTHER METALS	OTHER
HOLDING TIMES	O	O	
CALIBRATIONS	NA	NA	
BLANKS	NA	NA	
SURROGATES	NA	NA	
MATRIX SPIKE/DUP	NA	NA	
OTHER QC	NA	NA	
INTERNAL STANDARDS	NA	NA	
COMPOUND IDENTIFICATION	O	O	
SYSTEM PERFORMANCE	NA	NA	
OVERALL ASSESSMENT	O	O	

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M=DATA QUALIFIED DUE TO MAJOR PROBLEMS.
Z=DATA UNACCEPTABLE.
X=PROBLEMS, BUT DO NOT AFFECT DATA.

ACTION ITEMS:

AREAS OF CONCERN: No supporting QA/QC

NOTABLE PERFORMANCE:

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

ANALYSIS AND EXTRACTION DATE/HOLDIG TIMES

PROJECT: BN Skykomish
PROJECT #: 3-1161
SAMPLE MATRIX: 7 Soils
PAGE 1 of 2

ANALYSIS			WTPH - 418.1		VOC - 8240		SVOC - 8270		PCB - 8080			
Sample Number	Lab Number	Sample Date	Extract	Analyze	Extract	Analyze	Extract	Analyze	Extract	Analyze	Analyze	Analyze
SED-6		10/7/93										
SED-7	590-2936	↓	10/15/93	10/19/93	NA	10/20/93	10/19/93	11/17/93	10/14/93	10/27/93		
HA1-2	590-2937	↓	10/15/93	10/19/93	↓	10/20/93	↓	↓				
HA2-1	590-2938	↓	10/15/93	10/19/93	↓	10/20/93	↓	↓				
HA3-1	590-2939	↓	10/15/93	10/19/93	↓	10/20/93	↓	↓				
HA4-D	590-2940	↓	10/15/93	10/19/93	↓	10/20/93	10/19/93	11/18/93				
HA10-2	590-2941	↓	10/15/93	10/19/93	↓	10/21/93	11/18/93	11/23/93				

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

ANALYSIS AND EXTRACTION DATE/HOLDIG TIMES

PROJECT: BN SKYKOMISH
PROJECT #: 3-1161
SAMPLE MATRIX: 7 Soils
PAGE 2 of 2

ANALYSIS			metals - 6010/7000									
Sample Number	Lab Number	Sample Date	Extract	Analyze	Extract	Analyze	Extract	Analyze	Extract	Analyze	Analyze	Analyze
SED-6		10/7/93		10/30/93								
SED-7	590-2936	↓		10/30/93								
HA1-2	2937	↓		10/30/93								
HA2-1	2938	↓		10/30/93								
HA3-1	2939	↓		10/30/93								
HA4-0	2940	↓		10/30/93								
HA10-2	2941	↓		10/30/93								

ORGANIC DATA ASSESSMENT

LABORATORY: ACZ
SITE: BN SKYKOMISH
NO. OF SAMPLE/MATRIX: 14 Soils
REVIEWER'S NAME: Kim Lofgren

DATA ASSESSMENT SUMMARY

	OTHER WTPH-418.1	OTHER WTPH-D/8015M	OTHER VOC/8240
HOLDING TIMES	O	O	O
CALIBRATIONS	NA	NA	NA
BLANKS	NA	NA	NA
SURROGATES	NA	O –	NA
MATRIX SPIKE/DUP	NA	NA	NA
OTHER QC	NA	NA	NA
INTERNAL STANDARDS	NA	NA	NA
COMPOUND IDENTIFICATION	NA	NA	NA
SYSTEM PERFORMANCE	NA	NA	NA
OVERALL ASSESSMENT	O	O	O

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X=PROBLEMS, BUT DO NOT AFFECT DATA.

ACTION ITEMS: 8015-m – mw93-10 qualified with a "J" value due to no surrogate recoveries

AREAS OF CONCERN: 418.1 - no supporting QA/QC

NOTABLE PERFORMANCE:

ORGANIC DATA ASSESSMENT

LABORATORY: ACZ
SITE: BNI SKYKOMISH
NO. OF SAMPLE/MATRIX: 14 Soils
REVIEWER'S NAME: Kim Lofgren

DATA ASSESSMENT SUMMARY

	OTHER PCB/8080	OTHER metals 6010/7000	OTHER
HOLDING TIMES	O	O	
CALIBRATIONS	NA	NA	
BLANKS	NA	NA	
SURROGATES	NA	NA	
MATRIX SPIKE/DUP	NA	NA	
OTHER QC	NA	NA	
INTERNAL STANDARDS	NA	NA	
COMPOUND IDENTIFICATION	NA	NA	
SYSTEM PERFORMANCE	NA	NA	
OVERALL ASSESSMENT	O	O	

O=DATA HAD NO PROBLEMS/OR QUALIFIED DUE TO MINOR PROBLEMS.
M=DATA QUALIFIED DUE TO MAJOR PROBLEMS.
Z=DATA UNACCEPTABLE.
X=PROBLEMS, BUT DO NOT AFFECT DATA.

ACTION ITEMS:

AREAS OF CONCERN:

NOTABLE PERFORMANCE:

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

ANALYSIS AND EXTRACTION DATE/HOLDIG TIMES

PROJECT: BN SKYKOMISH
PROJECT #: 3-1161
SAMPLE MATRIX: 14 Soils
PAGE 1 of 1

ANALYSIS			WTPH-418.1		WTPH-D/8015M		VOC/8240		PCB/8080		metals	
Sample Number	Lab Number	Sample Date	Extract	Analyze	Extract	Analyze	Extract	Analyze	Extract	Analyze	Analyze	Analyze
MW93-10	621-3140	10/19/93			10/29/93	11/7/93						
MW39-15½	621-3135		10/25/93	11/4/93								
MW35B-12½	621-3136		10/25/93	11/4/93								
B8-0	621-3146	10/20/93							10/27/93	11/3/93	11/01/93	
B8-12	621-3141				10/29/93	11/7/93						
B8-17	621-3142		10/25/93	11/4/93	10/29/93	11/7/93						
B8-22	621-3137		10/25/93	11/4/93								
OW48-12½	621-3138		10/25/93	11/4/93								
B80-17	621-3143		10/25/93	11/4/93	10/29/93	11/7/93						
MW36-0		10/21/93								—	11/01/93	
MW36-6	621-3145		10/28/93	11/4/93	10/29/93	11/7/93		10/31/93				
MW36-7½	621-3144		10/28/93	11/4/93	10/29/93	11/7/93						
MW36-17	621-3139		10/25/93	11/4/93								
MW37-0											11/01/93	

ORGANIC DATA ASSESSMENT

LABORATORY: ACZ
SITE: BN SKYKOMISH
NO. OF SAMPLE/MATRIX: 1 soil
REVIEWER'S NAME: Kim Lofgren

DATA ASSESSMENT SUMMARY

	OTHER	OTHER	OTHER
HOLDING TIMES	O		
CALIBRATIONS	NA		
BLANKS	NA		
SURROGATES	NA		
MATRIX SPIKE/DUP	NA		
OTHER QC	NA		
INTERNAL STANDARDS	NA		
COMPOUND IDENTIFICATION	O		
SYSTEM PERFORMANCE	NA		
OVERALL ASSESSMENT	O		

O=DATA HAD NO PROBLEMS/OR QUALIFIED DUE TO MINOR PROBLEMS.
M=DATA QUALIFIED DUE TO MAJOR PROBLEMS.
Z=DATA UNACCEPTABLE.
X=PROBLEMS, BUT DO NOT AFFECT DATA.

ACTION ITEMS:

AREAS OF CONCERN: No QA/QC supporting documentation

NOTABLE PERFORMANCE:

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

ANALYSIS AND EXTRACTION DATE/HOLDIG TIMES

PROJECT: BN SKYKOMISH
PROJECT #: 3-1161
SAMPLE MATRIX: 1 SOIL
PAGE 1 of 1

ANALYSIS			WTPH		WTPH-D							
Sample Number	Lab Number	Sample Date	Extract	Analyze	Extract	Analyze	Extract	Analyze	Extract	Analyze	Analyze	Analyze
DW4-2 1/2	568-2822	9/27/93	10/10/93	10/19/93	10/9/93	11/6/93						

ORGANIC DATA ASSESSMENT

LABORATORY: ACZ
SITE: BN SKYKOMISH
NO. OF SAMPLE/MATRIX: 3 Soils
REVIEWER'S NAME: Kim Lofgren

DATA ASSESSMENT SUMMARY

	VOC/8240	SVOC/8270	TPH/ 418.1	METALS/
HOLDING TIMES	O	O	O	O
CALIBRATIONS	NA	NA	NA	NA
BLANKS	NA	NA	NA	NA
SURROGATES	NA	NA	NA	NA
MATRIX SPIKE/DUP	NA	NA	NA	NA
OTHER QC	NA	NA	NA	NA
INTERNAL STANDARDS	NA	NA	NA	NA
COMPOUND IDENTIFICATION	O	O	O	O
SYSTEM PERFORMANCE	NA	NA	NA	NA
OVERALL ASSESSMENT	O	O	O	O

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Z=DATA UNACCEPTABLE.
X=PROBLEMS, BUT DO NOT AFFECT DATA.

ACTION ITEMS: VOC - methylene chloride detected in B12-7 1/2 qualified w/ "K"

AREAS OF CONCERN: 418.1 → no QC with data
SVOC - NO QA/QC w/ data, VOC no supporting QA/QC data

NOTABLE PERFORMANCE:

ORGANIC DATA ASSESSMENT

LABORATORY: ACZ
SITE: BN SKY/KOMISH
NO. OF SAMPLE/MATRIX: 3 SOILS
REVIEWER'S NAME: Kim Lofgren

DATA ASSESSMENT SUMMARY

	OTHER WTPH-G	OTHER WTPH-D	OTHER
HOLDING TIMES	O	O	
CALIBRATIONS	NA	NA	
BLANKS	NA	NA	
SURROGATES	NA	O	
MATRIX SPIKE/DUP	NA	NA	
OTHER QC	NA	NA	
INTERNAL STANDARDS	NA	NA	
COMPOUND IDENTIFICATION	O	O	
SYSTEM PERFORMANCE	NA	NA	
OVERALL ASSESSMENT	O	O	

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Z=DATA UNACCEPTABLE.
X=PROBLEMS, BUT DO NOT AFFECT DATA.

ACTION ITEMS:

AREAS OF CONCERN:

NOTABLE PERFORMANCE:

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

ANALYSIS AND EXTRACTION DATE/HOLDIG TIMES

PROJECT: BN Skykomish
PROJECT #: 3-1161
SAMPLE MATRIX: 3 Soils
PAGE 1 **of** 2

ANALYSIS			WTPH - 418.1		WTPH-G		VOC 8240		SVOC 8270			
Sample Number	Lab Number	Sample Date	Extract	Analyze	Extract	Analyze	Extract	Analyze	Extract	Analyze	Analyze	Analyze
B-12-0		10/29/93										
B-12-7½	640-3235	↓	11/22/93	11/17/93	11/8/93	11/9/93	11/2/93	11/4/93	11/12/93	12/1/93		
B12-12½	640-3236	↓	↓	↓								

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

ANALYSIS AND EXTRACTION DATE/HOLDIG TIMES

PROJECT: BN SKYKOMISH
PROJECT #: 3-1161
SAMPLE MATRIX: 3 Soils
PAGE 2 **of** 2

ANALYSIS			PCB 8080		METALS 6010/7000		WTPH-D					
Sample Number	Lab Number	Sample Date	Extract	Analyze	Extract	Analyze	Extract	Analyze	Extract	Analyze	Analyze	Analyze
B12-0		10/29/93				11/18/93	~~11/12/93~~	~~11/16/93~~				
B12-7½	640-3235	↓					11/12/93	11/16/93				
B12-12½	640-3236	↓										

ORGANIC DATA ASSESSMENT

LABORATORY: ACZ
SITE: BN SKYKOMISH
NO. OF SAMPLE/MATRIX: 7 So, 7S
REVIEWER'S NAME: Kim Lofgren

DATA ASSESSMENT SUMMARY

	VOC/8240	SVOC/8270	TPH/418.1	METALS/6010/7000
HOLDING TIMES	O	O	O	O
CALIBRATIONS	NA	NA	NA	NA
BLANKS	NA	NA	NA	NA
SURROGATES	NA	NA	NA	NA
MATRIX SPIKE/DUP	NA	NA	NA	NA
OTHER QC	NA	NA	NA	NA
INTERNAL STANDARDS	NA	NA	NA	NA
COMPOUND IDENTIFICATION	NA	NA	NA	NA
SYSTEM PERFORMANCE	NA	NA	NA	NA
OVERALL ASSESSMENT	O	O	O	O

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ACTION ITEMS: SED-1, SED-10, SED-3, SED-5, SED-4 - methylene chloride and Acetone qualified w a "U"

SED-2 - methylene chloride qualified w "U"

8270 - sample Sed-3 reanalyzed & reextracted outside holding time no positive results therefore, no qualifiers warranted.

AREAS OF CONCERN:

NOTABLE PERFORMANCE:

ORGANIC DATA ASSESSMENT

LABORATORY: ACZ
SITE: BN SKYKOMISH
NO. OF SAMPLE/MATRIX: 7 Soils
REVIEWER'S NAME: K. Lofgren

DATA ASSESSMENT SUMMARY

	OTHER PCB/8080	OTHER	OTHER
HOLDING TIMES	O		
CALIBRATIONS	NA		
BLANKS	NA		
SURROGATES	NA		
MATRIX SPIKE/DUP	NA		
OTHER QC	NA		
INTERNAL STANDARDS	NA		
COMPOUND IDENTIFICATION	NA		
SYSTEM PERFORMANCE	NA		
OVERALL ASSESSMENT	O		

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X=PROBLEMS, BUT DO NOT AFFECT DATA.

ACTION ITEMS:

AREAS OF CONCERN:

NOTABLE PERFORMANCE:

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

ANALYSIS AND EXTRACTION DATE/HOLDIG TIMES

PROJECT: BN Skykomish
PROJECT #: 3-1169
SAMPLE MATRIX: ~~B4~~ Soils (7)
PAGE 1 **of** 1

ANALYSIS			WTPH-418.1		VOC 8240		8270-SVOC		PCB 8080		metals	
Sample Number	Lab Number	Sample Date	Extract	Analyze	Extract	Analyze	Extract	Analyze	Extract	Analyze	Analyze	Analyze
SED-1	588-2927	10/7/93	10/14/93	10/19/93		10/19/93	10/18/93	11/17/93	10/14/93	10/26/93	10/30/93	
SED-2	588-2928	↓	10/14/93	10/19/93		10/19/93	10/18/93	11/11/93	10/14/93	10/26/93	10/30/93	
SED-10	588-2929	↓	10/14/93	10/19/93		10/19/93	10/18/93	11/11/93	10/14/93	10/27/93	10/30/93	
SED-3	588-2930	↓	10/14/93	10/19/93		10/20/93	10/17/93	11/18/93	10/14/93	10/27/93	10/30/93	
SED-4	588-2931	↓	10/14/93	10/19/93		10/21/93	10/18/93	11/17/93	10/14/93	10/27/93	10/30/93	
SED-5	588-2932	↓	10/14/93	10/19/93		10/26/93	10/18/93	11/17/93	10/14/93	10/27/93	10/30/93	
SED-6	588-2933	↓	10/15/93	10/19/93		10/26/93	10/18/93	11/17/93	10/14/93	10/27/93		

ORGANIC DATA ASSESSMENT

LABORATORY: Laucks
SITE: BN SKYKOMISH
NO. OF SAMPLE/MATRIX: 8 soils
REVIEWER'S NAME: K.Lofgren

DATA ASSESSMENT SUMMARY

	OTHER TOC	OTHER	OTHER
HOLDING TIMES	O		
CALIBRATIONS	NA		
BLANKS	O		
SURROGATES	NA		
MATRIX SPIKE/DUP	O		
OTHER QC	O		
INTERNAL STANDARDS	NA		
COMPOUND IDENTIFICATION	O		
SYSTEM PERFORMANCE	NA		
OVERALL ASSESSMENT	O		

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Z=DATA UNACCEPTABLE.
X=PROBLEMS, BUT DO NOT AFFECT DATA.

ACTION ITEMS:

AREAS OF CONCERN:

NOTABLE PERFORMANCE:

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

ANALYSIS AND EXTRACTION DATE/HOLDIG TIMES

PROJECT: Laucks
PROJECT #: 3-1161
SAMPLE MATRIX: 8 soils
PAGE 1 **of** 1

ANALYSIS											TOC -9060	
Sample Number	Lab Number	Sample Date	Extract	Analyze	Extract	Analyze	Extract	Analyze	Extract	Analyze	Analyze	Analyze
BW1-0	93-70-026-01	9/28/93									NP	
DW1-2	02											
DW1-5	03											
B4-10	04											
B10-0	05	9/29/93										
B10-2	06											
B10-10	07											
B10-15	08											

ORGANIC DATA ASSESSMENT

LABORATORY: Laucks
SITE: BN-Skykomish
NO. OF SAMPLE/MATRIX: 8 Soil
REVIEWER'S NAME: K. Lofgren

DATA ASSESSMENT SUMMARY

	OTHER TOC 9060	OTHER	OTHER
HOLDING TIMES	O–		
CALIBRATIONS	NA		
BLANKS	O		
SURROGATES	NA		
MATRIX SPIKE/DUP	O.		
OTHER QC	O		
INTERNAL STANDARDS	NA		
COMPOUND IDENTIFICATION	NA		
SYSTEM PERFORMANCE	O		
OVERALL ASSESSMENT	O		

O=DATA HAD NO PROBLEMS/OR QUALIFIED DUE TO MINOR PROBLEMS.
M=DATA QUALIFIED DUE TO MAJOR PROBLEMS.
Z=DATA UNACCEPTABLE.
X=PROBLEMS, BUT DO NOT AFFECT DATA.

ACTION ITEMS:

AREAS OF CONCERN: No Date analyzed or extracted on organic analysis

NOTABLE PERFORMANCE:

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

ANALYSIS AND EXTRACTION DATE/HOLDIG TIMES

PROJECT: BN- SKUMOKISH
PROJECT #: 3-1161
SAMPLE MATRIX: 8 Soils
PAGE 1 of 1

ANALYSIS											TDC 9060	
Sample Number	Lab Number	Sample Date	Extract	Analyze	Extract	Analyze	Extract	Analyze	Extract	Analyze	Analyze	Analyze
SED-1	93-10-274-01	10/07/93										
SED-2	02										ND	
SED-3	03											
SED-4	04											
SED-5	05											
SED-6	06											
SED-7	07											
SED-10	08											

ORGANIC DATA ASSESSMENT

LABORATORY: LAUCKS
SITE: BN-SYKOMISH
NO. OF SAMPLE/MATRIX: 7 soils
REVIEWER'S NAME: Lowgren

DATA ASSESSMENT SUMMARY

	OTHER TOC 9060	OTHER	OTHER
HOLDING TIMES	O –		
CALIBRATIONS	NA		
BLANKS	O		
SURROGATES	NA		
MATRIX SPIKE/DUP	O		
OTHER QC	O		
INTERNAL STANDARDS	NA		
COMPOUND IDENTIFICATION	O		
SYSTEM PERFORMANCE	NA		
OVERALL ASSESSMENT	O		

O=DATA HAD NO PROBLEMS/OR QUALIFIED DUE TO MINOR PROBLEMS.
M=DATA QUALIFIED DUE TO MAJOR PROBLEMS.
Z=DATA UNACCEPTABLE.
X=PROBLEMS, BUT DO NOT AFFECT DATA.

ACTION ITEMS:

AREAS OF CONCERN: TOC - Dates are not on report for analysis or extraction

NOTABLE PERFORMANCE:

93-10-845

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

ANALYSIS AND EXTRACTION DATE/HOLDIG TIMES

PROJECT: BN SKYKOMISH
PROJECT #: 3-1161
SAMPLE MATRIX: 7 Soils
PAGE ____ **of** ____

ANALYSIS											TOC	
Sample Number	Lab Number	Sample Date	Extract	Analyze	Extract	Analyze	Extract	Analyze	Extract	Analyze	Analyze	Analyze
B9-7½	93-10-845-01	10/18/93									ND	
B6-8	02	10/19/93										
MW36-0	03	10/21/93										
MW36-2	04											
MW36-6	05											
MW36-7½	06											
B5-7	07	10/24/93										

ATTACHMENT 2

ACZ Laboratories, Inc.

30400 Downhill Drive
Steamboat Springs, CO 80487-9400
(303) 879-6590 (800) 334-5493
FAX No. (303) 879-2216

November 18,1993

Mr. Ward Beebe
Remediation Technologies Inc.
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134

Dear Mr. Beebe:

Enclosed is a data package for the Burlington Northern - Skykomish Project 3-1161. The original was sent Saturday November 13, 1993 but did not include an invoice. The package contains, in the following order, an invoice, a copy of the chain of custody documentation and the analytical reports separated by method.

ACZ received 34 soil samples on October 2, 1993. The soils were sampled on September 28, 29 and 30, 1993 as outlined on the attached Chain of Custody record numbers 6402, 6403 and 6404 The samples were received intact and no problems were noted with the chain of custody procedures.

The samples were requested to be analyzed by one or more of the following analytical methods.

WTPH	EPA 418.1	IR
WTPH-D	EPA Mod 8015	GC/FID
VOC	EPA 8240	GC/MS
PCB	EPA 8080	GC/ECD
METALS	EPA 6010/7000	ICP/GFAA

All data is reported on an a dry weight basis and reporting levels are at the lowest level possible for the specific matrix. Comments and required QC recoveries have been added to the individual reports.

If you have any questions or comments regarding the content or format of this package please do not hesitate to give me a call at (800)334-5493.

Sincerely,

Scott Habermehl

Scott Habermehl
Project Manager

ACZ Laboratories, Inc.

30400 Downhill Drive
Steamboat Springs, CO 80487-9400
(303) 879-6590 (800) 334-5493
FAX No. (303) 879-2216

November 13, 1993

Mr. Ward Beebe
Remediation Technologies Inc.
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134

Dear Mr. Beebe:

I have enclosed the first long awaited data package for the Burlington Northern - Skykomish Project 3-1161. This package consists of the analytical reporting forms for the 34 soil samples received by ACZ Laboratories on October 2, 1993. These soils were sampled on September 28,29 and 30, 1993. The samples were received intact and no problems were noted with the chain of custody procedures.

The samples were requested to be run by one or more of the following analytical methods.

WTPH	EPA 418.1	IR
WTPH-D	EPA Mod 8015	GC/FID
VOC	EPA 8240	GC/MS
PCB	EPA 8080	GC/ECD
METALS	EPA 6010/7000	ICP/GFAA

The analytical reports are currently separated by method. If however, you have any ideas on project reporting format please give me a call at (800)334-5493.

I believe our bottleneck has opened somewhat and you can expect to receive future projects in a more timely fashion.

Sincerely

Scott Habermehl
Project Manager

QUALITY CONTROL DATA SUMMARY
Inorganic Metals

Client: ReTec Inc. - Seattle
Project: 3-1161 Skykomish
Attention: Kim Lofgren

Initial Calibration Verification Samples - Percent Recovery

Total Metals

Analyte	SW 846 Method	Analysis Date	Certified Value (mg/l)	Observed Value (mg/l)	% Recovery
Antimony	7041	10/12/93	0.030	0.034	113
		10/28/93	0.030	0.034	113
		11/08/93	0.030	0.033	110
Arsenic	7060	10/13/93	0.030	0.029	97
		10/27/93	0.030	0.031	104
		10/28/93	0.030	0.031	103
		11/03/93	0.030	0.031	104
		11/04/93	0.030	0.030	100
		11/10/93	0.030	0.028	93
Beryllium	6010	10/13/93	1.000	1.020	102
		10/27/93	1.000	1.010	101
		10/26/93	1.000	0.998	100
Cadmium	6010	10/13/93	1.000	1.040	104
		10/27/93	1.000	1.040	104
		10/26/93	1.000	1.010	101
Chromium	6010	10/11/93	1.00	1.04	104
		10/27/93	1.00	1.03	103
		10/26/93	1.00	1.02	102
Copper	6010	10/11/93	1.00	1.04	104
		10/27/93	1.00	1.04	104
		10/26/93	1.00	1.03	103

QUALITY CONTROL DATA SUMMARY
Inorganic Metals

Client: ReTec Inc. - Seattle
Project: 3-1161 Skykomish
Attention: Kim Lofgren

Initial Calibration Verification Samples - Percent Recovery

Total Metals

Analyte	SW 846 Method	Analysis Date	Certified Value (mg/l)	Observed Value (mg/l)	% Recovery
Lead	6010	10/13/93	1.00	1.04	104
		10/27/93	1.00	1.02	102
		10/26/93	1.00	1.02	102
Mercury	7470	10/14/93	0.0025	0.0024	96
		10/29/93	0.0025	0.0021	84
		11/11/93	0.0500	0.0525	105
Nickel	6010	10/13/93	1.00	1.03	103
		10/27/93	1.00	1.04	104
		10/26/93	1.00	1.03	103
Selenium	7741	10/12/93	0.030	0.030	100
		10/28/93	0.030	0.032	107
		11/02/93	0.030	0.031	102
		11/15/93	0.020	0.022	110
Silver	6010	10/13/93	1.00	1.03	103
		10/27/93	1.00	1.01	101
		10/26/93	1.00	1.00	100
Thallium	7841	10/25/93	0.030	0.032	105
		10/26/93	0.030	0.030	101
		11/08/93	0.030	0.031	103
Zinc	6010	10/13/93	1.00	1.06	106
		10/27/93	1.00	1.05	105
		10/26/93	1.00	1.04	104

QUALITY CONTROL DATA SUMMARY
Inorganic Metals

Client: ReTec Inc. - Seattle
Project: 3-1161 Skykomish
Attention: Kim Lofgren

Analytical Spikes - Percent Recovery

Total Metals

Analyte	EPA Method	Analysis Date	Sample Number	True Value (mg/l)	Observed Value (mg/l)	% Recovery
Antimony	7041	10/12/93	93-SI/01841	0.020	0.022	108
		10/28/93	93-SI/01919	0.020	0.020	98
		11/08/93	93-SI/02088	0.020	0.020	98
Arsenic	7060	10/27/93	93-SI/01921	0.020	0.022	110
		10/28/93	93-SI/01991	0.020	0.017	84
		11/03/93	93-SI/02064	0.020	0.020	101
		11/04/93	93-SI/02080	0.020	0.020	100
		11/10/93	93-SI/02086	0.030	0.022	72
		10/13/93	93-SI/01841	0.020	0.019	95
Beryllium	6010	10/13/93	93-SI/01836	0.500	0.486	97
		10/27/93	93-SI/01923	0.500	0.485	97
		10/26/93	93-SI/02043	0.500	0.438	88
Cadmium	6010	10/13/93	93-SI/01836	0.500	0.494	99
		10/27/93	93-SI/01923	0.500	0.485	97
		10/26/93	93-SI/02043	0.500	0.446	89
Chromium	6010	10/11/93	93-SI/01836	0.50	0.50	99
		10/27/93	93-SI/01923	0.50	0.49	98
		10/26/93	93-SI/02043	0.50	0.47	93
Copper	6010	10/11/93	93-SI/01836	0.50	0.50	100
		10/27/93	93-SI/01923	0.50	0.49	98
		10/26/93	93-SI/02043	0.50	0.48	96

Matrix Spike Recoveries are used to determine the accuracy (bias) associated with the sample matrix.

QUALITY CONTROL DATA SUMMARY
Inorganic Metals

Client: ReTec Inc. - Seattle
Project: 3-1161 Skykomish
Attention: Kim Lofgren

Analytical Spikes - Percent Recovery

Total Metals

Analyte	EPA Method	Analysis Date	Sample Number	True Value (mg/l)	Observed Value (mg/l)	% Recovery
Lead	6010	10/13/93	93-SI/01836	1.00	0.92	92
		10/27/93	93-SI/01923	1.00	0.97	97
		10/26/93	93-SI/02043	1.00	0.94	94
Mercury	7470	10/14/93	93-SI/01841	0.0010	0.0010	95
		10/29/93	93-SI/02055	0.0012	0.0010	80
		11/11/93	93-SI/02088	0.0010	0.0011	110
Nickel	6010	10/13/93	93-SI/01836	0.50	0.49	97
		10/27/93	93-SI/01923	0.50	0.49	97
		10/26/93	93-SI/02043	0.50	0.47	94
Selenium	7741	10/12/93	93-SI/01841	0.020	0.018	91
		10/28/93	93-SI/01921	0.020	0.020	100
		11/02/93	93-SI/02074	0.020	0.016	81
		11/15/93	93-SI/02088	0.020	0.013	67
Silver	6010	10/13/93	93-SI/01836	0.50	0.42	85
		10/27/93	93-SI/01923	0.50	0.46	93
		10/26/93	93-SI/02043	0.50	0.26	52
Thallium	7841	10/25/93	93-SI/01921	0.020	0.019	95
		10/26/93	93-SI/01939	0.020	0.016	82
		11/08/93	93-SI/02088	0.020	0.021	106
Zinc	6010	10/13/93	93-SI/01836	0.50	0.49	98
		10/27/93	93-SI/01923	0.50	0.49	98
		10/26/93	93-SI/02043	0.50	0.48	96

QUALITY CONTROL DATA SUMMARY
Inorganic Metals

Client: ReTec Inc. - Seattle
Project: 3-1161 Skykomish
Project: Kim Lofgren

Matrix Spike/Sample Duplicates - Relative Percent Difference (RPD)

Total Metals

Analyte	EPA Method	Analysis Date	Sample Number	Observed Value 1 (mg/l)	Observed Value 2 (mg/l)	RPD
Antimony	7041	10/12/93	93-SI/01841	0.0215	0.022	1.4
		10/28/93	93-SI/01919	0.0195	0.019	2.1
		11/08/93	93-SI/02088	0.0196	0.02	3.5
Arsenic	7060	10/27/93	93-SI/01921	0.0431	0.045	5.2
		10/28/93	93-SI/01991	0.0375	0.038	2.1
		11/03/93	93-SI/02064	0.0204	0.020	2.5
		11/04/93	93-SI/02080	0.0341	0.033	4.5
		11/10/93	93-SI/02086	0.0216	0.023	5.4
		10/13/93	93-SI/01841	0.035	0.035	0.0
Beryllium	6010	10/13/93	93-SI/01836	<0.004	<0.004	0.0
		10/27/93	93-SI/01923	0.485	0.515	6.0
		10/26/93	93-SI/02043	0.438	0.448	2.3
Cadmium	6010	10/13/93	93-SI/01836	0.005	<0.004	0.0
		10/27/93	93-SI/01923	0.485	0.516	6.2
		10/26/93	93-SI/02043	0.446	0.456	2.2
Chromium	6010	10/11/93	93-SI/01836	0.417	0.227	59.0
		10/27/93	93-SI/01923	0.605	0.578	4.6
		10/26/93	93-SI/02043	0.596	0.613	2.8
Copper	6010	10/11/93	93-SI/01836	0.518	0.513	1.0
		10/27/93	93-SI/01923	0.594	0.561	5.7
		10/26/93	93-SI/02043	0.623	0.634	1.8

QUALITY CONTROL DATA SUMMARY
Inorganic Metals

Client: ReTec Inc. - Seattle
Project: 3-1161 Skykomish
Project: Kim Lofgren

Matrix Spike/Sample Duplicates - Relative Percent Difference (RPD)
Total Metals

Analyte	EPA Method	Analysis Date	Sample Number	Observed Value 1	Observed Value 2	RPD
Lead	6010	10/13/93	93-SI/01836	2.570	2.820	9.3
		10/27/93	93-SI/01923	0.998	1.050	5.1
		10/26/93	93-SI/02043	0.980	0.996	1.6
Mercury	7470	10/14/93	93-SI/01841	0.001	0.001	0.0
		10/29/93	93-SI/02055	0.000	0.000	0.0
		11/11/93	93-SI/02088	0.001	0.001	0.0
Nickel	6010	10/13/93	93-SI/01836	0.312	0.245	24.1
		10/27/93	93-SI/01923	0.581	0.613	5.4
		10/26/93	93-SI/02043	0.597	0.606	1.5
Selenium	7741	10/12/93	93-SI/01841	0.018	0.018	1.1
		10/28/93	93-SI/01921	0.021	0.022	1.9
		11/02/93	93-SI/02074	0.017	0.018	4.6
		11/15/93	93-SI/02088	0.013	0.014	3.0
Silver	6010	10/13/93	93-SI/01836	<0.01	<0.01	0.0
		10/27/93	93-SI/01923	0.46	0.50	6.5
		10/26/93	93-SI/02043	0.26	0.26	1.2
Thallium	7841	10/25/93	93-SI/01921	0.021	0.024	10.8
		10/26/93	93-SI/01939	0.019	0.017	12.0
		11/08/93	93-SI/02088	0.022	0.023	2.2
Zinc	6010	10/13/93	93-SI/01836	1.79	1.76	1.7
		10/27/93	93-SI/01923	0.63	0.65	3.7
		10/26/93	93-SI/02043	0.74	0.73	2.2

QUALITY CONTROL DATA SUMMARY
Inorganic Metals

Client: ReTec Inc. - Seattle
Project: 3-1161 Skykomish
Attention: Kim Lofgren

Prep Blanks

Analyte	EPA Method	Analysis Date	
Antimony	7041	10/12/93	<0.001
		10/28/93	<0.001
		11/08/93	<0.001
Arsenic	7060	10/27/93	<0.001
		10/28/93	<0.001
		11/03/93	<0.001
		11/04/93	<0.001
		11/10/93	<0.001
		10/13/93	<0.001
Beryllium	6010	10/13/93	<0.005
		10/27/93	<0.005
		10/26/93	<0.005
Cadmium	6010	10/13/93	<0.005
		10/27/93	<0.005
		10/26/93	<0.005
Chromium	6010	10/11/93	<0.01
		10/27/93	<0.01
		10/26/93	<0.01
Copper	6010	10/11/93	<0.01
		10/27/93	<0.01
		10/26/93	<0.01

Prep Blanks are distilled/deionized water taken through any preparative steps in the methods.
They are used to determine the possiblity of laboratory contamination.

QUALITY CONTROL DATA SUMMARY
Inorganic Metals

Client: ReTec Inc. - Seattle
Project: 3-1161 Skykomish
Attention: Kim Lofgren

Analyte	EPA Method	Analysis Date	Prep Blanks mg/l
Lead	6010	10/13/93	<0.02
		10/27/93	<0.02
		10/26/93	<0.02
Mercury	7470	10/14/93	<0.0002
		10/29/93	<0.0002
		11/11/93	<0.0002
Nickel	6010	10/13/93	<0.02
		10/27/93	<0.02
		10/26/93	<0.02
Selenium	7741	10/12/93	<0.001
		10/28/93	<0.001
		11/02/93	<0.001
		11/15/93	<0.001
Silver	6010	10/13/93	<0.01
		10/27/93	<0.01
		10/26/93	<0.01
Thallium	7841	10/25/93	<0.002
		10/26/93	<0.002
		11/08/93	<0.002
Zinc	6010	10/13/93	<0.01
		10/27/93	<0.01
		10/26/93	<0.01

Prep Blanks are distilled/deionized water taken through any preparative steps in the methods. They are used to determine the possiblity of laboratory contamination.

QUALITY CONTROL DATA SUMMARY

Inorganic Metals

Client: ReTec Inc. - Seattle
Project: 3-1161 Skykomish
Attention: Kim Lofgren

Laboratory Control Sample - Percent Recovery

Total Metals

Analyte	SW 846 Method	Analysis Date	Certified Value (mg/kg)	Observed Value (mg/kg)	% Recovery
Arsenic	7060	10/13/93	194	150	77
		10/27/93	100	102	102
		11/03/93	100	85	85
Beryllium	6010	10/13/93	54	54.6	101
		10/27/93	54	24.2	45
		10/26/93	54	26.6	49
Cadmium	6010	10/13/93	120	122.0	102
		10/27/93	120	113.0	94
		10/26/93	120	128.0	107
Chromium	6010	10/11/93	66	67	102
		10/27/93	66	83	126
		10/26/93	66	91	138
Copper	6010	10/11/93	149	144	97
		10/27/93	149	78	52
		10/26/93	149	84	56

CRM - Certified Reference Materials are prepared using distilled water and are an indication of the overall accuracy (bias) associated with the analytical methods.

ACZ Laboratories

QUALITY CONTROL DATA SUMMARY

Client: ReTec Inc.
Project: CMBF 3-0071-211 ?
Attention: Lesli Nunn

Laboratory Control Samples - Percent Recovery
Total Metals

Analyte	SW 846 Method	Analysis Date	Certified Value (mg/kg)	Observed Value (mg/kg)	% Recovery
Lead	6010	10/13/93	117	129	110
		10/27/93	117	145	124
		10/26/93	117	156	133
Mercury	7470	10/14/93	29	26	90
		10/29/93	9.5	12.9	136
		11/04/93	9.5	9.5	100
		11/11/93	9.5	10.5	111
Nickel	6010	10/13/93	226	222	98
		10/27/93	226	113	50
		10/26/93	226	128	57
Selenium	7741	10/12/93	107	92	86
		10/28/93	46	46	100
		11/02/93	46	44	96
		11/15/93	46	44	96
Thallium	7841	10/25/93	14	14	99
		11/08/93	14	14	100
Zinc	6010	10/13/93	258	258	100
		10/27/93	258	380	147
		10/26/93	258	410	159

ORG 573 (93-50/ 2845 - 2875)

6402

CHAIN OF CUSTODY RECORD

(93-SI/ 1916 - 1939)

PROJ. NO.	PROJECT NAME	SEND RESULTS TO:
3-1161	BN-SKYKOMISH	W. BEEBE

SAMPLERS: W. BEEBE

RECEIVING LABORATORY: ACZ LABS

LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS	WTPH-418.1	WTPH-G	WTPH-D	VOC (EPA 8240)	SVOC (EPA 8270)	PCB (EPA 8080)	METALS (6010/7000)	REMARKS
	9/28/93	1701	MW35-0	1							X	
	↓	1714	MW35-7½	1				X				
		1718	MW35-10	1	X		X					
		1741	MW53-7½	1				X				
		1748	MW53-10	1	X		X					
	9/29/93	0810	DW3-0	2						X	X	
	↓	0815	DW3-2	1						X		
		0821	DW3-7½	1	X		X					
		0833	DW3-17½	1	X							
		1120	B10-0	1							X	
		1135	B10-10	1	X		X					
		1153	B10-15	1	X		X					
		1528	SS28-0	2	X					X	X	
	9/30/93	0912	SS30-0	2	X					X	X	
	↓	0935	BG2-0	1	X					X		

Condition of Samples Upon Receipt By ACZ Laboratories, Inc:
Temperature of Contents: 2 °C
Sample Containers: intact
~~Custody Seals~~: WA 5+6 - intact

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
[signature]	10/1/93 0815				

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time
		[signature]	10/2/93 10:00

Shipper Information: FED EX # 7806647682

RETEC REMEDIATION TECHNOLOGIES INC

REMEDIATION TECHNOLOGIES
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PINK COPY - Sampler   YELLOW COPY - Laboratory   WHITE COPY - ReTeC

6403

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME	SAMPLERS	RECEIVING LABORATORY	SEND RESULTS TO
3-1161	BN-SKYKOMISH	W. BEEBE	ACZ LABORATORIES	W. BEEBE

LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS	WTPH-418.1	PCB (EPA 8080)	METALS (6010/7000)	REMARKS
	9/30/93	0935	BG2-0	1			X	
	↓	0953	SS32-0	2	X	X	X	
	↓	1009	SS31-0	2	X	X	X	
	↓	1042	SS29-0	2	X	X	X	
	↓	1102	SS27-0	2	X	X	X	
	↓	1024	SS92-0	2	X	X	X	
	↓	1127	SS13-0	2	X	X	X	
	↓	1302	SS14-0	2	X	X	X	
	↓	1320	SS41-0	2	X	X	X	
	↓	1322	SS15-0	2	X	X	X	

Condition of Samples Upon Receipt
By ACZ Laboratories, Inc:
Temperature of Contents: 2 °C
Sample Containers: Intact
Custody Seals: WA 7+8 - Intact

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
[signature]	10/1/93 0855				

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time
		[signature]	10/2/93 10:00

Shipper Information
FED EX AIRBILL # 780664767 1

RETEC
REMEDIATION TECHNOLOGIES INC
REMEDIATION TECHNOLOGIES
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

6404

CHAIN OF CUSTODY RECORD

PROJ. NO.: 3-1161

PROJECT NAME: BN-SKYKOMISH

SAMPLERS: W. BEEBE

RECEIVING LABORATORY: ACZ LABORATORIES

SEND RESULTS TO: W. BEEBE

LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS	WTPH-418.1	PCB (EPA 8080)	METALS (6010/7000)				REMARKS
	9/30/93	1342	SS16-0	2	X	X	X				
	↓	1402	SS18-0	2	X	X	X				
	↓	1433	SS17-0	2	X	X	X				
	↓	1451	SS19-0	2	X	X	X				
	↓	1506	SS19.1-0	2	X	X	X				
	↓	1624	SS21-0	2	X	X	X				
	↓	1645	SS22-0	2	X	X	X				
	↓	1705	SS23-0	2	X	X	X				
	↓	1721	SS24-0	2	X	X	X				

~~Condition of Samples Upon Receipt~~
By ACZ Laboratories, Inc:
Temperature of Contents: 2 °C
Sample Containers: Intact
~~Custody Seals:~~ WA 9+10 - Intact

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
[signature]	10/1/93 0925				

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time
		[signature]	10/2/93 10:20

Shipper Information: FEDEX AIRBILL # 7806647660

RETEC
REMEDIATION TECHNOLOGIES INC

REMEDIATION TECHNOLOGIES
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

ACZ Laboratories, Inc.

QUALITY CONTROL DATA SUMMARY

Client:	Retec	Report Date:	1/27/94
Attn:	Ms. Kim Lofgren		
Project:	3-1161, Skykomish		

ACZ Sample ID:	Client Sample ID:	Performed Analysis	Sampled	Received
93-SO/573-2845	MW35-7 1/2	V	9/28/93	10/02/93
93-SO/573-2846	MW53-7 1/2	V	9/28/93	10/02/93
93-SO/573-2847	DW3-17 1/2	I	9/29/93	10/02/93
93-SO/573-2848	MW35-10	D,I	9/28/93	10/02/93
93-SO/573-2849	MW53-10	D,I	9/28/93	10/02/93
93-SO/573-2850	DW3-7 1/2	D,I	9/29/93	10/02/93
93-SO/573-2851	B10-10	D,I	9/29/93	10/02/93
93-SO/573-2852	B10-15	D,I	9/29/93	10/02/93
93-SO/573-2853	DW3-2	P	9/29/93	10/02/93
93-SO/573-2854	BG2-0	P,I	9/30/93	10/02/93
93-SO/573-2855	SS28-0	P,I	9/29/93	10/02/93
93-SO/573-2856	SS30-0	P,I	9/30/93	10/02/93
93-SO/573-2857	DW3-0	P	9/30/93	10/02/93
93-SO/573-2858	SS32-0	P,I	9/30/93	10/02/93
93-SO/573-2859	SS31-0	P,I	9/30/93	10/02/93
93-SO/573-2860	SS29-0	P,I	9/30/93	10/02/93
93-SO/573-2861	SS27-0	P,I	9/30/93	10/02/93
93-SO/573-2862	SS92-0	P,I	9/30/93	10/02/93
93-SO/573-2863	SS13-0	P,I	9/30/93	10/02/93
93-SO/573-2864	SS14-0	P,I	9/30/93	10/02/93
93-SO/573-2865	SS41-0	P,I	9/30/93	10/02/93
93-SO/573-2866	SS15-0	P,I	9/30/93	10/02/93
93-SO/573-2867	SS16-0	P,I	9/30/93	10/02/93
93-SO/573-2868	SS18-0	P,I	9/30/93	10/02/93
93-SO/573-2869	SS17-0	P,I	9/30/93	10/02/93
93-SO/573-2870	SS19-0	P,I	9/30/93	10/02/93
93-SO/573-2871	SS19.1-0	P,I	9/30/93	10/02/93
93-SO/573-2872	SS21-0	P,I	9/30/93	10/02/93
93-SO/573-2873	SS22-0	P,I	9/30/93	10/02/93
93-SO/573-2874	SS23-0	P,I	9/30/93	10/02/93
93-SO/573-2875	SS24-0	P,I	9/30/93	10/02/93

Analyses performed on the above samples includes; (V) = VOA's by EPA 8240 (cap. column) - GC/MS
(P) = PCB's by EPA 8080 - GC/ECD
(D) = WTPH-D by Washington Method - GC/FID
(I) = TPH by EPA 418.1 - IR

This summary package includes the following sections for each of the above mentioned analyses:

Surrogate Recoveries
Matrix Spike/Matrix Spike Duplicates

Abbreviations:

MS/MSD = Matrix Spike/Matrix Spike Duplicate
% R = Percent Recovery
RPD = Relative Percent Difference
DO = Diluted Out

Jeffrey E. Filkins
QA/QC Officer

ACZ Laboratories, Inc.

QUALITY CONTROL DATA SUMMARY
VOA's by EPA 8240 (cap. column) - GC/MS
Matrix: Soil

Client:	Retec	Report Date:	1/27/94
Attn:	Ms. Kim Lofgren		
Project:	3-1161, Skykomish		

Surrogate Recoveries
Units: %

Analysis Date	Sample Lab #	Spike Conc. ug/Kg	Dibromo-fluoro-methane	Toluene-d8	Bromo-fluoro-benzene
10/11/93	573-2845	50	111	99	110
10/08/93	573-2846	50	101	99	106
Method Blank Surrogate Recoveries					
10/08/93	VBLK 10/8	50	98	98	99
10/11/93	VBLK 10/11	50	110	103	108

Matrix Spike and Matrix Spike Duplicate Recoveries

Analysis Date	Sample Lab #	Spike Conc. ug/Kg	Compound	Matrix Spike % R	Matrix Spike Duplicate % R	RPD %
10/11/93	559-2769 *	50	1,1-Dichloroethene	94	92	3
		50	Benzene	102	98	4
		50	Trichloroethene	87	84	4
		50	Toluene	102	102	0
		50	Chlorobenzene	94	91	4

* = One set of MS/MSD's are analyzed for every 20 samples. The reported MS/MSD is the closest associated for this set of samples.

ACZ Laboratories, Inc.

QUALITY CONTROL DATA SUMMARY
PCB's by EPA 8080, GC/ECD
Matrix: Soil

Client:	Retec	Report Date:	1/27/94
Attn:	Ms. Kim Lofgren		
Project:	3-1161, Skykomish		

Surrogate Recoveries
Units: %

Extraction Date	Sample Lab #	Spike Conc. ug/Kg	Tetrachloro-m-xylene (TCMX)	Decachloro-biphenyl (DCBP)	Analysis Date
10/11/93	573-2853 OW-3-2	20	73	61	10/18/93
10/11/93	573-2854 BG2-0	20	60	56	10/18/93
10/11/93	573-2855 SS28-0	20	60	110	10/18/93
10/11/93	573-2856 SS30-0	20	73	69	10/18/93
10/11/93	573-2857 OW-30	20	75	89	10/18/93
10/11/93	573-2858 SS32-0	20	60	65	10/18/93
10/12/93	573-2859 SS31-0	20	73	149	10/18/93
10/11/93	573-2860 SS29-0	20	84	84	10/18/93
10/11/93	573-2861 SS27-0	20	80	72	10/18/93
10/11/93	573-2861MS SS27-0	20	65	266 *	10/25/93
10/11/93	573-2861MSD	20	66	289 *	10/25/93
10/11/93	573-2862 SS92-0	20	84	57	10/18/93
10/11/93	573-2863 SS13-0	20	72	72	10/18/93
10/11/93	573-2864 SS14-0	20	78	94	10/18/93
10/11/93	573-2865 SS41-0	20	86	69	10/18/93
10/11/93	573-2866 SS15-0	20	87	75	10/19/93
10/11/93	573-2867 SS16-0	20	70	71	10/24/93
10/11/93	573-2868 SS18-0	20	73	60	10/25/93
10/11/93	573-2869 SS17-D	20	61	62	10/25/93
10/11/93	573-2870 SS19-D	20	69	62	10/25/93
10/11/93	573-2871 SS19.1-D	20	75	119	10/25/93
10/11/93	573-2872 SS21-0	20	66	66	10/25/93
10/11/93	573-2873 SS22-0	20	72	80	10/25/93
10/11/93	573-2874 SS-23-0	20	63	81	10/25/93
10/11/93	573-2875 SS24-0	20	57	67	10/25/93

* = Surrogate recovery elevated due to coellution with a PCB isomer from the fortification standard.

Prep. Blank Surrogate Recoveries

10/11/93	PBK1S 10/11	20	65	62	10/18/93
10/12/93	PBK1S 10/12	20	69	65	10/27/93

Matrix Spike and Matrix Spike Duplicate Recoveries

Analysis Date	Sample Lab #	Spike Conc. ug/Kg	Compound	Matrix Spike % R	Matrix Spike Duplicate % R	RPD %
10/25/93	573-2861	333	Aroclor 1268	85	102	18
10/26/93	578-2895 **	333	Aroclor 1268	88	92	4

** = MS/MSD reported here due to its preparation with project 573.

ACZ Laboratories, Inc.

QUALITY CONTROL DATA SUMMARY
WTPH-D by Washington Method - GC/FID
Matrix: Soil

Client:	Retec	Report Date:	1/27/94
Attn:	Ms. Kim Lofgren		
Project:	3-1161, Skykomish		

Surrogate Recoveries
Units: %

Extraction Date	Sample Lab #	Spike Conc. ug/Kg	Nitro-benzene (NB)	Spike Conc. ug/Kg	o-Terphenyl (o-TP)	Analysis Date
10/09/93	573-2848 MW35-10	10	12 ✓	10	113	11/04/93
10/09/93	573-2849 MW53-10	10	81	10	113	11/05/93
10/09/93	573-2850 DW3-7 1/2	10	73	10	111	11/05/93
10/09/93	573-2851 B10-10	10	DO	10	DO	11/05/93
10/09/93	573-2852 B10-15	10	DO	10	DO	11/05/93

Prep. Blank Surrogate Recoveries

Extraction Date	Sample Lab #	Spike Conc. ug/Kg	Nitro-benzene (NB)	Spike Conc. ug/Kg	o-Terphenyl (o-TP)	Analysis Date
10/09/93	TBLK 10/9	10	56	10	110	10/28/93

Duplicate Recoveries

Extraction Date	Sample Lab #	Sample Conc. mg/Kg	Sample Conc. (Dup) mg/Kg	RPD %	Analysis Date
10/09/93	568-2822 *	89	97	9	11/06/93

* = Duplicate analyses are performed on every tenth sample. The reported duplicates represent the closest associated with this case.

Matrix Spike and Matrix Spike Duplicate Recoveries

Analysis Date	Sample Lab #	Spike Conc. mg/Kg	Component	Matrix Spike % R	Matrix Spike Duplicate % R	RPD %
11/04/93	559-2775 **	50	API Diesel Std.	79	68 ***	15

** = One set of MS/MSD's are analyzed for every 20 samples. The reported MS/MSD is the closest associated for this set of samples.

*** = The % recovery for the MSD is based on a 500 mg/Kg fortification due to a probable spiking error during sample preparation.

ACZ Laboratories, Inc.

QUALITY CONTROL DATA SUMMARY
TPH by EPA 418.1 - IR
Matrix: Soil

Client: Retec
Attn: Ms. Kim Lofgren
Project: 3-1161, Skykomish

Report Date: 1/27/94

Duplicate Recoveries

Extraction Date	Sample Lab #	Sample Conc. mg/Kg	Sample Conc. (Dup) mg/Kg	RPD %	Analysis Date
10/10/93	573-2848 MW 35-10	7.6	13.3	55	10/19/93
10/10/93	573-2868 SS 38-0	73.5	126.0	53	10/19/93

Matrix Spike and Matrix Spike Duplicate Recoveries

Analysis Date	Sample Lab #	Spike Conc. mg/Kg	Component	Matrix Spike % R	Matrix Spike Duplicate % R	RPD %
11/19/93	573-2858 SS 32-0	900	Mix for 418.1	88	90	3
11/19/93	573-2875 SS 24-0	900	Mix for 418.1	87	88	1

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2847
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	DW3-17 1/2	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/29/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	85.1
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)		118	U

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2848
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	MW35-10	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/28/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	96.7
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)		103	U

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2849
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	MW53-10	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/28/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	96.9
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)		103	U

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2850
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	DW3-7 1/2	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/29/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	84.1
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

	COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)			119	U

Compound ID:

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2851
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	B10-10	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/19
Sample Date:	9/29/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	16
		% Solids:	91.2
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)	14000	1,754	

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2852
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	B10-15	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/29/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	16
		% Solids:	89.1
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)	3900	1,796	

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

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FAX: (303) 879-2216

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2854
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	BG2-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/30/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	67.1
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)		149	U

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2855
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	SS28-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/28/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	16
		% Solids:	94.3
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)	4900	1,697	

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
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ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2856
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	SS30-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/30/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	85.3
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)		117	U

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for OW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2858
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	SS32-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/30/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	95.2
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)		105	U

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2859
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	SS31-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/30/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	92.7
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)		108	U

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2860
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	SS29-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/30/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	95.4
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)	880	105	

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
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FAX: (303) 879-2216

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ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2861
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	SS27-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/30/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	94.9
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)	660	105	

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2862
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	SS92-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/30/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	95.4
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)	950	105	

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

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FAX: (303) 879-2216

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2863
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	SS13-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/30/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	96.4
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)		104	U

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2864
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	SS14-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/30/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	98
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)	190	102	

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2865
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	SS41-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/30/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	98
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)	200	102	

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2866
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	SS15-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/30/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	96.9
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)	250	103	

Compound ID:

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2867
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	SS16-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/30/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	94.6
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)	270	106	

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2868
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	SS18-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/30/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	95.4
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)	130	105	

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2869
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	SS17-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/30/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	80.1
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)		125	U

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

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FAX: (303) 879-2216

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2870
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	SS19-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/30/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	8
		% Solids:	96.2
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)	2800	832	

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
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ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2871
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	SS19. 1-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/30/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	8
		% Solids:	93
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)	3600	860	

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

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ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2872
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	SS21-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/30/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	90.9
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)	180	110	

Compound ID:

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2873
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	SS22-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/30/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	97.2
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)	110	103	

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc.
30400 Downhill Dr.
Steamboat Springs, CO 80487
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FAX: (303) 879-2216

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2874
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	SS23-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/30/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	84
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)	270	119	

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2875
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	SS24-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/30/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	97.6
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)		102	U

Compound ID:

Q FORMAT:

"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
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ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2848
Client Project No:	3-1161, Skykomish	Lab File ID:	1104F006
Sample ID:	MW35-10	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/28/93	Date Analyzed:	11/4/93
Report Date:	11/10/93	Dilution Factor:	1
		% Solids:	96.7
Method ID:	WTPH - D, GC/FID Hydrocarbon Scan (Diesel Range)	Concentration Units:	mg/kg

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons - Diesel Range (> C10 - C28)	17	26	J

Compound ID:

Surrogate recoveries: nitrobenzene 12%
o-terphenyl 113%

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulson for CW
Organic Laboratory Supervisor

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ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2849
Client Project No:	3-1161, Skykomish	Lab File ID:	1104F007
Sample ID:	MW53-10	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/28/93	Date Analyzed:	11/5/93
Report Date:	11/10/93	Dilution Factor:	1
		% Solids:	96.9
Method ID:	WTPH - D, GC/FID Hydrocarbon Scan (Diesel Range)	Concentration Units:	mg/kg

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons - Diesel Range (> C10 - C28)		26	U

Compound ID:

Surrogate recoveries: nitrobenzene 81%
o-terphenyl 113%

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: C. J. Wakefield
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2850
Client Project No:	3-1161, Skykomish	Lab File ID:	1104F008
Sample ID:	DW3-7 1/2	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/29/93	Date Analyzed:	11/5/93
Report Date:	11/10/93	Dilution Factor:	1
		% Solids:	84.1
Method ID:	WTPH - D, GC/FID Hydrocarbon Scan (Diesel Range)	Concentration Units:	mg/kg

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons - Diesel Range (> C10 - C28)	43	30	

Compound ID:

Surrogate recoveries: nitrobenzene 73%
o-terphenyl 111%

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2851
Client Project No:	3-1161, Skykomish	Lab File ID:	1104F009
Sample ID:	B10-10	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/29/93	Date Analyzed:	11/5/93
Report Date:	11/10/93	Dilution Factor:	10
		% Solids:	91.2
Method ID:	WTPH - D, GC/FID Hydrocarbon Scan (Diesel Range)	Concentration Units:	mg/kg

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons - Diesel Range (> C10 - C28)	9500	274	

Compound ID:

Surrogate recoveries:

nitrobenzene	diluted out
o-terphenyl	diluted out

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2852
Client Project No:	3-1161, Skykomish	Lab File ID:	1104F010
Sample ID:	B10-15	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/29/93	Date Analyzed:	11/5/93
Report Date:	11/12/93	Dilution Factor:	10
		% Solids:	89.1
Method ID:	WTPH - D, GC/FID Hydrocarbon Scan (Diesel Range)	Concentration Units:	mg/kg

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons - Diesel Range (> C10 - C28)	2800	281	

Compound ID:

Surrogate recoveries: nitrobenzene diluted out
o-terphenyl diluted out

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulson for CW
Organic Laboratory Supervisor

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VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2845
Client Project No:	3-1161, Skykomish	Lab File ID:	A8748
Sample ID:	MW35-7 1/2	Date Received:	10/2/93
Matrix:	Soil	Date Analyzed:	10/11/93
Sample Date:	9/28/93	Dilution Factor:	1
Report Date:	10/31/93	% Solids:	96.7
Method ID:	EPA 8240, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
74-87-3	Chloromethane		10	U
74-83-9	Bromomethane		10	U
75-01-4	Vinyl Chloride		10	U
75-00-3	Chloroethane		10	U
75-09-2	Methylene Chloride	5	5	B
107-02-8	Acrolein		10	U
107-13-1	Acrylonitrile		10	U
67-64-1	Acetone	10	5	B
75-15-0	Carbon Disulfide		5	U
75-35-4	1,1-Dichloroethene		5	U
75-34-3	1,1-Dichloroethane		5	U
540-59-0	Total-1,2-Dichloroethene		5	U
67-66-3	Chloroform		5	U
107-06-2	1,2-Dichloroethane		5	U
78-93-3	2-Butanone		10	U
71-55-6	1,1,1-Trichloroethane		5	U
56-23-5	Carbon Tetrachloride		5	U
108-05-4	Vinyl Acetate		10	U
75-27-4	Bromodichloromethane		5	U
78-87-5	1,2-Dichloropropane		5	U
10061-01-5	cis-1,3-Dichloropropene		5	U
79-01-6	Trichloroethene		5	U
124-48-1	Dibromochloromethane		5	U
79-00-5	1,1,2-Trichloroethane		5	U
71-43-2	Benzene		5	U
10061-02-6	trans-1,3-dichloropropene		5	U
110-75-8	2-chloroethylvinylether		5	U
75-25-2	Bromoform		5	U
108-10-1	4-Methyl-2-Pentanone		10	U
591-78-6	2-Hexanone		10	U
127-18-4	Tetrachloroethene		5	U
79-34-5	1,1,2,2-Tetrachloroethane		5	U
108-88-3	Toluene		5	U
108-90-7	Chlorobenzene		5	U

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VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2845
Client Project No:	3-1161, Skykomish	Lab File ID:	A8748
Sample ID:	MW35-7 1/2	Date Received:	34244
Matrix:	Soil	Date Analyzed:	34253
Sample Date:	9/28/93	Dilution Factor:	1
Report Date:	10/31/93	% Solids:	96.7
Method ID:	EPA 8240, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL Q
100-41-4	Ethylbenzene		5 U
100-42-5	Styrene		5 U
1330-20-7	Xylene (total)		5 U

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Calb. Blank - Methylene Chloride and Acetone at 6 ug/L.

APPROVED: Ralph V. Poulson for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2846
Client Project No:	3-1161, Skykomish	Lab File ID:	A8738
Sample ID:	MW53-7 1/2	Date Received:	10/2/93
Matrix:	Soil	Date Analyzed:	10/8/93
Sample Date:	9/28/93	Dilution Factor:	1
Report Date:	10/31/93	% Solids:	96.8
Method ID:	EPA 8240, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
74-87-3	Chloromethane		10	U
74-83-9	Bromomethane		10	U
75-01-4	Vinyl Chloride		10	U
75-00-3	Chloroethane		10	U
75-09-2	Methylene Chloride	12	5	B
107-02-8	Acrolein		10	U
107-13-1	Acrylonitrile		10	U
67-64-1	Acetone	12	5	B
75-15-0	Carbon Disulfide		5	U
75-35-4	1,1-Dichloroethene		5	U
75-34-3	1,1-Dichloroethane		5	U
540-59-0	Total-1,2-Dichloroethene		5	U
67-66-3	Chloroform		5	U
107-06-2	1,2-Dichloroethane		5	U
78-93-3	2-Butanone		10	U
71-55-6	1,1,1-Trichloroethane		5	U
56-23-5	Carbon Tetrachloride		5	U
108-05-4	Vinyl Acetate		10	U
75-27-4	Bromodichloromethane		5	U
78-87-5	1,2-Dichloropropane		5	U
10061-01-5	cis-1,3-Dichloropropene		5	U
79-01-6	Trichloroethene		5	U
124-48-1	Dibromochloromethane		5	U
79-00-5	1,1,2-Trichloroethane		5	U
71-43-2	Benzene		5	U
10061-02-6	trans-1,3-dichloropropene		5	U
110-75-8	2-chloroethylvinylether		5	U
75-25-2	Bromoform		5	U
108-10-1	4-Methyl-2-Pentanone		10	U
591-78-6	2-Hexanone		10	U
127-18-4	Tetrachloroethene		5	U
79-34-5	1,1,2,2-Tetrachloroethane		5	U
108-88-3	Toluene		5	U
108-90-7	Chlorobenzene		5	U

ACZ Laboratories, Inc.

VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2846
Client Project No:	3-1161, Skykomish	Lab File ID:	A8738
Sample ID:	MW53-7 1/2	Date Received:	34244
Matrix:	Soil	Date Analyzed:	34250
Sample Date:	9/28/93	Dilution Factor:	1
Report Date:	10/31/93	% Solids:	96.8
Method ID:	EPA 8240, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
100-41-4	Ethylbenzene		5	U
100-42-5	Styrene		5	U
1330-20-7	Xylene (total)		5	U

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Calb. Blank - Methylene Chloride at 4 and Acetone at 7 ug/L.

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2853
Client Project No:	3-1161, Skykomish	Lab File ID:	31018-01
Sample ID:	DW3-2	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/11/93
Sample Date:	9/29/93	Date Analyzed:	10/18/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	82.4
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		97	U
11104-28-2	Aroclor - 1221		97	U
11141-16-5	Aroclor - 1232		97	U
53469-21-9	Aroclor - 1242		97	U
12672-29-6	Aroclor - 1248		97	U
11097-69-1	Aroclor - 1254		194	U
11096-82-5	Aroclor - 1260		194	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

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ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2854
Client Project No:	3-1161, Skykomish	Lab File ID:	31018-02
Sample ID:	BG2-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/11/93
Sample Date:	9/30/93	Date Analyzed:	10/18/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	67.1
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		119	U
11104-28-2	Aroclor - 1221		119	U
11141-16-5	Aroclor - 1232		119	U
53469-21-9	Aroclor - 1242		119	U
12672-29-6	Aroclor - 1248		119	U
11097-69-1	Aroclor - 1254		238	U
11096-82-5	Aroclor - 1260		238	U

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
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ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2855
Client Project No:	3-1161, Skykomish	Lab File ID:	31018-03
Sample ID:	SS28-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/11/93
Sample Date:	9/28/93	Date Analyzed:	10/18/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	94.3
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		85	U
11104-28-2	Aroclor - 1221		85	U
11141-16-5	Aroclor - 1232		85	U
53469-21-9	Aroclor - 1242		85	U
12672-29-6	Aroclor - 1248		85	U
11097-69-1	Aroclor - 1254		170	U
11096-82-5	Aroclor - 1260		170	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2856
Client Project No:	3-1161, Skykomish	Lab File ID:	31018-04
Sample ID:	SS30-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/11/93
Sample Date:	9/30/93	Date Analyzed:	10/18/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	85.3
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		94	U
11104-28-2	Aroclor - 1221		94	U
11141-16-5	Aroclor - 1232		94	U
53469-21-9	Aroclor - 1242		94	U
12672-29-6	Aroclor - 1248		94	U
11097-69-1	Aroclor - 1254		188	U
11096-82-5	Aroclor - 1260		188	U

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW

Organic Laboratory Supervisor

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ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2857
Client Project No:	3-1161, Skykomish	Lab File ID:	31018-05
Sample ID:	DW3-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/11/93
Sample Date:	9/29/93	Date Analyzed:	10/18/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	89.1
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL Q
12674-11-2	Aroclor - 1016		90 U
11104-28-2	Aroclor - 1221		90 U
11141-16-5	Aroclor - 1232		90 U
53469-21-9	Aroclor - 1242		90 U
12672-29-6	Aroclor - 1248		90 U
11097-69-1	Aroclor - 1254		180 U
11096-82-5	Aroclor - 1260		180 U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2858
Client Project No:	3-1161, Skykomish	Lab File ID:	31018-06
Sample ID:	SS32-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/11/93
Sample Date:	9/30/93	Date Analyzed:	10/18/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	95.2
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		84	U
11104-28-2	Aroclor - 1221		84	U
11141-16-5	Aroclor - 1232		84	U
53469-21-9	Aroclor - 1242		84	U
12672-29-6	Aroclor - 1248		84	U
11097-69-1	Aroclor - 1254		168	U
11096-82-5	Aroclor - 1260		168	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
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ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2859
Client Project No:	3-1161, Skykomish	Lab File ID:	31018-07
Sample ID:	SS31-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/12/93
Sample Date:	9/30/93	Date Analyzed:	10/18/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	92.6
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		86	U
11104-28-2	Aroclor - 1221		86	U
11141-16-5	Aroclor - 1232		86	U
53469-21-9	Aroclor - 1242		86	U
12672-29-6	Aroclor - 1248		86	U
11097-69-1	Aroclor - 1254		173	U
11096-82-5	Aroclor - 1260		173	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2860
Client Project No:	3-1161, Skykomish	Lab File ID:	31018-08
Sample ID:	SS29-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/11/93
Sample Date:	9/30/93	Date Analyzed:	10/18/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	95.4
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		84	U
11104-28-2	Aroclor - 1221		84	U
11141-16-5	Aroclor - 1232		84	U
53469-21-9	Aroclor - 1242		84	U
12672-29-6	Aroclor - 1248		84	U
11097-69-1	Aroclor - 1254		168	U
11096-82-5	Aroclor - 1260		168	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2861
Client Project No:	3-1161, Skykomish	Lab File ID:	31018-09
Sample ID:	SS27-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/11/93
Sample Date:	9/30/93	Date Analyzed:	10/18/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	94.9
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		84	U
11104-28-2	Aroclor - 1221		84	U
11141-16-5	Aroclor - 1232		84	U
53469-21-9	Aroclor - 1242		84	U
12672-29-6	Aroclor - 1248		84	U
11097-69-1	Aroclor - 1254	1200	169	
11096-82-5	Aroclor - 1260		169	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulson for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2862
Client Project No:	3-1161, Skykomish	Lab File ID:	31018-12
Sample ID:	SS92-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/11/93
Sample Date:	9/30/93	Date Analyzed:	10/18/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	95.4
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		84	U
11104-28-2	Aroclor - 1221		84	U
11141-16-5	Aroclor - 1232		84	U
53469-21-9	Aroclor - 1242		84	U
12672-29-6	Aroclor - 1248		84	U
11097-69-1	Aroclor - 1254		168	U
11096-82-5	Aroclor - 1260		168	U

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2863
Client Project No:	3-1161, Skykomish	Lab File ID:	31018-13
Sample ID:	SS13-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/11/93
Sample Date:	9/30/93	Date Analyzed:	10/18/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	96.4
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		83	U
11104-28-2	Aroclor - 1221		83	U
11141-16-5	Aroclor - 1232		83	U
53469-21-9	Aroclor - 1242		83	U
12672-29-6	Aroclor - 1248		83	U
11097-69-1	Aroclor - 1254		166	U
11096-82-5	Aroclor - 1260		166	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW

Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2864
Client Project No:	3-1161, Skykomish	Lab File ID:	31018-14
Sample ID:	SS14-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/11/93
Sample Date:	9/30/93	Date Analyzed:	10/18/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	98.0
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		82	U
11104-28-2	Aroclor - 1221		82	U
11141-16-5	Aroclor - 1232		82	U
53469-21-9	Aroclor - 1242		82	U
12672-29-6	Aroclor - 1248		82	U
11097-69-1	Aroclor - 1254		163	U
11096-82-5	Aroclor - 1260		163	U

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW

Organic Laboratory Supervisor

ACZ Laboratories, Inc.
30400 Downhill Dr.
Steamboat Springs, CO 80487
(800) 334-5493
FAX: (303) 879-2216

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2865
Client Project No:	3-1161, Skykomish	Lab File ID:	31018-15
Sample ID:	SS41-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/11/93
Sample Date:	9/30/93	Date Analyzed:	10/18/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	98.0
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		82	U
11104-28-2	Aroclor - 1221		82	U
11141-16-5	Aroclor - 1232		82	U
53469-21-9	Aroclor - 1242		82	U
12672-29-6	Aroclor - 1248		82	U
11097-69-1	Aroclor - 1254		163	U
11096-82-5	Aroclor - 1260		163	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2866
Client Project No:	3-1161, Skykomish	Lab File ID:	31018-16
Sample ID:	SS15-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/11/93
Sample Date:	9/30/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	96.9
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		83	U
11104-28-2	Aroclor - 1221		83	U
11141-16-5	Aroclor - 1232		83	U
53469-21-9	Aroclor - 1242		83	U
12672-29-6	Aroclor - 1248		83	U
11097-69-1	Aroclor - 1254		165	U
11096-82-5	Aroclor - 1260		165	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2867
Client Project No:	3-1161, Skykomish	Lab File ID:	3101/-17
Sample ID:	SS16-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/11/93
Sample Date:	9/30/93	Date Analyzed:	10/24/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	94.6
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		85	U
11104-28-2	Aroclor - 1221		85	U
11141-16-5	Aroclor - 1232		85	U
53469-21-9	Aroclor - 1242		85	U
12672-29-6	Aroclor - 1248		85	U
11097-69-1	Aroclor - 1254		169	U
11096-82-5	Aroclor - 1260	137	169	J

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc.
30400 Downhill Dr.
Steamboat Springs, CO 80487

(800) 334-5493
FAX: (303) 879-2216

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2868
Client Project No:	3-1161, Skykomish	Lab File ID:	31018-18
Sample ID:	SS18-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/11/93
Sample Date:	9/30/93	Date Analyzed:	10/24/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	95.4
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		84	U
11104-28-2	Aroclor - 1221		84	U
11141-16-5	Aroclor - 1232		84	U
53469-21-9	Aroclor - 1242		84	U
12672-29-6	Aroclor - 1248		84	U
11097-69-1	Aroclor - 1254		168	U
11096-82-5	Aroclor - 1260		168	U

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2869
Client Project No:	3-1161, Skykomish	Lab File ID:	31018-19
Sample ID:	SS17-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/11/93
Sample Date:	9/30/93	Date Analyzed:	10/24/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	80.1
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		100	U
11104-28-2	Aroclor - 1221		100	U
11141-16-5	Aroclor - 1232		100	U
53469-21-9	Aroclor - 1242		100	U
12672-29-6	Aroclor - 1248		100	U
11097-69-1	Aroclor - 1254		200	U
11096-82-5	Aroclor - 1260		200	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2870
Client Project No:	3-1161, Skykomish	Lab File ID:	31018-20
Sample ID:	SS19-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/12/93
Sample Date:	9/30/93	Date Analyzed:	10/24/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	96.1
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		83	U
11104-28-2	Aroclor - 1221		83	U
11141-16-5	Aroclor - 1232		83	U
53469-21-9	Aroclor - 1242		83	U
12672-29-6	Aroclor - 1248		83	U
11097-69-1	Aroclor - 1254	83	166	J
11096-82-5	Aroclor - 1260	92	166	J

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CN

Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2871
Client Project No:	3-1161, Skykomish	Lab File ID:	31018-21
Sample ID:	SS19. 1-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/12/93
Sample Date:	9/30/93	Date Analyzed:	10/25/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	93.0
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		86	U
11104-28-2	Aroclor - 1221		86	U
11141-16-5	Aroclor - 1232		86	U
53469-21-9	Aroclor - 1242		86	U
12672-29-6	Aroclor - 1248		86	U
11097-69-1	Aroclor - 1254		172	U
11096-82-5	Aroclor - 1260		172	U

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2872
Client Project No:	3-1161, Skykomish	Lab File ID:	31026-17
Sample ID:	SS21-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/12/93
Sample Date:	9/30/93	Date Analyzed:	10/27/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	90.9
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		88	U
11104-28-2	Aroclor - 1221		88	U
11141-16-5	Aroclor - 1232		88	U
53469-21-9	Aroclor - 1242		88	U
12672-29-6	Aroclor - 1248		88	U
11097-69-1	Aroclor - 1254		176	U
11096-82-5	Aroclor - 1260		176	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Carlson for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2873
Client Project No:	3-1161, Skykomish	Lab File ID:	31026-18
Sample ID:	SS22-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/12/93
Sample Date:	9/30/93	Date Analyzed:	10/27/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	97.2
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		82	U
11104-28-2	Aroclor - 1221		82	U
11141-16-5	Aroclor - 1232		82	U
53469-21-9	Aroclor - 1242		82	U
12672-29-6	Aroclor - 1248		82	U
11097-69-1	Aroclor - 1254		165	U
11096-82-5	Aroclor - 1260		165	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2874
Client Project No:	3-1161, Skykomish	Lab File ID:	31026/19
Sample ID:	SS23-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/12/93
Sample Date:	9/30/93	Date Analyzed:	10/27/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	84.0
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		95	U
11104-28-2	Aroclor - 1221		95	U
11141-16-5	Aroclor - 1232		95	U
53469-21-9	Aroclor - 1242		95	U
12672-29-6	Aroclor - 1248		95	U
11097-69-1	Aroclor - 1254		190	U
11096-82-5	Aroclor - 1260		190	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	573-2875
Client Project No:	3-1161, Skykomish	Lab File ID:	31026-20
Sample ID:	SS24-0	Date Received:	10/2/93
Matrix:	Soil	Date Extracted:	10/12/93
Sample Date:	9/30/93	Date Analyzed:	10/27/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	97.6
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		82	U
11104-28-2	Aroclor - 1221		82	U
11141-16-5	Aroclor - 1232		82	U
53469-21-9	Aroclor - 1242		82	U
12672-29-6	Aroclor - 1248		82	U
11097-69-1	Aroclor - 1254		164	U
11096-82-5	Aroclor - 1260		164	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc.
30400 Downhill Dr.
Steamboat Springs, CO 80487

(800) 334-5493
FAX: (303) 879-2216

Client : ReTec, Inc.
Address : 1011 SW Klickitat Way, Ste. 207
Seattle, WA 98134
Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: SS28-0
Sample Date Time: 09/29/93 15:28

Lab No. : 93-SI/01916
Date Received: 10/02/93

Parameters

Antimony, total	2.7	mg/kg	4
Arsenic, total	8.	mg/kg	4
Beryllium, total	0.5	mg/kg	4
Cadmium, total	-0.6	mg/kg	4
Chromium, total	10.3	mg/kg	4
Copper, total	195.	mg/kg	4
Lead, total	920.0	mg/kg	4
Mercury, total	-0.02	mg/kg	4
Nickel, total	35.0	mg/kg	4
Selenium, total	0.3	mg/kg	4
Silver, total	-1.	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	101.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager /SH.

Frank E. Polniak, Inorganic Laboratory Supervisor /FP

Client : ReTec, Inc.
Address : 1011 S.W. Klickitat Way
Seattle, WA 98134
Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: SS30-0 Lab No. : 93-SI/01917
Sample Date Time: 09/30/93 09:12 Date Received: 10/02/93

Parameters			
Antimony, total	-0.3	mg/kg	4
Arsenic, total	20.	mg/kg	4
Beryllium, total	-0.6	mg/kg	4
Cadmium, total	-0.6	mg/kg	4
Chromium, total	35.0	mg/kg	4
Copper, total	26.7	mg/kg	4
Lead, total	18.3	mg/kg	4
Mercury, total	0.18	mg/kg	4
Nickel, total	29.1	mg/kg	4
Selenium, total	0.2	mg/kg	4
Silver, total	-1.2	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	62.5	mg/kg	4

4 EPA SW846, Method 3051 Digestion.
Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/SH.

Frank E. Polniak, Inorganic Laboratory Supervisor/FP

Client : ReTec, Inc.
Address : 1011 S.W. Klickitat Way
Seattle, WA 98134
Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: DW3-0
Sample Date Time: 09/29/93 08:10

Lab No. : 93-SI/01918
Date Received: 10/02/93

Parameters

Antimony, total	0.6	mg/kg	4
Arsenic, total	17.	mg/kg	4
Beryllium, total	-1.1	mg/kg	4
Cadmium, total	1.4	mg/kg	4
Chromium, total	20.7	mg/kg	4
Copper, total	124.	mg/kg	4
Lead, total	179.	mg/kg	4
Mercury, total	0.06	mg/kg	4
Nickel, total	27.1	mg/kg	4
Selenium, total	0.2	mg/kg	4
Silver, total	-2.3	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	306.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/SH.

Frank E. Polniak, Inorganic Laboratory Supervisor/FP

Client : ReTec, Inc.
Address : 1011 S.W. Klickitat Way
Seattle, WA 98134
Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: MW35-0
Sample Date Time: 09/28/93 17:01

Lab No. : 93-SI/01919
Date Received: 10/02/93

Parameters

Antimony, total	-0.2	mg/kg	4
Arsenic, total	10.	mg/kg	4
Beryllium, total	-0.6	mg/kg	4
Cadmium, total	-0.6	mg/kg	4
Chromium, total	24.3	mg/kg	4
Copper, total	16.6	mg/kg	4
Lead, total	3.6	mg/kg	4
Mercury, total	-0.02	mg/kg	4
Nickel, total	22.0	mg/kg	4
Selenium, total	0.1	mg/kg	4
Silver, total	-1.0	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	34.7	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/S.H.

Frank E. Polniak, Inorganic Laboratory Supervisor/FP

Client : ReTec, Inc.
Address : 1011 S.W. Klickitat Way
Seattle, WA 98134
Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: B10-0 Lab No. : 93-SI/01920
Sample Date Time: 09/29/93 11:20 Date Received: 10/02/93

Parameters

Antimony, total	-0.3	mg/kg	4
Arsenic, total	10	mg/kg	4
Beryllium, total	-0.5	mg/kg	4
Cadmium, total	-0.6	mg/kg	4
Chromium, total	35.4	mg/kg	4
Copper, total	28.4	mg/kg	4
Lead, total	11.3	mg/kg	4
Mercury, total	-0.02	mg/kg	4
Nickel, total	33.0	mg/kg	4
Selenium, total	-0.1	mg/kg	4
Silver, total	-1.0	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	47.8	mg/kg	4

4 EPA SW846, Method 3051 Digestion.
Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/S.H.

Frank E. Polniak, Inorganic Laboratory Supervisor

Client : ReTec, Inc.
Address : 1011 S.W. Klickitat Way
Seattle, WA 98134
Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: BG2-0 Lab No. : 93-SI/01921
Sample Date Time: 09/30/93 09:35 Date Received: 10/02/93

Parameters			
Antimony, total	-0.3	mg/kg	4
Arsenic, total	31.	mg/kg	4
Beryllium, total	-0.7	mg/kg	4
Cadmium, total	-0.7	mg/kg	4
Chromium, total	41.7	mg/kg	4
Copper, total	26.2	mg/kg	4
Lead, total	28.2	mg/kg	4
Mercury, total	0.06	mg/kg	4
Nickel, total	33.7	mg/kg	4
Selenium, total	0.1	mg/kg	4
Silver, total	-1.5	mg/kg	4
Thallium, total	0.3	mg/kg	4
Zinc, total	75.3	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/SH.

Frank E. Polniak, Inorganic Laboratory Supervisor/FP

Client : ReTec, Inc.
Address : 1011 S.W. Klickitat Way
Seattle, WA 98134
Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: SS32-0
Sample Date Time: 09/30/93 09:53

Lab No. : 93-SI/01922
Date Received: 10/02/93

Parameters			
Antimony, total	-0.3	mg/kg	4
Arsenic, total	6.	mg/kg	4
Beryllium, total	-0.5	mg/kg	4
Cadmium, total	-0.6	mg/kg	4
Chromium, total	36.2	mg/kg	4
Copper, total	22.5	mg/kg	4
Lead, total	9.7	mg/kg	4
Mercury, total	-0.02	mg/kg	4
Nickel, total	37.5	mg/kg	4
Selenium, total	0.1	mg/kg	4
Silver, total	-1.0	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	35.7	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

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Frank E. Polniak, Inorganic Laboratory Supervisor/FP

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| 10/30/93 | ANALYTICAL REPORT | 17:50 |

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Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: SS31-0 Lab No. : 93-SI/01923
Sample Date Time: 09/30/93 10:09 Date Received: 10/02/93

Parameters			
Antimony, total	-0.3	mg/kg	4
Arsenic, total	24.	mg/kg	4
Beryllium, total	-2.7	mg/kg	4
Cadmium, total	-2.7	mg/kg	4
Chromium, total	47.0	mg/kg	4
Copper, total	37.3	mg/kg	4
Lead, total	11.9	mg/kg	4
Mercury, total	0.06	mg/kg	4
Nickel, total	51.3	mg/kg	4
Selenium, total	0.1	mg/kg	4
Silver, total	-5.4	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	74.0	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

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Frank E. Polniak, Inorganic Laboratory Supervisor/FP

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Address : 1011 S.W. Klickitat Way
Seattle, WA 98134
Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: SS29-0 Lab No. : 93-SI/01924
Sample Date Time: 09/30/93 10:42 Date Received: 10/02/93

Parameters			
Antimony, total	2.6	mg/kg	4
Arsenic, total	21.	mg/kg	4
Beryllium, total	-1.1	mg/kg	4
Cadmium, total	-1.1	mg/kg	4
Chromium, total	18.1	mg/kg	4
Copper, total	323.	mg/kg	4
Lead, total	402.	mg/kg	4
Mercury, total	0.05	mg/kg	4
Nickel, total	71.9	mg/kg	4
Selenium, total	0.2	mg/kg	4
Silver, total	-2.1	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	264.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

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Frank E. Polniak, Inorganic Laboratory Supervisor/FP

Client : ReTec, Inc.
Address : 1011 S.W. Klickitat Way
Seattle, WA 98134
Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: SS27-0
Sample Date Time: 09/30/93 11:02

Lab No. : 93-SI/01925
Date Received: 10/02/93

Parameters			
Antimony, total	0.20	mg/kg	4
Arsenic, total	11.	mg/kg	4
Beryllium, total	-0.5	mg/kg	4
Cadmium, total	0.6	mg/kg	4
Chromium, total	22.	mg/kg	4
Copper, total	36.0	mg/kg	4
Lead, total	151.	mg/kg	4
Mercury, total	0.13	mg/kg	4
Nickel, total	21.5	mg/kg	4
Selenium, total	-0.2	mg/kg	4
Silver, total	-1.0	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	223.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

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Frank E. Polniak, Inorganic Laboratory Supervisor/

Client : ReTec, Inc.
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Seattle, WA 98134
Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: SS92-0
Sample Date Time: 09/30/93 10:24

Lab No. : 93-SI/01926
Date Received: 10/02/93

Parameters

Antimony, total	1.6	mg/kg	4
Arsenic, total	17.	mg/kg	4
Beryllium, total	-0.5	mg/kg	4
Cadmium, total	-0.6	mg/kg	4
Chromium, total	22.3	mg/kg	4
Copper, total	350.	mg/kg	4
Lead, total	440.	mg/kg	4
Mercury, total	0.06	mg/kg	4
Nickel, total	72.2	mg/kg	4
Selenium, total	0.5	mg/kg	4
Silver, total	-1.0	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	262.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

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Scott Habermehl, Project Manager/S.H.

Frank E. Polniak, Inorganic Laboratory Supervisor/

Client : ReTec, Inc.
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Seattle, WA 98134
Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: SS13-0 Lab No. : 93-SI/01927
Sample Date Time: 09/30/93 11:27 Date Received: 10/02/93

Parameters			
Antimony, total	-0.3	mg/kg	4
Arsenic, total	14.	mg/kg	4
Beryllium, total	-0.5	mg/kg	4
Cadmium, total	-0.6	mg/kg	4
Chromium, total	23.2	mg/kg	4
Copper, total	36.5	mg/kg	4
Lead, total	106.	mg/kg	4
Mercury, total	0.11	mg/kg	4
Nickel, total	22.2	mg/kg	4
Selenium, total	-0.1	mg/kg	4
Silver, total	-1.0	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	162.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

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Frank E. Polniak, Inorganic Laboratory Supervisor/F

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Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: SS14-0
Sample Date Time: 09/30/93 13:02

Lab No. : 93-SI/01928
Date Received: 10/02/93

Parameters

Antimony, total	-0.3	mg/kg	4
Arsenic, total	12.	mg/kg	4
Beryllium, total	-0.5	mg/kg	4
Cadmium, total	-0.6	mg/kg	4
Chromium, total	17.5	mg/kg	4
Copper, total	39.5	mg/kg	4
Lead, total	67.4	mg/kg	4
Mercury, total	0.02	mg/kg	4
Nickel, total	17.5	mg/kg	4
Selenium, total	-0.1	mg/kg	4
Silver, total	-1.0	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	60.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/S.H.

Frank E. Polniak, Inorganic Laboratory Supervisor/FP

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Address : 1011 S.W. Klickitat Way
Seattle, WA 98134
Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: SS41-0 Lab No. : 93-SI/01929
Sample Date Time: 09/30/93 13:20 Date Received: 10/02/93

Parameters			
Antimony, total	-0.3	mg/kg	4
Arsenic, total	11.	mg/kg	4
Beryllium, total	-0.5	mg/kg	4
Cadmium, total	-0.6	mg/kg	4
Chromium, total	18.9	mg/kg	4
Copper, total	40.	mg/kg	4
Lead, total	73.3	mg/kg	4
Mercury, total	-0.02	mg/kg	4
Nickel, total	18.7	mg/kg	4
Selenium, total	-0.1	mg/kg	4
Silver, total	-1.0	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	62.5	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

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Frank E. Polniak, Inorganic Laboratory Supervisor/FP

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Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: SS15-0 Lab No. : 93-SI/01930
Sample Date Time: 09/30/93 13:22 Date Received: 10/02/93

Parameters

Antimony, total	-0.3	mg/kg	4
Arsenic, total	19.	mg/kg	4
Beryllium, total	-0.5	mg/kg	4
Cadmium, total	-0.6	mg/kg	4
Chromium, total	20.8	mg/kg	4
Copper, total	63.4	mg/kg	4
Lead, total	196.	mg/kg	4
Mercury, total	0.03	mg/kg	4
Nickel, total	22.0	mg/kg	4
Selenium, total	-0.1	mg/kg	4
Silver, total	-1.0	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	95.2	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

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Frank E. Polniak, Inorganic Laboratory Supervisor/FP

Client : ReTec, Inc.
Address : 1011 S.W. Klickitat Way
Seattle, WA 98134
Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: SS16-0 Lab No. : 93-SI/01931
Sample Date Time: 09/30/93 13:42 Date Received: 10/02/93

Parameters			
Antimony, total	8.8	mg/kg	4
Arsenic, total	22.	mg/kg	4
Beryllium, total	-2.7	mg/kg	4
Cadmium, total	-3.0	mg/kg	4
Chromium, total	22.0	mg/kg	4
Copper, total	160.	mg/kg	4
Lead, total	1300.	mg/kg	4
Mercury, total	0.06	mg/kg	4
Nickel, total	27.3	mg/kg	4
Selenium, total	0.1	mg/kg	4
Silver, total	-5.2	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	149.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.
Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/S.H.

Frank E. Polniak, Inorganic Laboratory Supervisor/FP

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Address : 1011 S.W. Klickitat Way
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Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: SS18-0
Sample Date Time: 09/30/93 14:02

Lab No. : 93-SI/01932
Date Received: 10/02/93

Parameters			
Antimony, total	-0.3	mg/kg	4
Arsenic, total	12.	mg/kg	4
Beryllium, total	-2.7	mg/kg	4
Cadmium, total	-2.6	mg/kg	4
Chromium, total	30.4	mg/kg	4
Copper, total	37.8	mg/kg	4
Lead, total	133.	mg/kg	4
Mercury, total	0.05	mg/kg	4
Nickel, total	28.9	mg/kg	4
Selenium, total	-0.1	mg/kg	4
Silver, total	-5.2	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	99.2	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/SH.

Frank E. Polniak, Inorganic Laboratory Supervisor/FP

Client : ReTec, Inc.
Address : 1011 S.W. Klickitat Way
Seattle, WA 98134
Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: SS17-0
Sample Date Time: 09/30/93 14:33

Lab No. : 93-SI/01933
Date Received: 10/02/93

Parameters

Antimony, total	0.2	mg/kg	4
Arsenic, total	18.	mg/kg	4
Beryllium, total	-0.6	mg/kg	4
Cadmium, total	-0.7	mg/kg	4
Chromium, total	39.4	mg/kg	4
Copper, total	32.4	mg/kg	4
Lead, total	79.1	mg/kg	4
Mercury, total	0.05	mg/kg	4
Nickel, total	35.4	mg/kg	4
Selenium, total	-0.1	mg/kg	4
Silver, total	-1.2	mg/kg	4
Thallium, total	0.2	mg/kg	4
Zinc, total	178.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

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Scott Habermehl, Project Manager/SH.

Frank E. Polniak, Inorganic Laboratory Supervisor/FP

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Seattle, WA 98134
Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: SS19-0
Sample Date Time: 09/30/93 14:51

Lab No. : 93-SI/01934
Date Received: 10/02/93

Parameters

Antimony, total	0.9	mg/kg	4
Arsenic, total	64.	mg/kg	4
Beryllium, total	-5.2	mg/kg	4
Cadmium, total	-5.2	mg/kg	4
Chromium, total	42.2	mg/kg	4
Copper, total	125.	mg/kg	4
Lead, total	660.	mg/kg	4
Mercury, total	0.08	mg/kg	4
Nickel, total	52.5	mg/kg	4
Selenium, total	-0.2	mg/kg	4
Silver, total	-10.	mg/kg	4
Thallium, total	0.30	mg/kg	4
Zinc, total	337.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/S.H.

Frank E. Polniak, Inorganic Laboratory Supervisor/FP

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Address : 1011 S.W. Klickitat Way
Seattle, WA 98134
Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: SS19.1-0 Lab No. : 93-SI/01935
Sample Date Time: 09/30/93 15:06 Date Received: 10/02/93

Parameters			
Antimony, total	-0.3	mg/kg	4
Arsenic, total	48.	mg/kg	4
Beryllium, total	-2.6	mg/kg	4
Cadmium, total	-2.6	mg/kg	4
Chromium, total	27.0	mg/kg	4
Copper, total	126.	mg/kg	4
Lead, total	357.	mg/kg	4
Mercury, total	0.08	mg/kg	4
Nickel, total	27.6	mg/kg	4
Selenium, total	-0.2	mg/kg	4
Silver, total	-5.3	mg/kg	4
Thallium, total	0.2	mg/kg	4
Zinc, total	308.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/SH.

Frank E. Polniak, Inorganic Laboratory Supervisor/F

Client : ReTec, Inc.
Address : 1011 S.W. Klickitat Way
Seattle, WA 98134
Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: SS21-0
Sample Date Time: 09/30/93 16:24

Lab No. : 93-SI/01936
Date Received: 10/02/93

Parameters

Antimony, total	-0.3	mg/kg	4
Arsenic, total	20.	mg/kg	4
Beryllium, total	-2.7	mg/kg	4
Cadmium, total	-2.7	mg/kg	4
Chromium, total	26.5	mg/kg	4
Copper, total	118.	mg/kg	4
Lead, total	425	mg/kg	4
Mercury, total	0.08	mg/kg	4
Nickel, total	32.4	mg/kg	4
Selenium, total	-0.2	mg/kg	4
Silver, total	-5.4	mg/kg	4
Thallium, total	0.3	mg/kg	4
Zinc, total	170.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

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Scott Habermehl, Project Manager /S.H.

Frank E. Polniak, Inorganic Laboratory Supervisor /[signature]

Client : ReTec, Inc.
Address : 1011 S.W. Klickitat Way
Seattle, WA 98134
Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: SS22-0
Sample Date Time: 09/30/93 16:45
Lab No. : 93-SI/01937
Date Received: 10/02/93

Parameters			
Antimony, total	-0.3	mg/kg	4
Arsenic, total	24.	mg/kg	4
Beryllium, total	-2.6	mg/kg	4
Cadmium, total	-2.6	mg/kg	4
Chromium, total	23.2	mg/kg	4
Copper, total	73.6	mg/kg	4
Lead, total	222.	mg/kg	4
Mercury, total	0.02	mg/kg	4
Nickel, total	29.9	mg/kg	4
Selenium, total	-0.2	mg/kg	4
Silver, total	-5.2	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	151.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

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Scott Habermehl, Project Manager/S.H.

Frank E. Polniak, Inorganic Laboratory Supervisor/FP

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Seattle, WA 98134
Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: SS23-0
Sample Date Time: 09/30/93 17:05

Lab No. : 93-SI/01938
Date Received: 10/02/93

Parameters			
Antimony, total	-0.3	mg/kg	4
Arsenic, total	21.	mg/kg	4
Beryllium, total	-0.6	mg/kg	4
Cadmium, total	1.3	mg/kg	4
Chromium, total	23.6	mg/kg	4
Copper, total	130.	mg/kg	4
Lead, total	156.	mg/kg	4
Mercury, total	0.06	mg/kg	4
Nickel, total	23.2	mg/kg	4
Selenium, total	-0.2	mg/kg	4
Silver, total	-1.2	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	208.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/S.H.

Frank E. Polniak, Inorganic Laboratory Supervisor/F

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Address : 1011 S.W. Klickitat Way
Seattle, WA 98134
Attn. : Mr. Ward Beebe
Project : 3-1161, BN-Skykomish

Sample Matrix: Soil
Sample ID: SS24-0 Lab No. : 93-SI/01939
Sample Date Time: 09/30/93 17:21 Date Received: 10/02/93

Parameters			
Antimony, total	-0.3	mg/kg	4
Arsenic, total	10.	mg/kg	4
Beryllium, total	-0.5	mg/kg	4
Cadmium, total	-0.6	mg/kg	4
Chromium, total	18.4	mg/kg	4
Copper, total	45.9	mg/kg	4
Lead, total	28.4	mg/kg	4
Mercury, total	-0.02	mg/kg	4
Nickel, total	18.6	mg/kg	4
Selenium, total	-0.1	mg/kg	4
Silver, total	-1.0	mg/kg	4
Thallium, total	0.3	mg/kg	4
Zinc, total	52.8	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

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Scott Habermehl, Project Manager/S.H.

Frank E. Polniak, Inorganic Laboratory Supervisor/FP

ACZ Laboratories, Inc.

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Steamboat Springs, CO 80487-9400
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November 18,1993

Mr. Ward Beebe
Remediation Technologies Inc.
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134

Dear Mr. Beebe:

Enclosed is a data package for the Burlington Northern - Skykomish Project 3-1161. The package contains, in the following order, an invoice, a copy of the chain of custody documentation and the analytical reports separated by method.

ACZ received 30 soil samples on September 30, 1993. The soils were sampled on September 27 and 28, 1993 as outlined on the attached Chain of Custody record numbers 5351 and 5329 The samples were received intact and no problems were noted with the chain of custody procedures.

The samples were requested to be analyzed by one or more of the following analytical methods.

WTPH	EPA 418.1	IR
WTPH-G	EPA Mod 8020	GC/FID
WTPH-D	EPA Mod 8015	GC/FID
VOC	EPA 8240	GC/MS
SEMI-VOA	EPA 8270	GC/MS
PCB	EPA 8080	GC/ECD
METALS	EPA 6010/7000	ICP/GFAA

All data is reported on an a dry weight basis and reporting levels are at the lowest level possible for the specific matrix. Comments and required QC recoveries have been added to the individual reports. Other anomalies associated with this project are:

1. There was not enough sample to perform the WTPH-D analysis on sample B4-10.
2. Sample MW40-5 was missed at login for the WTPH-418.1 analysis.

If you have any questions or comments regarding the content or format of this package please do not hesitate to give me a call at (800)334-5493.

Sincerely,

Scott Habermehl

Scott Habermehl
Project Manager

ORG 559 (93-50/2767-2789) (93-5I/1834-1842)

№ 5351

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME	SAMPLERS	RECEIVING LABORATORY	SEND RESULTS TO
3-1161	BN-SKYKOMISH	W BEEBE	ACZ LABS	W BEEBE

LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS	WTPH-418.1	WTPH-G	WTPH-D	VOC (EPA 8240)	SVOC (EPA 8270)	PCB (EPA 8080)	METALS (6010/7000)	REMARKS
	9/27/93	1658	DW4-7½	1	X		X					
	~~↓~~	~~1650~~	~~DW4-2½~~	~~1~~	~~X~~		~~X~~					
	↓	0923	DW2-0	2						X	X	
	↓	0926	DW2-2	1						X		
	9/28/93	0851	DW1-22½	1	X							
		1217	B4-0	2						X	X	
		0815	DW10-22½	1	X							
		1220	B4-2	1						X		
		1232	B4-10	1	X		X		X	X		
		1252	B4-10	1				X				
		1225	B40-10	1				X				
		1340	MW34-0	1							X	
		1355	MW34-7½	1				X				
		1358	MW34-10	1	X		X		X			
		1446	MW33-0	1							X	
		1452	MW33-2½	1	X	X	X		X			
		1456	MW33-5	1				X				
		~~1515~~	~~MW33-12½~~	~~1~~	~~X~~							

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time
[signature]	9/28/93 2022	[signature]	9/30/93 10:05

Shipper Information

~~Condition of Samples Upon Receipt~~
By ACZ Laboratories, Inc:
Temperature of Contents: 3 °C
~~Sample Containers: Intact~~
Custody Seals: WA-3-4-Intact

RETEC
REMEDIATION TECHNOLOGIES INC

REMEDIATION TECHNOLOGIES
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PINK COPY - Sampler   YELLOW COPY - Laboratory   WHITE COPY - ReTeC

№ 5349

CHAIN OF CUSTODY RECORD

PROJ. NO.: 3-1161

PROJECT NAME: BN-SKYKOMISH

SAMPLERS: W. BEESE

RECEIVING LABORATORY: ACZ LABORATORIES

SEND RESULTS TO: W. BEESE

LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS	WTPH-418.1	WTPH-G	WTPH-D	VOC (EPA 8240)	SVOC (EPA 8270)	PCB (EPA 8080)	METALS (6010/7000)	REMARKS
	~~9/27/93~~	~~0923~~	~~DW2-0~~	2						X	X	
		~~0926~~	~~DW2-2~~	1						X		
		0930	DW2-5	1	X		x		X			
		0937	DW2-10	1				X				
		0941	DW2-12½	1	X							
		1317	MW40-0	1							X	
		1335	MW40-5	2	x	x	x	x	x	x		
		1352	MW40-12½	1	X							
		1534	B11-0	1							X	
		1544	B11-5	1	X		X					
		1550	B11-10	1	X							
		1543	B110-0	1							X	
		1644	DW4-0	1							X	
		~~1650~~	~~DW4-2½~~	1	X		X					STET
		~~1658~~	~~DW4-7½~~	1	X		X					
	9/28/93	0815	DW1-0	1							X	
		0822	DW1-5	1	X		X					

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
[signature]	9/28/93 2020				

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time
		[signature]	9/30/93 10:00

Condition of Samples Upon Receipt By ACZ Laboratories, Inc:
Temperature of Contents: 3 °C
Sample Containers: Intact
Custody Seals: NA/+a - Intact

Shipper Information

RETEC REMEDIATION TECHNOLOGIES INC
REMEDIATION TECHNOLOGIES
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PINK COPY - Sampler YELLOW COPY - Laboratory WHITE COPY - ReTeC

ACZ Laboratories, Inc.

QUALITY CONTROL DATA SUMMARY

Client: Retec — Report Date: 1/27/94
Attn: Ms. Kim Lofgren
Project: 3-1161, Skykomish

ACZ Sample ID:	Client Sample ID:	Performed Analysis	Sampled	Received
93-SO/559-2767	DW2-10	V	9/27/93	9/30/93
93-SO/559-2768	B4-10	V	9/28/93	9/30/93
93-SO/559-2769	B40-10	V	9/28/93	9/30/93
93-SO/559-2770	MW34-7 1/2	V	9/28/93	9/30/93
93-SO/559-2771	MW33-5	V	9/28/93	9/30/93
93-SO/559-2772	MW40-5	V,S,P,G,D	9/27/93	9/30/93
93-SO/559-2773	MW34-10	S,D,I	9/28/93	9/30/93
93-SO/559-2774	DW2-5	S,D,I	9/27/93	9/30/93
93-SO/559-2775	MW33-2 1/2	S,G,D,I	9/28/93	9/30/93
93-SO/559-2776	B11-5	D,I	9/27/93	9/30/93
93-SO/559-2777	DW1-5	D,I	9/28/93	9/30/93
93-SO/559-2778	DW4-7 1/2	D,I	9/27/93	9/30/93
93-SO/559-2779	DW2-12 1/2	I	9/27/93	9/30/93
93-SO/559-2780	MW40-12 1/2	I	9/27/93	9/30/93
93-SO/559-2781	B11-10	I	9/27/93	9/30/93
93-SO/559-2782	DW1-22 1/2	I	9/28/93	9/30/93
93-SO/559-2783	DW10-22 1/2	I	9/28/93	9/30/93
93-SO/559-2784	MW33-12 1/2	I	9/28/93	9/30/93
93-SO/559-2785	B4-10	S,P,I	9/28/93	9/30/93
93-SO/559-2786	DW2-2	P	9/27/93	9/30/93
93-SO/559-2787	B4-2	P	9/28/93	9/30/93
93-SO/559-2788	DW2-0	P	9/27/93	9/30/93
93-SO/559-2789	B4-0	P	9/28/93	9/30/93

Analyses performed on the above samples includes; (V) = VOA's by EPA 8240 (cap. column) - GC/MS
(S) = BNA's by EPA 8270 - GC/MS
(P) = PCB's by EPA 8080 - GC/ECD
(G) = WTPH-G by Washington Method by Purge and Trap - GC/FID
(D) = WTPH-D by Washington Method - GC/FID
(I) = TPH by EPA 418.1 - IR

This summary package includes the following sections for each of the above mentioned analyses:

Surrogate Recoveries
Matrix Spike/Matrix Spike Duplicates

Abbreviations:

MS/MSD = Matrix Spike/Matrix Spike Duplicate
% R = Percent Recovery
RPD = Relative Percent Difference
N/A = Not Applicable
DO = Diluted Out

Jeffrey E. Pilkins
QA/QC Officer

ACZ Laboratories, Inc.

QUALITY CONTROL DATA SUMMARY
VOA's by EPA 8240 (cap. column) - GC/MS
Matrix: Soil

Client:	Retec	Report Date:	1/27/94
Attn:	Ms. Kim Lofgren		
Project:	3-1161, Skykomish		

Surrogate Recoveries
Units: %

Analysis Date	Sample Lab #	Spike Conc. ug/Kg	Dibromo-fluoro-methane		Toluene-d8		Bromo-fluoro-benzene	
10/08/93	559-2767 DW2-10	50	99		97		100	
10/11/93	559-2768 B4-10	50	123	*	118		163	*
10/11/93	559-2768MS B4-10	50	140	*	131		160	*
10/11/93	559-2768MSD	50	132	*	160	*	183	*
10/11/93	559-2769 B4D-10	50	120		127		185	*
10/11/93	559-2769MS B4D-10	50	113		112		151	*
10/11/93	559-2769MSD	50	115		113		158	*
10/07/93	559-2770 MW34-7½	50	97		102		103	
10/07/93	559-2771 MW33-5	50	123	*	147	*	150	*
10/07/93	559-2772 MW 40-5	50	95		99		105	

* = Surrogate recoveries above QC criteria due to matrix interferences with internal standards. This matrix effect was confirmed by re-analysis.

Method Blank Surrogate Recoveries

10/05/93	VBLK 10/5	50	103	97	101
10/07/93	VBLK 10/7	50	102	100	101
10/08/93	VBLK 10/8	50	98	98	99
10/11/93	VBLK 10/11	50	110	103	108

Matrix Spike and Matrix Spike Duplicate Recoveries

Analysis Date	Sample Lab #	Spike Conc. ug/Kg	Compound	Matrix Spike % R	Matrix Spike Duplicate % R	RPD %	
10/05/93	559-2768	50	1,1-Dichloroethene	117	126	8	D-234
		50	Benzene	121	120	1	37-151
		50	Trichloroethene	80	84	5	71-157
		50	Toluene	115	144	22	47-150
		50	Chlorobenzene	90	98	8	37-160
10/11/93	559-2769	50	1,1-Dichloroethene	94	92	3	
		50	Benzene	102	98	4	
		50	Trichloroethene	87	84	4	
		50	Toluene	102	102	0	
		50	Chlorobenzene	94	91	4	

ACZ Laboratories, Inc.

QUALITY CONTROL DATA SUMMARY
BNA's by EPA 8270 - GC/MS
Matrix: Soil

Client:	Retec	Report Date:	1/27/94
Attn:	Ms. Kim Lofgren		
Project:	3-1161, Skykomish		

Surrogate Recoveries
Units: %

Extraction Date	Sample Lab #	Spike Conc. (ug/Kg) BN	/ A	Base/Neutral Surrogates NB-d5	2-FBP	TP-d14	Acid Surrogates Ph-d5	2-FPh	246-TBPh	Analysis Date
10/08/93	559-2772 MW40-5	3333	6667	74	78	101	63	59	99	11/13/93
10/08/93	559-2773 MW34-10	3322	6645	75	79	95	65	58	92	11/13/93
10/08/93	559-2774 DW2-5	3300	6601	74	80	130	64	58	102	11/13/93
10/08/93	559-2775 MW33-2½	3300	6601	72	88	152	70	57	115	11/13/93
10/08/93	559-2775MS	3300	6601	80	76	97	68	64	113	11/16/93
10/08/93	559-2775MSD	3311	6623	75	69	75	65	63	100	11/16/93
10/08/93	559-2785 B4-10	3300	6601	DO	DO	DO	DO	DO	DO	11/16/93

Prep. Blank Surrogate Recoveries

Extraction Date	Sample Lab #	BN	A	NB-d5	2-FBP	TP-d14	Ph-d5	2-FPh	246-TBPh	Analysis Date
10/08/93	SBLK 10/8	3279	6557	65	68	77	56	52	71	11/13/93

Matrix Spike and Matrix Spike Duplicate Recoveries

Analysis Date	Sample Lab #	Compound	MS Spike Conc. ug/Kg	MS % R	MSD Spike Conc. ug/Kg	MSD % R	RPD %
11/13/93	559-2775	Phenol	6601	62	6623	60	4
		2-Chlorophenol	6601	60	6623	58	3
		1,4-Dichlorobenzene	3300	58	3311	57	2
		N-Nitroso-di-n-propylamine	3300	100	3311	102	2
		1,2,4-Trichlorobenzene	3300	65	3311	63	3
		4-Chloro-3-methylphenol	6601	71	6623	66	6
		Acenaphthene	3300	59	3311	55	7
		4-Nitrophenol	6601	120	6623	111	8
		2,4-Dinitrotoluene	3300	78	3311	68	13
		Pentachlorophenol	6601	50	6623	51	3
		Pyrene	3300	78	3311	73	7

ACZ Laboratories, Inc.

QUALITY CONTROL DATA SUMMARY
PCB's by EPA 8080, GC/ECD
Matrix: Soil

Client:	Retec	Report Date:	1/27/94
Attn:	Ms. Kim Lofgren		
Project:	3-1161, Skykomish		

Surrogate Recoveries
Units: %

Extraction Date	Sample Lab #	Spike Conc. ug/Kg	Tetrachloro-m-xylene (TCMX)	Decachloro-biphenyl (DCBP)	Analysis Date
10/08/93	559-2772	20	26	140	10/25/93
10/08/93	559-2785	20	79	100	10/25/93
10/08/93	559-2786	20	61	105	10/25/93
10/08/93	559-2787	20	81	77	10/25/93
10/08/93	559-2788	20	78	121	10/25/93
10/08/93	559-2788MS	20	72	116	10/25/93
10/08/93	559-2788MSD	20	77	121	10/25/93
10/08/93	559-2789	20	76	117	10/25/93

Prep. Blank Surrogate Recoveries

Extraction Date	Sample Lab #	Spike Conc. ug/Kg	Tetrachloro-m-xylene (TCMX)	Decachloro-biphenyl (DCBP)	Analysis Date
10/08/93	PBK1S 10/8	20	55	48	10/25/93

Matrix Spike and Matrix Spike Duplicate Recoveries

Analysis Date	Sample Lab #	Sample Conc. ug/Kg	Compound	Matrix Spike % R	Matrix Spike Duplicate % R	RPD %
10/08/93	559-2788 *	0	Aroclor 1268	0	0	0

* = Due to preparation error, no Aroclor spike was added to the sample for this project.

ACZ Laboratories, Inc.

QUALITY CONTROL DATA SUMMARY
WTPH-G by Washington Method by Purge and Trap - GC/FID
Matrix: Soil

Client: Retec
Attn: Ms. Kim Lofgren
Project: 3-1161, Skykomish

Report Date: 1/27/94

Surrogate Recoveries
Units: %

Extraction Date	Sample Lab #	Spike Conc. ug/Kg	Trifluoro-toluene (TFT)	Bromofluoro-benzene (BFB)	Analysis Date
10/11/93	559-2772 mw 40.5	40	25 *	34 *	10/18/93
10/11/93	559-2775 mw 32.2.12	40	44 *	40 *	10/18/93

* = Low surrogate recoveries due to matrix interferences.

Analytical Blank Surrogate Recoveries

N/A	WBLK-00	40	104	54	10/18/93
N/A	WBLK-01	40	98	59	10/21/93
N/A	WBLK-02	40	98	59	10/21/93

Matrix Spike and Matrix Spike Duplicate Recoveries

Analysis Date	Sample Lab #	Spike Conc. mg/Kg	Component	Matrix Spike % R	Matrix Spike Duplicate % R	RPD %
10/21/93	618-3097 **	24.5	API Gasoline Std.	91	94	3

** = One set of MS/MSD's are analyzed for every 20 samples. The reported MS/MSD is the closest associated for this set of samples.

ACZ Laboratories, Inc.

QUALITY CONTROL DATA SUMMARY
WTPH-D by Washington Method - GC/FID
Matrix: Soil

Client: Retec
Attn: Ms. Kim Lofgren
Project: 3-1161, Skykomish

Report Date: 1/27/94

Surrogate Recoveries
Units: %

Extraction Date	Sample Lab #	Spike Conc. ug/Kg	Nitro-benzene (NB)	Spike Conc. ug/Kg	o-Terphenyl (o-TP)	Analysis Date
10/09/93	559-2772 MW40-5	10	77	10	94	11/03/93
10/09/93	559-2772DUP - MW40-5 Dup	10	109	10	128	11/03/93
10/09/93	559-2773 MW34-10	10	65	10	89	11/03/93
10/09/93	559-2774 DW 2-5	10	63	10	86	11/03/93
10/09/93	559-2775 MW33-2 1/2	10	69	10	87	11/04/93
10/09/93	559-2775MS	10	85	10	109	11/04/93
10/09/93	559-2775MSD	10	25	10	97	11/04/93
10/09/93	559-2776 B11-5	10	42	10	109	11/04/93
10/09/93	559-2777 DW1-5	10	33	10	89	11/04/93
10/09/93	559-2778 DW4-7 1/2	10	DO	10	DO	11/04/93

Prep. Blank Surrogate Recoveries

Extraction Date	Sample Lab #	Spike Conc. ug/Kg	Nitro-benzene (NB)	Spike Conc. ug/Kg	o-Terphenyl (o-TP)	Analysis Date
10/09/93	TBLK 10/9	10	56	10	110	10/28/93

Duplicate Recoveries

Extraction Date	Sample Lab #	Sample Conc. mg/Kg	Sample Conc. (Dup) mg/Kg	RPD %	Analysis Date
10/09/93	559-2772	7.05	5.09	32	11/03/93

Matrix Spike and Matrix Spike Duplicate Recoveries

Analysis Date	Sample Lab #	Spike Conc. mg/Kg	Component	Matrix Spike % R	Matrix Spike Duplicate % R	RPD %
11/04/93	559-2775	50	API Diesel Std.	79	68 *	15

* = The % recovery for the MSD is based on a 500 mg/Kg fortification due to a probable spiking error during sample preparation.

ACZ Laboratories, Inc.

QUALITY CONTROL DATA SUMMARY
TPH by EPA 418.1 - IR
Matrix: Soil

Client:	Retec	Report Date:	1/27/94
Attn:	Ms. Kim Lofgren		
Project:	3-1161, Skykomish		

Duplicate Recoveries

Extraction Date	Sample Lab #	Sample Conc. mg/Kg	Sample Conc. (Dup) mg/Kg	RPD %		Analysis Date
10/09/93	559-2778 OW 4-7'/2	27189	12614	73	*	10/19/93
10/09/93	559-2783 OW 10-22'/2	111	0	200	*	10/19/93

* = Large RPDs appear to be due to non-homogeneity of the sample.

Matrix Spike and Matrix Spike Duplicate Recoveries

Analysis Date	Sample Lab #	Spike Conc. mg/Kg	Component	Matrix Spike % R	Matrix Spike Duplicate % R	RPD %
11/19/93	573-2858 **	900	Mix for 418.1	88	90	3

** = One set of MS/MSD's are analyzed for every 20 samples. The reported MS/MSD is the closest associated for this set of samples.

ACZ Laboratories, Inc.

QUALITY CONTROL DATA SUMMARY

Client:	Retec			Report Date:	1/27/94
Attn:	Ms. Kim Lofgren				
Project:	3-1161, Skykomish				
	ACZ Sample ID:	Client Sample ID:	Performed Analysis	Sampled	Received
	93-SO/568-2822	DW4-2 1/2	D,I	9/27/93	9/30/93

Analyses performed on the above samples includes; (D) = WTPH-D by Washington Method - GC/FID
(I) = TPH by EPA 418.1 - IR

This summary package includes the following sections for each of the above mentioned analyses:

Surrogate Recoveries
Matrix Spike/Matrix Spike Duplicates

Abbreviations:

RPD = Relative Percent Difference
% R = Percent Recovery

Jeffrey E. Filkins
QA/QC Officer

ACZ Laboratories, Inc.

QUALITY CONTROL DATA SUMMARY
WTPH-D by Washington Method - GC/FID
Matrix: Soil

Client:	Retec	Report Date:	1/27/94
Attn:	Ms. Kim Lofgren		
Project:	3-1161, Skykomish		

Surrogate Recoveries
Units: %

Extraction Date	Sample Lab #	Spike Conc. ug/Kg	Nitro-benzene (NB)	Spike Conc. ug/Kg	o-Terphenyl (o-TP)	Analysis Date
10/09/93	568-2822	10	56	10	94	11/06/93
10/09/93	568-2822DUP	10	63	10	94	11/06/93

Prep. Blank Surrogate Recoveries

10/09/93	TBLK 10/9	10	56	10	110	10/18/93

Duplicate Recoveries

Extraction Date	Sample Lab #	Sample Conc. mg/Kg	Sample Conc. (Dup) mg/Kg	RPD %	Analysis Date
10/09/93	568-2822	89	97	9	11/06/93

Matrix Spike and Matrix Spike Duplicate Recoveries

Analysis Date	Sample Lab #	Spike Conc. mg/Kg	Component	Matrix Spike % R	Matrix Spike Duplicate % R	RPD %
11/04/93	559-2775 *	50	API Diesel Std.	79	68 **	15

* = One set of MS/MSD's are analyzed for every 20 samples. The reported MS/MSD is the closest associated for this set of samples.

** = The % recovery for the MSD is based on a 500 mg/Kg fortification due to a probable spiking error during sample preparation.

ACZ Laboratories, Inc.

QUALITY CONTROL DATA SUMMARY
TPH by EPA 418.1 - IR
Matrix: Soil

Client:	Retec	Report Date:	1/27/94
Attn:	Ms. Kim Lofgren		
Project:	3-1161, Skykomish		

Duplicate Recoveries

Extraction Date	Sample Lab #	Sample Conc. mg/Kg	Sample Conc. (Dup) mg/Kg	RPD %		Analysis Date
10/09/93	559-2778 * DW4-7 1/2	27189	12614	73	**	10/19/93
10/09/93	559-2783 * DW16-22 1/2	111	0	200	**	10/19/93
10/10/93	573-2848 *	7.60	13.3	55		10/19/93

* = Duplicate analyses are performed on every tenth sample. The reported duplicates represent the closest associated with this case.

** = Large RPDs appear to be due to non-homogeneity of the sample.

Matrix Spike and Matrix Spike Duplicate Recoveries

Analysis Date	Sample Lab #	Spike Conc. mg/Kg	Component	Matrix Spike % R	Matrix Spike Duplicate % R	RPD %
11/19/93	573-2858 ***	900	Mix for 418.1	88	90	3

*** = One set of MS/MSD's are analyzed for every 20 samples. The reported MS/MSD is the closest associated for this set of samples.

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2773
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	MW34-10	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/28/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	95.1
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)		105	U

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. V. Vande Velde for cw
Organic Laboratory Supervisor

ACZ Laboratories, Inc.
30400 Downhill Dr.
Steamboat Springs, CO 80487
(800) 334-5493
FAX: (303) 879-2216

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2774
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	DW2-5	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/27/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	90.6
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

	COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)			110	U

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. V. Vand Veldt for CW

Organic Laboratory Supervisor

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ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2775
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	MW33-2 1/2	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/28/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	81.6
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)		123	U

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. K. Vand Veld for cw
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2776
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	B11-5	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/27/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	95.3
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)		105	U

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature] for CW
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ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2777
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	DW1-5	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/28/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	83
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)		120	U

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. V. Van de Velde for cw
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2778
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	DW4-7 1/2	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/27/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	16
		% Solids:	83.8
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)	27000	1,909	

Compound ID:

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Sample not homogenous: free oil present on sides of container.

APPROVED: R. V. Vander Veld for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2779
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	DW2- 12 1/2	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/27/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	82.9
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)		121	U

Compound ID:

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. T. Vande Velde for cw
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2780
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	MW40-12 1/2	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/27/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	85.3
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)		117	U

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature] for CW
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ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2781
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	B11-10	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/27/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	86.6
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)		115	U

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. VandeVelde for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2782
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	DW1-22 1/2	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/28/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	75.7
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)		132	U

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. V. Vonk Velde for cw
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2783
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	DW10-22 1/2	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/28/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	75.9
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

	COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)			132	U

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. V. Vande Velde for ew
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ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2784
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	MW33-12 1/2	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/28/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	75.1
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)		133	U

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. V. Vandel Velde for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2785
Client Project No:	3-1161, Skykomish	Lab File ID:	N/A
Sample ID:	B4-10	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/10/93
Sample Date:	9/28/93	Date Analyzed:	10/19/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	100
Method ID:	WTPH by 418.1, IR Hydrocarbon Scan	Concentration Units:	mg/Kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Total Petroleum Hydrocarbons (C8 - C30+)	340	100	

Compound ID:

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. V. Van de Velde for CW
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ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2772
Client Project No:	3-1161, Skykomish	Lab File ID:	31017-06
Sample ID:	MW40-5	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/11/93
Sample Date:	9/27/93	Date Analyzed:	11/18/93
Report Date:	11/9/93	Dilution Factor:	1
		% Solids:	95.1
Method ID:	WTPH - G, GC/FID Hydrocarbon Scan (Gasoline Range)	Concentration Units:	mg/kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons - Gasoline Range (C6 - C10)		5	U

Compound ID:

Surrogate recoveries:		
	trifluorotoluene	28%
	bromofluorobenzene	35%

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Low surrogate due to matrix interference.

APPROVED: L. V. Vande Velde for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2775
Client Project No:	3-1161, Skykomish	Lab File ID:	31017-07
Sample ID:	MW33-2 1/2	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/11/93
Sample Date:	9/28/93	Date Analyzed:	10/18/93
Report Date:	11/9/93	Dilution Factor:	1
		% Solids:	81.6
Method ID:	WTPH - G, GC/FID Hydrocarbon Scan (Gasoline Range)	Concentration Units:	mg/kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons - Gasoline Range (C6 - C10)		6	U

Compound ID:

Surrogate recoveries:

trifluorotoluene	48%
bromofluorobenzene	42%

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Low surrogates due to matrix interferences.

APPROVED: R. V. Vande Velde for CW
Organic Laboratory Supervisor

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ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2772
Client Project No:	3-1161, Skykomish	Lab File ID:	1102F019
Sample ID:	MW40-5	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/28/93	Date Analyzed:	11/3/93
Report Date:	11/10/93	Dilution Factor:	1
		% Solids:	95.1
Method ID:	WTPH - D, GC/FID Hydrocarbon Scan (Diesel Range)	Concentration Units:	mg/kg

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons - Diesel Range (> C10 - C28)		26	U

Compound ID:

Surrogate recoveries:		
	nitrobenzene	77 %
	o-terphenyl	94 %

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. V. Vandeveld for CW
Organic Laboratory Supervisor

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ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2773
Client Project No:	3-1161, Skykomish	Lab File ID:	1102F020
Sample ID:	MW34-10	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/28/93	Date Analyzed:	11/3/93
Report Date:	11/10/93	Dilution Factor:	1
		% Solids:	95.1
Method ID:	WTPH - D, GC/FID Hydrocarbon Scan (Diesel Range)	Concentration Units:	mg/kg

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons - Diesel Range (> C10 - C28)		26	U

Compound ID:

Surrogate recoveries:		
	nitrobenzene	65 %
	o-terphenyl	89 %

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. V. Vand Veld for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2774
Client Project No:	3-1161, Skykomish	Lab File ID:	1102F021
Sample ID:	DW2-5	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/27/93	Date Analyzed:	11/3/93
Report Date:	11/10/93	Dilution Factor:	1
		% Solids:	90.6
Method ID:	WTPH - D, GC/FID Hydrocarbon Scan (Diesel Range)	Concentration Units:	mg/kg

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons - Diesel Range (> C10 - C28)	18	28	J

Compound ID:

Surrogate recoveries:	nitrobenzene	63 %
	o-terphenyl	86 %

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. V. Vande Velde for CW
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ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2775
Client Project No:	3-1161, Skykomish	Lab File ID:	1102F022
Sample ID:	MW33-2 1/2	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/28/93	Date Analyzed:	11/4/93
Report Date:	11/10/93	Dilution Factor:	1
		% Solids:	81.6
Method ID:	WTPH - D, GC/FID Hydrocarbon Scan (Diesel Range)	Concentration Units:	mg/kg

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons - Diesel Range (> C10 - C28)	63	31	

Compound ID:

Surrogate recoveries:		
	nitrobenzene	69 %
	o-terphenyl	87 %

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. V. Vande Veld for CW
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ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2776
Client Project No:	3-1161, Skykomish	Lab File ID:	1102F023
Sample ID:	B11-5	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/27/93	Date Analyzed:	11/4/93
Report Date:	11/10/93	Dilution Factor:	1
		% Solids:	95.3
Method ID:	WTPH - D, GC/FID Hydrocarbon Scan (Diesel Range)	Concentration Units:	mg/kg

	COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons - Diesel Range (> C10 - C28)			26	U

Compound ID:

Surrogate recoveries:	nitrobenzene	42 %
	o-terphenyl	109 %

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. V. Vande Velde for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2777
Client Project No:	3-1161, Skykomish	Lab File ID:	1102F024
Sample ID:	DW1-5	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/28/93	Date Analyzed:	11/4/93
Report Date:	11/10/93	Dilution Factor:	1
		% Solids:	83
Method ID:	WTPH - D, GC/FID Hydrocarbon Scan (Diesel Range)	Concentration Units:	mg/kg

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons - Diesel Range (> C10 - C28)		30	U

Compound ID:

Surrogate recoveries:		
	nitrobenzene	33 %
	o-terphenyl	89 %

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. V. Vander Veld for cw
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2778
Client Project No:	3-1161, Skykomish	Lab File ID:	1104F003
Sample ID:	DW4-7 1/2	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/9/93
Sample Date:	9/27/93	Date Analyzed:	11/4/93
Report Date:	11/10/93	Dilution Factor:	10
		% Solids:	83.8
Method ID:	WTPH - D, GC/FID Hydrocarbon Scan (Diesel Range)	Concentration Units:	mg/kg

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons - Diesel Range (> C10 - C28)	12172	298	

Compound ID:

Surrogate recoveries:		
	nitrobenzene	diluted out
	o-terphenyl	diluted out

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. V. Vande Yeld for CW
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ACZ Laboratories, Inc.

VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2767
Client Project No:	3-1161, Skykomish	Lab File ID:	A8733
Sample ID:	DW2-10	Date Received:	9/30/93
Matrix:	Soil	Date Analyzed:	10/8/93
Sample Date:	9/27/93	Dilution Factor:	1
Report Date:	10/30/93	% Solids:	93.3
Method ID:	EPA 8240, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
74-87-3	Chloromethane		11	U
74-83-9	Bromomethane		11	U
75-01-4	Vinyl Chloride		11	U
75-00-3	Chloroethane		11	U
75-09-2	Methylene Chloride	4	5	JB
107-02-8	Acrolein		11	U
107-13-1	Acrylonitrile		11	U
67-64-1	Acetone	23	5	B
75-15-0	Carbon Disulfide		5	U
75-35-4	1,1-Dichloroethene		5	U
75-34-3	1,1-Dichloroethane		5	U
540-59-0	Total-1,2-Dichloroethene		5	U
67-66-3	Chloroform		5	U
107-06-2	1,2-Dichloroethane		5	U
78-93-3	2-Butanone		11	U
71-55-6	1,1,1-Trichloroethane		5	U
56-23-5	Carbon Tetrachloride		5	U
108-05-4	Vinyl Acetate		11	U
75-27-4	Bromodichloromethane		5	U
78-87-5	1,2-Dichloropropane		5	U
10061-01-5	cis-1,3-Dichloropropene		5	U
79-01-6	Trichloroethene		5	U
124-48-1	Dibromochloromethane		5	U
79-00-5	1,1,2-Trichloroethane		5	U
71-43-2	Benzene		5	U
10061-02-6	trans-1,3-dichloropropene		5	U
110-75-8	2-chloroethylvinylether		5	U
75-25-2	Bromoform		5	U
108-10-1	4-Methyl-2-Pentanone		11	U
591-78-6	2-Hexanone		11	U
127-18-4	Tetrachloroethene		5	U
79-34-5	1,1,2,2-Tetrachloroethane		5	U
108-88-3	Toluene		5	U
108-90-7	Chlorobenzene		5	U

ACZ Laboratories, Inc.

VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2767
Client Project No:	3-1161, Skykomish	Lab File ID:	A8733
Sample ID:	DW2-10	Date Received:	34242
Matrix:	Soil	Date Analyzed:	34250
Sample Date:	9/27/93	Dilution Factor:	1
Report Date:	10/30/93	% Solids:	93.3
Method ID:	EPA 8240, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
100-41-4	Ethylbenzene		5	U
100-42-5	Styrene		5	U
1330-20-7	Xylene (total)		5	U

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. V. Vande Velde for cw
Organic Laboratory Supervisor

ACZ Laboratories, Inc

VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2768
Client Project No:	3-1161, Skykomish	Lab File ID:	A8749
Sample ID:	B4-10	Date Received:	9/30/93
Matrix:	Soil	Date Analyzed:	10/11/93
Sample Date:	9/28/93	Dilution Factor:	5
Report Date:	10/30/93	% Solids:	93.6
Method ID:	EPA 8240, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
74-87-3	Chloromethane		53	U
74-83-9	Bromomethane		53	U
75-01-4	Vinyl Chloride		53	U
75-00-3	Chloroethane		53	U
75-09-2	Methylene Chloride	38	27	B
107-02-8	Acrolein		53	U
107-13-1	Acrylonitrile		53	U
67-64-1	Acetone	109	27	B
75-15-0	Carbon Disulfide		27	U
75-35-4	1,1-Dichloroethene		27	U
75-34-3	1,1-Dichloroethane		27	U
540-59-0	Total-1,2-Dichloroethene		27	U
67-66-3	Chloroform		27	U
107-06-2	1,2-Dichloroethane		27	U
78-93-3	2-Butanone		53	U
71-55-6	1,1,1-Trichloroethane		27	U
56-23-5	Carbon Tetrachloride		27	U
108-05-4	Vinyl Acetate		53	U
75-27-4	Bromodichloromethane		27	U
78-87-5	1,2-Dichloropropane		27	U
10061-01-5	cis-1,3-Dichloropropene		27	U
79-01-6	Trichloroethene		27	U
124-48-1	Dibromochloromethane		27	U
79-00-5	1,1,2-Trichloroethane		27	U
71-43-2	Benzene		27	U
10061-02-6	trans-1,3-dichloropropene		27	U
110-75-8	2-chloroethylvinylether		27	U
75-25-2	Bromoform		27	U
108-10-1	4-Methyl-2-Pentanone		53	U
591-78-6	2-Hexanone		53	U
127-18-4	Tetrachloroethene		27	U
79-34-5	1,1,2,2-Tetrachloroethane		27	U
108-88-3	Toluene		27	U
108-90-7	Chlorobenzene		27	U

ACZ Laboratories, Inc.

VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2768
Client Project No:	3-1161, Skykomish	Lab File ID:	A8749
Sample ID:	B4-10	Date Received:	34242
Matrix:	Soil	Date Analyzed:	34253
Sample Date:	9/28/93	Dilution Factor:	5
Report Date:	10/30/93	% Solids:	94
Method ID:	EPA 8240, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
100-41-4	Ethylbenzene		27	U
100-42-5	Styrene		27	U
1330-20-7	Xylene (total)		27	U

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Calb. Blank - Acetone @ 6 and Methylene Chloride @ 6 ug/L.. Sample had a low Int. Std. (1,4-DCB), confirmed by re-analysis. Late eluting hydrocarbons present. Non-8240 compounds (n-Propylbenzene, 1,2,4-Trimethylbenzene, 4-Isopropyltoluene, and Naphthalene) present in high concentrations.

APPROVED: R. V. Vande Velde for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2769
Client Project No:	3-1161, Skykomish	Lab File ID:	A8750
Sample ID:	B40-10	Date Received:	9/30/93
Matrix:	Soil	Date Analyzed:	10/11/93
Sample Date:	9/28/93	Dilution Factor:	5
Report Date:	10/30/93	% Solids:	94.2
Method ID:	EPA 8240, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
74-87-3	Chloromethane		53	U
74-83-9	Bromomethane		53	U
75-01-4	Vinyl Chloride		53	U
75-00-3	Chloroethane		53	U
75-09-2	Methylene Chloride	37	27	B
107-02-8	Acrolein		53	U
107-13-1	Acrylonitrile		53	U
67-64-1	Acetone	100	27	B
75-15-0	Carbon Disulfide		27	U
75-35-4	1,1-Dichloroethene		27	U
75-34-3	1,1-Dichloroethane		27	U
540-59-0	Total-1,2-Dichloroethene		27	U
67-66-3	Chloroform		27	U
107-06-2	1,2-Dichloroethane		27	U
78-93-3	2-Butanone		53	U
71-55-6	1,1,1-Trichloroethane		27	U
56-23-5	Carbon Tetrachloride		27	U
108-05-4	Vinyl Acetate		53	U
75-27-4	Bromodichloromethane		27	U
78-87-5	1,2-Dichloropropane		27	U
10061-01-5	cis-1,3-Dichloropropene		27	U
79-01-6	Trichloroethene		27	U
124-48-1	Dibromochloromethane		27	U
79-00-5	1,1,2-Trichloroethane		27	U
71-43-2	Benzene		27	U
10061-02-6	trans-1,3-dichloropropene		27	U
110-75-8	2-chloroethylvinylether		27	U
75-25-2	Bromoform		27	U
108-10-1	4-Methyl-2-Pentanone		53	U
591-78-6	2-Hexanone		53	U
127-18-4	Tetrachloroethene		27	U
79-34-5	1,1,2,2-Tetrachloroethane		27	U
108-88-3	Toluene		27	U
108-90-7	Chlorobenzene		27	U

ACZ Laboratories, Inc.

VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2769
Client Project No:	3-1161, Skykomish	Lab File ID:	A8750
Sample ID:	B40-10	Date Received:	34242
Matrix:	Soil	Date Analyzed:	34253
Sample Date:	9/28/93	Dilution Factor:	5
Report Date:	10/30/93	% Solids:	94
Method ID:	EPA 8240, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL Q
100-41-4	Ethylbenzene		27 U
100-42-5	Styrene		27 U
1330-20-7	Xylene (total)		27 U

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Calb. Blank - Acetone @ 6 and Methylene Chloride @ 6 ug/L.. Sample had a low Int. Std. (1,4-DCB), confirmed by re-analysis. Late eluting hydrocarbons present. Non-8240 compounds (n-Propylbenzene, 1,2,4-Trimethylbenzene, 4-Isopropyltoluene, and Naphthalene) present in high concentrations.

APPROVED: [signature] for cw
Organic Laboratory Supervisor

ACZ Laboratories, Inc

VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2770
Client Project No:	3-1161, Skykomish	Lab File ID:	B8720
Sample ID:	MW34-7 1/2	Date Received:	9/30/93
Matrix:	Soil	Date Analyzed:	10/7/93
Sample Date:	9/28/93	Dilution Factor:	1
Report Date:	10/30/93	% Solids:	96.2
Method ID:	EPA 8240, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
74-87-3	Chloromethane		10	U
74-83-9	Bromomethane		10	U
75-01-4	Vinyl Chloride		10	U
75-00-3	Chloroethane		10	U
75-09-2	Methylene Chloride	4	5	JB
107-02-8	Acrolein		10	U
107-13-1	Acrylonitrile		10	U
67-64-1	Acetone	15	5	B
75-15-0	Carbon Disulfide		5	U
75-35-4	1,1-Dichloroethene		5	U
75-34-3	1,1-Dichloroethane		5	U
540-59-0	Total-1,2-Dichloroethene		5	U
67-66-3	Chloroform		5	U
107-06-2	1,2-Dichloroethane		5	U
78-93-3	2-Butanone		10	U
71-55-6	1,1,1-Trichloroethane		5	U
56-23-5	Carbon Tetrachloride		5	U
108-05-4	Vinyl Acetate		10	U
75-27-4	Bromodichloromethane		5	U
78-87-5	1,2-Dichloropropane		5	U
10061-01-5	cis-1,3-Dichloropropene		5	U
79-01-6	Trichloroethene		5	U
124-48-1	Dibromochloromethane		5	U
79-00-5	1,1,2-Trichloroethane		5	U
71-43-2	Benzene		5	U
10061-02-6	trans-1,3-dichloropropene		5	U
110-75-8	2-chloroethylvinylether		5	U
75-25-2	Bromoform		5	U
108-10-1	4-Methyl-2-Pentanone		10	U
591-78-6	2-Hexanone		10	U
127-18-4	Tetrachloroethene		5	U
79-34-5	1,1,2,2-Tetrachloroethane		5	U
108-88-3	Toluene		5	U
108-90-7	Chlorobenzene		5	U

ACZ Laboratories, Inc.

VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2770
Client Project No:	3-1161, Skykomish	Lab File ID:	B8720
Sample ID:	MW34-7 1/2	Date Received:	34242
Matrix:	Soil	Date Analyzed:	34249
Sample Date:	9/28/93	Dilution Factor:	1
Report Date:	10/30/93	% Solids:	96.2
Method ID:	EPA 8240, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
100-41-4	Ethylbenzene		5	U
100-42-5	Styrene		5	U
1330-20-7	Xylene (total)		5	U

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Calb. Blank - Acetone @ 7 and Methylene Chloride @ 4 ug/L.

APPROVED: R. V. Vande Velde for cw
Organic Laboratory Supervisor

ACZ Laboratories, Inc

VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2771
Client Project No:	3-1161, Skykomish	Lab File ID:	A8721
Sample ID:	MW33-5	Date Received:	9/30/93
Matrix:	Soil	Date Analyzed:	10/7/93
Sample Date:	9/28/93	Dilution Factor:	1
Report Date:	10/30/93	% Solids:	93.9
Method ID:	EPA 8240, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
74-87-3	Chloromethane		11	U
74-83-9	Bromomethane		11	U
75-01-4	Vinyl Chloride		11	U
75-00-3	Chloroethane		11	U
75-09-2	Methylene Chloride	13	5	B
107-02-8	Acrolein		11	U
107-13-1	Acrylonitrile		11	U
67-64-1	Acetone	14	5	B
75-15-0	Carbon Disulfide		5	U
75-35-4	1,1-Dichloroethene		5	U
75-34-3	1,1-Dichloroethane		5	U
540-59-0	Total-1,2-Dichloroethene		5	U
67-66-3	Chloroform		5	U
107-06-2	1,2-Dichloroethane	9	5	
78-93-3	2-Butanone		11	U
71-55-6	1,1,1-Trichloroethane		5	U
56-23-5	Carbon Tetrachloride		5	U
108-05-4	Vinyl Acetate		11	U
75-27-4	Bromodichloromethane		5	U
78-87-5	1,2-Dichloropropane		5	U
10061-01-5	cis-1,3-Dichloropropene		5	U
79-01-6	Trichloroethene		5	U
124-48-1	Dibromochloromethane		5	U
79-00-5	1,1,2-Trichloroethane		5	U
71-43-2	Benzene		5	U
10061-02-6	trans-1,3-dichloropropene		5	U
110-75-8	2-chloroethylvinylether		5	U
75-25-2	Bromoform		5	U
108-10-1	4-Methyl-2-Pentanone		11	U
591-78-6	2-Hexanone		11	U
127-18-4	Tetrachloroethene		5	U
79-34-5	1,1,2,2-Tetrachloroethane		5	U
108-88-3	Toluene		5	U
108-90-7	Chlorobenzene		5	U

ACZ Laboratories, Inc.

VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2771
Client Project No:	3-1161, Skykomish	Lab File ID:	A8721
Sample ID:	MW33-5	Date Received:	34242
Matrix:	Soil	Date Analyzed:	34249
Sample Date:	9/28/93	Dilution Factor:	1
Report Date:	10/30/93	% Solids:	93.9
Method ID:	EPA 8240, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL Q
100-41-4	Ethylbenzene		5 U
100-42-5	Styrene		5 U
1330-20-7	Xylene (total)		5 U

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:
Calb. Blank - Acetone @ 7 and Methylene Chloride @ 4 ug/L.
Low Int. Std. (1,4-DCB), confirmed by re-analysis.

APPROVED: [signature] for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc.
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Steamboat Springs, CO 80487

(800) 334-5493
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ACZ Laboratories, Inc

VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2772
Client Project No:	3-1161, Skykomish	Lab File ID:	A8722
Sample ID:	MW40-5	Date Received:	9/30/93
Matrix:	Soil	Date Analyzed:	10/7/93
Sample Date:	9/27/93	Dilution Factor:	1
Report Date:	10/30/93	% Solids:	96.8
Method ID:	EPA 8240, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
74-87-3	Chloromethane		10	U
74-83-9	Bromomethane		10	U
75-01-4	Vinyl Chloride		10	U
75-00-3	Chloroethane		10	U
75-09-2	Methylene Chloride	4	5	JB
107-02-8	Acrolein		10	U
107-13-1	Acrylonitrile		10	U
67-64-1	Acetone	7	5	B
75-15-0	Carbon Disulfide		5	U
75-35-4	1,1-Dichloroethene		5	U
75-34-3	1,1-Dichloroethane		5	U
540-59-0	Total-1,2-Dichloroethene		5	U
67-66-3	Chloroform		5	U
107-06-2	1,2-Dichloroethane		5	U
78-93-3	2-Butanone		10	U
71-55-6	1,1,1-Trichloroethane		5	U
56-23-5	Carbon Tetrachloride		5	U
108-05-4	Vinyl Acetate		10	U
75-27-4	Bromodichloromethane		5	U
78-87-5	1,2-Dichloropropane		5	U
10061-01-5	cis-1,3-Dichloropropene		5	U
79-01-6	Trichloroethene		5	U
124-48-1	Dibromochloromethane		5	U
79-00-5	1,1,2-Trichloroethane		5	U
71-43-2	Benzene		5	U
10061-02-6	trans-1,3-dichloropropene		5	U
110-75-8	2-chloroethylvinylether		5	U
75-25-2	Bromoform		5	U
108-10-1	4-Methyl-2-Pentanone		10	U
591-78-6	2-Hexanone		10	U
127-18-4	Tetrachloroethene		5	U
79-34-5	1,1,2,2-Tetrachloroethane		5	U
108-88-3	Toluene		5	U
108-90-7	Chlorobenzene		5	U

ACZ Laboratories, Inc.

VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2772
Client Project No:	3-1161, Skykomish	Lab File ID:	A8722
Sample ID:	MW40-5	Date Received:	34242
Matrix:	Soil	Date Analyzed:	34249
Sample Date:	9/27/93	Dilution Factor:	1
Report Date:	10/30/93	% Solids:	96.8
Method ID:	EPA 8240, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
100-41-4	Ethylbenzene		5	U
100-42-5	Styrene		5	U
1330-20-7	Xylene (total)		5	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Calb. Blank - Acetone @ 7 and Methylene Chloride @ 4 ug/L.

APPROVED: R. V. Vand Veldt for cw
Organic Laboratory Supervisor

ACZ Laboratories, Inc

SEMI-VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2772
Client Project No:	3-1161, Skykomish	Lab File ID:	C1327
Sample ID:	MW40-5	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/8/93
Sample Date:	9/27/93	Date Analyzed:	11/13/93
Report Date:	11/18/93	Cleanup:	None
		Dilution Factor:	1
		% Solids	95
Method ID:	SEMI-VOLATILES BY EPA 8270, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
108-95-2	Phenol		347	U
111-44-4	bis-(2-Chloroethyl)ether		347	U
95-57-8	2-Chlorophenol		347	U
541-73-1	1,3-Dichlorobenzene		347	U
106-46-7	1,4-Dichlorobenzene		347	U
100-51-6	Benzyl Alcohol		347	U
95-50-1	1,2-Dichlorobenzene		347	U
95-48-7	2-Methylphenol		347	U
39638-32-9	bis(2-Chloroisopropyl)ether		347	U
106-44-5	4-Methylphenol		347	U
621-64-7	N-Nitroso-di-n-propylamine		347	U
67-72-1	Hexachloroethane		347	U
98-95-3	Nitrobenzene		347	U
78-59-1	Isophorone		347	U
88-75-5	2-Nitrophenol		347	U
105-67-9	2,4-Dimethylphenol		1737	U
65-85-0	Benzoic Acid		347	U
111-91-1	bis(2-Chloroethoxy)methane		347	U
120-83-2	2,4-Dichlorophenol		347	U
120-82-1	1,2,4-Trichlorobenzene		347	U
91-20-3	Naphthalene		347	U
106-47-8	4-Chloroaniline		347	U
87-68-3	Hexachlorobutadiene		347	U
59-50-7	4-Chloro-3-methylphenol		347	U
91-57-6	2-Methylnaphthalene		347	U
77-47-4	Hexachlorocylopentadiene		347	U
88-06-2	2,4,6-Trichlorophenol		347	U
95-95-4	2,4,5-Trichlorophenol		1737	U
91-58-7	2,Chloronaphthalene		347	U
88-74-4	2-Nitroaniline		1737	U
131-11-3	Dimethyl phthalate		347	U
208-96-8	Acenaphthylene		347	U
606-20-8	2,6-Dinitrotoluene		1737	U

ACZ Laboratories, Inc.

SEMI-VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2772
Client Project No:	3-1161, Skykomish	Lab File ID:	C1327
Sample ID:	MW40-5	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/8/93
Sample Date:	9/27/93	Date Analyzed:	11/13/93
Report Date:	11/18/93	Cleanup:	None
		Dilution Factor:	1
		% Solids	95
Method ID:	SEMI-VOLATILES BY EPA 8270, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
99-09-2	3-Nitroaniline		1737	U
534-52-1	2-Methyl-4,6-dinitrophenol		1737	U
62-75-9	N-nitrosodimethylamine		347	U
103-33-3	Azobenzene		1737	U
83-32-9	Acenaphthene		347	U
51-28-5	2,4-Dinitrophenol		1737	U
100-02-07	4-Nitrophenol		1737	U
132-64-9	Dibenzofuran		347	U
121-14-2	2,4-Dinitrotoluene		347	U
84-66-2	Diethylphthalate		347	U
7005-72-3	4,Chlorophenyl-phenylether		347	U
86-73-7	Fluorene		347	U
100-01-6	4-Nitroaniline		1737	U
86-30-6	N-Nitrosodiphenylamine(1)		347	U
101-55-3	4-Bromophenyl-phenylether		347	U
118-74-1	Hexachlorobenzene		347	U
87-86-5	Pentachlorophenol		1737	U
85-01-8	Phenanthrene		347	U
120-12-7	Anthracene		347	U
84-74-2	Di-n-butylphthalate		347	U
206-44-0	Fluoranthene		347	U
129-00-0	Pyrene		347	U
85-68-7	Butylbenzylphthalate		347	U
91-94-1	3,3'-Dichlorobenzidine		695	U
56-55-3	Benzo(a)anthracene		347	U
117-81-7	Bis(2-ethylhexyl)phthalate		347	U
218-01-9	Chrysene		347	U
117-84-0	Di-n-octyl phthalate		347	U
205-99-2	Benzo(b)fluoranthene		347	U
207-08-9	Benzo(k)fluoranthene		347	U
50-32-8	Benzo(a)pyrene		347	U
193-39-5	Indeno(1,2,3-cd)pyrene		347	U
53-70-3	Dibenz(a,h)anthracene		347	U
191-24-2	Benzo(g,h,i)perylene		347	U

ACZ Laboratories, Inc.

SEMI-VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2772
Client Project No:	3-1161, Skykomish	Lab File ID:	C1327
Sample ID:	MW40-5	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/8/93
Sample Date:	9/27/93	Date Analyzed:	11/13/93
Report Date:	11/18/93	Cleanup:	None
		Dilution Factor:	1
		% Solids	95
Method ID:	SEMI-VOLATILES BY EPA 8270, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL Q

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

SEMI-VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2773
Client Project No:	3-1161, Skykomish	Lab File ID:	C1328
Sample ID:	MW34-10	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/8/93
Sample Date:	9/28/93	Date Analyzed:	11/13/93
Report Date:	11/18/93	Cleanup:	None
		Dilution Factor:	1
		% Solids	95
Method ID:	SEMI-VOLATILES BY EPA 8270, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
108-95-2	Phenol		347	U
111-44-4	bis-(2-Chloroethyl)ether		347	U
95-57-8	2-Chlorophenol		347	U
541-73-1	1,3-Dichlorobenzene		347	U
106-46-7	1,4-Dichlorobenzene		347	U
100-51-6	Benzyl Alcohol		347	U
95-50-1	1,2-Dichlorobenzene		347	U
95-48-7	2-Methylphenol		347	U
39638-32-9	bis(2-Chloroisopropyl)ether		347	U
106-44-5	4-Methylphenol		347	U
621-64-7	N-Nitroso-di-n-propylamine		347	U
67-72-1	Hexachloroethane		347	U
98-95-3	Nitrobenzene		347	U
78-59-1	Isophorone		347	U
88-75-5	2-Nitrophenol		347	U
105-67-9	2,4-Dimethylphenol		1737	U
65-85-0	Benzoic Acid		347	U
111-91-1	bis(2-Chloroethoxy)methane		347	U
120-83-2	2,4-Dichlorophenol		347	U
120-82-1	1,2,4-Trichlorobenzene		347	U
91-20-3	Naphthalene		347	U
106-47-8	4-Chloroaniline		347	U
87-68-3	Hexachlorobutadiene		347	U
59-50-7	4-Chloro-3-methylphenol		347	U
91-57-6	2-Methylnaphthalene		347	U
77-47-4	Hexachlorocylopentadiene		347	U
88-06-2	2,4,6-Trichlorophenol		347	U
95-95-4	2,4,5-Trichlorophenol		1737	U
91-58-7	2,Chloronaphthalene		347	U
88-74-4	2-Nitroaniline		1737	U
131-11-3	Dimethyl phthalate		347	U
208-96-8	Acenaphthylene		347	U
606-20-8	2,6-Dinitrotoluene		1737	U

ACZ Laboratories, Inc.

SEMI-VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2773
Client Project No:	3-1161, Skykomish	Lab File ID:	C1328
Sample ID:	MW34-10	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/8/93
Sample Date:	9/28/93	Date Analyzed:	11/13/93
Report Date:	11/18/93	Cleanup:	None
		Dilution Factor:	1
		% Solids	95
Method ID:	SEMI-VOLATILES BY EPA 8270, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
99-09-2	3-Nitroaniline		1737	U
534-52-1	2-Methyl-4,6-dinitrophenol		1737	U
62-75-9	N-nitrosodimethylamine		347	U
103-33-3	Azobenzene		1737	U
83-32-9	Acenaphthene		347	U
51-28-5	2,4-Dinitrophenol		1737	U
100-02-07	4-Nitrophenol		1737	U
132-64-9	Dibenzofuran		347	U
121-14-2	2,4-Dinitrotoluene		347	U
84-66-2	Diethylphthalate		347	U
7005-72-3	4,Chlorophenyl-phenylether		347	U
86-73-7	Fluorene		347	U
100-01-6	4-Nitroaniline		1737	U
86-30-6	N-Nitrosodiphenylamine(1)		347	U
101-55-3	4-Bromophenyl-phenylether		347	U
118-74-1	Hexachlorobenzene		347	U
87-86-5	Pentachlorophenol		1737	U
85-01-8	Phenanthrene		347	U
120-12-7	Anthracene		347	U
84-74-2	Di-n-butylphthalate		347	U
206-44-0	Fluoranthene		347	U
129-00-0	Pyrene		347	U
85-68-7	Butylbenzylphthalate		347	U
91-94-1	3,3'-Dichlorobenzidine		695	U
56-55-3	Benzo(a)anthracene		347	U
117-81-7	Bis(2-ethylhexyl)phthalate		347	U
218-01-9	Chrysene		347	U
117-84-0	Di-n-octyl phthalate		347	U
205-99-2	Benzo(b)fluoranthene		347	U
207-08-9	Benzo(k)fluoranthene		347	U
50-32-8	Benzo(a)pyrene		347	U
193-39-5	Indeno(1,2,3-cd)pyrene		347	U
53-70-3	Dibenz(a,h)anthracene		347	U
191-24-2	Benzo(g,h,i)perylene		347	U

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SEMI-VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2773
Client Project No:	3-1161, Skykomish	Lab File ID:	C1328
Sample ID:	MW34-10	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/8/93
Sample Date:	9/28/93	Date Analyzed:	11/13/93
Report Date:	11/18/93	Cleanup:	None
		Dilution Factor:	1
		% Solids	95
Method ID:	SEMI-VOLATILES BY EPA 8270, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

SEMI-VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2774
Client Project No:	3-1161, Skykomish	Lab File ID:	C1329
Sample ID:	DW2-5	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/8/93
Sample Date:	9/27/93	Date Analyzed:	11/13/93
Report Date:	11/18/93	Cleanup:	None
		Dilution Factor:	1
		% Solids	90
Method ID:	SEMI-VOLATILES BY EPA 8270, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
108-95-2	Phenol		367	U
111-44-4	bis-(2-Chloroethyl)ether		367	U
95-57-8	2-Chlorophenol		367	U
541-73-1	1,3-Dichlorobenzene		367	U
106-46-7	1,4-Dichlorobenzene		367	U
100-51-6	Benzyl Alcohol		367	U
95-50-1	1,2-Dichlorobenzene		367	U
95-48-7	2-Methylphenol		367	U
39638-32-9	bis(2-Chloroisopropyl)ether		367	U
106-44-5	4-Methylphenol		367	U
621-64-7	N-Nitroso-di-n-propylamine		367	U
67-72-1	Hexachloroethane		367	U
98-95-3	Nitrobenzene		367	U
78-59-1	Isophorone		367	U
88-75-5	2-Nitrophenol		367	U
105-67-9	2,4-Dimethylphenol		1833	U
65-85-0	Benzoic Acid		367	U
111-91-1	bis(2-Chloroethoxy)methane		367	U
120-83-2	2,4-Dichlorophenol		367	U
120-82-1	1,2,4-Trichlorobenzene		367	U
91-20-3	Naphthalene		367	U
106-47-8	4-Chloroaniline		367	U
87-68-3	Hexachlorobutadiene		367	U
59-50-7	4-Chloro-3-methylphenol		367	U
91-57-6	2-Methylnaphthalene		367	U
77-47-4	Hexachlorocylopentadiene		367	U
88-06-2	2,4,6-Trichlorophenol		367	U
95-95-4	2,4,5-Trichlorophenol		1833	U
91-58-7	2,Chloronaphthalene		367	U
88-74-4	2-Nitroaniline		1833	U
131-11-3	Dimethyl phthalate		367	U
208-96-8	Acenaphthylene		367	U
606-20-8	2,6-Dinitrotoluene		1833	U

ACZ Laboratories, Inc.

SEMI-VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2774
Client Project No:	3-1161, Skykomish	Lab File ID:	C1329
Sample ID:	DW2-5	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/8/93
Sample Date:	9/27/93	Date Analyzed:	11/13/93
Report Date:	11/18/93	Cleanup:	None
		Dilution Factor:	1
		% Solids	90
Method ID:	SEMI-VOLATILES BY EPA 8270, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
99-09-2	3-Nitroaniline		1833	U
534-52-1	2-Methyl-4,6-dinitrophenol		1833	U
62-75-9	N-nitrosodimethylamine		367	U
103-33-3	Azobenzene		1833	U
83-32-9	Acenaphthene		367	U
51-28-5	2,4-Dinitrophenol		1833	U
100-02-07	4-Nitrophenol		1833	U
132-64-9	Dibenzofuran		367	U
121-14-2	2,4-Dinitrotoluene		367	U
84-66-2	Diethylphthalate		367	U
7005-72-3	4,Chlorophenyl-phenylether		367	U
86-73-7	Fluorene		367	U
100-01-6	4-Nitroaniline		1833	U
86-30-6	N-Nitrosodiphenylamine(1)		367	U
101-55-3	4-Bromophenyl-phenylether		367	U
118-74-1	Hexachlorobenzene		367	U
87-86-5	Pentachlorophenol		1833	U
85-01-8	Phenanthrene	144	367	J
120-12-7	Anthracene		367	U
84-74-2	Di-n-butylphthalate		367	U
206-44-0	Fluoranthene	144	367	J
129-00-0	Pyrene		367	U
85-68-7	Butylbenzylphthalate	300	367	J
91-94-1	3,3'-Dichlorobenzidine		733	U
56-55-3	Benzo(a)anthracene		367	U
117-81-7	Bis(2-ethylhexyl)phthalate		367	U
218-01-9	Chrysene	189	367	J
117-84-0	Di-n-octyl phthalate		367	U
205-99-2	Benzo(b)fluoranthene		367	U
207-08-9	Benzo(k)fluoranthene		367	U
50-32-8	Benzo(a)pyrene		367	U
193-39-5	Indeno(1,2,3-cd)pyrene		367	U
53-70-3	Dibenz(a,h)anthracene		367	U
191-24-2	Benzo(g,h,i)perylene		367	U

ACZ Laboratories, Inc.

SEMI-VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2774
Client Project No:	3-1161, Skykomish	Lab File ID:	C1329
Sample ID:	DW2-5	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/8/93
Sample Date:	9/27/93	Date Analyzed:	11/13/93
Report Date:	11/18/93	Cleanup:	None
		Dilution Factor:	1
		% Solids	90
Method ID:	SEMI-VOLATILES BY EPA 8270, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL Q

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:
Low internal standard (perylene-d12), confirmed by reanalysis.
Late eluting hydrocarbons are present.

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

SEMI-VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2775
Client Project No:	3-1161, Skykomish	Lab File ID:	C1331
Sample ID:	MW33-2 1/2	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/8/93
Sample Date:	9/28/93	Date Analyzed:	11/13/93
Report Date:	11/18/93	Cleanup:	None
		Dilution Factor:	1
		% Solids	82
Method ID:	SEMI-VOLATILES BY EPA 8270, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
108-95-2	Phenol		402	U
111-44-4	bis-(2-Chloroethyl)ether		402	U
95-57-8	2-Chlorophenol		402	U
541-73-1	1,3-Dichlorobenzene		402	U
106-46-7	1,4-Dichlorobenzene		402	U
100-51-6	Benzyl Alcohol		402	U
95-50-1	1,2-Dichlorobenzene		402	U
95-48-7	2-Methylphenol		402	U
39638-32-9	bis(2-Chloroisopropyl)ether		402	U
106-44-5	4-Methylphenol		402	U
621-64-7	N-Nitroso-di-n-propylamine		402	U
67-72-1	Hexachloroethane		402	U
98-95-3	Nitrobenzene		402	U
78-59-1	Isophorone		402	U
88-75-5	2-Nitrophenol		402	U
105-67-9	2,4-Dimethylphenol		2012	U
65-85-0	Benzoic Acid		402	U
111-91-1	bis(2-Chloroethoxy)methane		402	U
120-83-2	2,4-Dichlorophenol		402	U
120-82-1	1,2,4-Trichlorobenzene		402	U
91-20-3	Naphthalene		402	U
106-47-8	4-Chloroaniline		402	U
87-68-3	Hexachlorobutadiene		402	U
59-50-7	4-Chloro-3-methylphenol		402	U
91-57-6	2-Methylnaphthalene		402	U
77-47-4	Hexachlorocylopentadiene		402	U
88-06-2	2,4,6-Trichlorophenol		402	U
95-95-4	2,4,5-Trichlorophenol		2012	U
91-58-7	2,Chloronaphthalene		402	U
88-74-4	2-Nitroaniline		1650	U
131-11-3	Dimethyl phthalate		402	U
208-96-8	Acenaphthylene		402	U
606-20-8	2,6-Dinitrotoluene		1650	U

ACZ Laboratories, Inc.

SEMI-VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2775
Client Project No:	3-1161, Skykomish	Lab File ID:	C1331
Sample ID:	MW33-2 1/2	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/8/93
Sample Date:	9/28/93	Date Analyzed:	11/13/93
Report Date:	11/18/93	Cleanup:	None
		Dilution Factor:	1
		% Solids	82
Method ID:	SEMI-VOLATILES BY EPA 8270, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
99-09-2	3-Nitroaniline		2012	U
534-52-1	2-Methyl-4,6-dinitrophenol		2012	U
62-75-9	N-nitrosodimethylamine		402	U
103-33-3	Azobenzene		2012	U
83-32-9	Acenaphthene		402	U
51-28-5	2,4-Dinitrophenol		2012	U
100-02-07	4-Nitrophenol		2012	U
132-64-9	Dibenzofuran		402	U
121-14-2	2,4-Dinitrotoluene		402	U
84-66-2	Diethylphthalate		402	U
7005-72-3	4,Chlorophenyl-phenylether		402	U
86-73-7	Fluorene		402	U
100-01-6	4-Nitroaniline		2012	U
86-30-6	N-Nitrosodiphenylamine(1)		402	U
101-55-3	4-Bromophenyl-phenylether		402	U
118-74-1	Hexachlorobenzene		402	U
87-86-5	Pentachlorophenol		2012	U
85-01-8	Phenanthrene		402	U
120-12-7	Anthracene		402	U
84-74-2	Di-n-butylphthalate		402	U
206-44-0	Fluoranthene		402	U
129-00-0	Pyrene		402	U
85-68-7	Butylbenzylphthalate		402	U
91-94-1	3,3'-Dichlorobenzidine		805	U
56-55-3	Benzo(a)anthracene		402	U
117-81-7	Bis(2-ethylhexyl)phthalate		402	U
218-01-9	Chrysene		402	U
117-84-0	Di-n-octyl phthalate		402	U
205-99-2	Benzo(b)fluoranthene		402	U
207-08-9	Benzo(k)fluoranthene		402	U
50-32-8	Benzo(a)pyrene		402	U
193-39-5	Indeno(1,2,3-cd)pyrene		402	U
53-70-3	Dibenz(a,h)anthracene		402	U
191-24-2	Benzo(g,h,i)perylene		402	U

ACZ Laboratories, Inc.

SEMI-VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2775
Client Project No:	3-1161, Skykomish	Lab File ID:	C1331
Sample ID:	MW33-2 1/2	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/8/93
Sample Date:	9/28/93	Date Analyzed:	11/13/93
Report Date:	11/18/93	Cleanup:	None
		Dilution Factor:	1
		% Solids	82
Method ID:	SEMI-VOLATILES BY EPA 8270, GC/MS	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL Q

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Low internal standard (Perylene-d12), confirmed by reanalysis. L

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

SEMI-VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2785
Client Project No:	3-1161, Skykomish	Lab File ID:	C1357
Sample ID:	B4-10	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/8/93
Sample Date:	9/28/93	Date Analyzed:	11/15/93
Report Date:	11/18/93	Cleanup:	None
		Dilution Factor:	20
		% Solids	100
Method ID:	SEMI-VOLATILES BY EPA 8270, GC/MS	Concentration Units:	ug/Kg "as Received"

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
108-95-2	Phenol		6600	U
111-44-4	bis-(2-Chloroethyl)ether		6600	U
95-57-8	2-Chlorophenol		6600	U
541-73-1	1,3-Dichlorobenzene		6600	U
106-46-7	1,4-Dichlorobenzene		6600	U
100-51-6	Benzyl Alcohol		6600	U
95-50-1	1,2-Dichlorobenzene		6600	U
95-48-7	2-Methylphenol		6600	U
39638-32-9	bis(2-Chloroisopropyl)ether		6600	U
106-44-5	4-Methylphenol		6600	U
621-64-7	N-Nitroso-di-n-propylamine		6600	U
67-72-1	Hexachloroethane		6600	U
98-95-3	Nitrobenzene		6600	U
78-59-1	Isophorone		6600	U
88-75-5	2-Nitrophenol		6600	U
105-67-9	2,4-Dimethylphenol		33000	U
65-85-0	Benzoic Acid		6600	U
111-91-1	bis(2-Chloroethoxy)methane		6600	U
120-83-2	2,4-Dichlorophenol		6600	U
120-82-1	1,2,4-Trichlorobenzene		6600	U
91-20-3	Naphthalene		6600	U
106-47-8	4-Chloroaniline		6600	U
87-68-3	Hexachlorobutadiene		6600	U
59-50-7	4-Chloro-3-methylphenol		6600	U
91-57-6	2-Methylnaphthalene	8,300	6600	
77-47-4	Hexachlorocylopentadiene		6600	U
88-06-2	2,4,6-Trichlorophenol		6600	U
95-95-4	2,4,5-Trichlorophenol		33000	U
91-58-7	2,Chloronaphthalene		6600	U
88-74-4	2-Nitroaniline		33000	U
131-11-3	Dimethyl phthalate		6600	U
208-96-8	Acenaphthylene		6600	U
606-20-8	2,6-Dinitrotoluene		33000	U

ACZ Laboratories, Inc.

SEMI-VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2785
Client Project No:	3-1161, Skykomish	Lab File ID:	C1357
Sample ID:	B4-10	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/8/93
Sample Date:	9/28/93	Date Analyzed:	11/15/93
Report Date:	11/18/93	Cleanup:	None
		Dilution Factor:	20
		% Solids	100
Method ID:	SEMI-VOLATILES BY EPA 8270, GC/MS	Concentration Units:	ug/Kg "as Received"

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
99-09-2	3-Nitroaniline		33000	U
534-52-1	2-Methyl-4,6-dinitrophenol		33000	U
62-75-9	N-nitrosodimethylamine		6600	U
103-33-3	Azobenzene		33000	U
83-32-9	Acenaphthene		6600	U
51-28-5	2,4-Dinitrophenol		33000	U
100-02-07	4-Nitrophenol		33000	U
132-64-9	Dibenzofuran		6600	U
121-14-2	2,4-Dinitrotoluene		6600	U
84-66-2	Diethylphthalate		6600	U
7005-72-3	4,Chlorophenyl-phenylether		6600	U
86-73-7	Fluorene		6600	U
100-01-6	4-Nitroaniline		33000	U
86-30-6	N-Nitrosodiphenylamine(1)		6600	U
101-55-3	4-Bromophenyl-phenylether		6600	U
118-74-1	Hexachlorobenzene		6600	U
87-86-5	Pentachlorophenol		33000	U
85-01-8	Phenanthrene	7,500	6600	
120-12-7	Anthracene		6600	U
84-74-2	Di-n-butylphthalate		6600	U
206-44-0	Fluoranthene		6600	U
129-00-0	Pyrene		6600	U
85-68-7	Butylbenzylphthalate		6600	U
91-94-1	3,3'-Dichlorobenzidine		13200	U
56-55-3	Benzo(a)anthracene		6600	U
117-81-7	Bis(2-ethylhexyl)phthalate		6600	U
218-01-9	Chrysene		6600	U
117-84-0	Di-n-octyl phthalate		6600	U
205-99-2	Benzo(b)fluoranthene		6600	U
207-08-9	Benzo(k)fluoranthene		6600	U
50-32-8	Benzo(a)pyrene		6600	U
193-39-5	Indeno(1,2,3-cd)pyrene		6600	U
53-70-3	Dibenz(a,h)anthracene		6600	U
191-24-2	Benzo(g,h,i)perylene		6600	U

ACZ Laboratories, Inc.

SEMI-VOLATILE ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2785
Client Project No:	3-1161, Skykomish	Lab File ID:	C1357
Sample ID:	B4-10	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/8/93
Sample Date:	9/28/93	Date Analyzed:	11/15/93
Report Date:	11/18/93	Cleanup:	None
		Dilution Factor:	20
		% Solids	100
Method ID:	SEMI-VOLATILES BY EPA 8270, GC/MS	Concentration Units:	ug/Kg "as Received

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: High concentration of late eluting hydrocarbons present.

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2772
Client Project No:	3-1161, Skykomish	Lab File ID:	31016-03
Sample ID:	MW40-5	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/8/93
Sample Date:	9/27/93	Date Analyzed:	10/16/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	96.8
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		83	U
11104-28-2	Aroclor - 1221		83	U
11141-16-5	Aroclor - 1232		83	U
53469-21-9	Aroclor - 1242		83	U
12672-29-6	Aroclor - 1248		83	U
11097-69-1	Aroclor - 1254		165	U
11096-82-5	Aroclor - 1260		165	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2785
Client Project No:	3-1161, Skykomish	Lab File ID:	31016-04
Sample ID:	B4-10	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/8/93
Sample Date:	9/28/93	Date Analyzed:	10/16/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	100.0
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		80	U
11104-28-2	Aroclor - 1221		80	U
11141-16-5	Aroclor - 1232		80	U
53469-21-9	Aroclor - 1242		80	U
12672-29-6	Aroclor - 1248		80	U
11097-69-1	Aroclor - 1254		160	U
11096-82-5	Aroclor - 1260		160	U

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Sample did not allow for % solids determination. Sample reported on "as received" basis.

APPROVED: R. T. VandeVelde for cw
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2786
Client Project No:	3-1161, Skykomish	Lab File ID:	31016-05
Sample ID:	DW2-2	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/8/93
Sample Date:	9/27/93	Date Analyzed:	10/16/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	87.0
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		92	U
11104-28-2	Aroclor - 1221		92	U
11141-16-5	Aroclor - 1232		92	U
53469-21-9	Aroclor - 1242		92	U
12672-29-6	Aroclor - 1248		92	U
11097-69-1	Aroclor - 1254		184	U
11096-82-5	Aroclor - 1260		184	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. V. Vande Velde for cw
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2787
Client Project No:	3-1161, Skykomish	Lab File ID:	31016-06
Sample ID:	B4-2	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/8/93
Sample Date:	9/28/93	Date Analyzed:	10/16/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	87.4
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		92	U
11104-28-2	Aroclor - 1221		92	U
11141-16-5	Aroclor - 1232		92	U
53469-21-9	Aroclor - 1242		92	U
12672-29-6	Aroclor - 1248		92	U
11097-69-1	Aroclor - 1254		183	U
11096-82-5	Aroclor - 1260		183	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. Y. Van de Velde for cw
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2788
Client Project No:	3-1161, Skykomish	Lab File ID:	31016-07
Sample ID:	DW2-0	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/8/93
Sample Date:	9/27/93	Date Analyzed:	10/16/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	86.2
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		93	U
11104-28-2	Aroclor - 1221		93	U
11141-16-5	Aroclor - 1232		93	U
53469-21-9	Aroclor - 1242		93	U
12672-29-6	Aroclor - 1248		93	U
11097-69-1	Aroclor - 1254		186	U
11096-82-5	Aroclor - 1260		186	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. V. Vande Velde / for cw
Organic Laboratory Supervisor

ACZ Laboratories, Inc.
30400 Downhill Dr.
Steamboat Springs, CO 80487

(800) 334-5493
FAX: (303) 879-2216

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	559-2789
Client Project No:	3-1161, Skykomish	Lab File ID:	31016-08
Sample ID:	B4-0	Date Received:	9/30/93
Matrix:	Soil	Date Extracted:	10/8/93
Sample Date:	9/28/93	Date Analyzed:	10/16/93
Report Date:	10/30/93	Dilution Factor:	1
		% Solids:	93.9
Method ID:	PCB's by EPA 8080, GC/ECD	Concentration Units:	ug/Kg

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor - 1016		85	U
11104-28-2	Aroclor - 1221		85	U
11141-16-5	Aroclor - 1232		85	U
53469-21-9	Aroclor - 1242		85	U
12672-29-6	Aroclor - 1248		85	U
11097-69-1	Aroclor - 1254	86	170	J
11096-82-5	Aroclor - 1260		170	U

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: R. V. Vande Velde for cw
Organic Laboratory Supervisor

Client : ReTec, Inc.
Address : 1011 S.W. Klickitat Way, Ste. 207
Seattle, WA 98134
Attn. : Lena Blais
Project : Skykomish, WA

Sample Matrix: Soil
Sample ID: DW-2-0 Lab No. : 93-SI/01834
Sample Date Time: 09/27/93 09:23 Date Received: 09/30/93

Parameters			
Antimony, total	-0.1	mg/kg	4
Arsenic, total	11.	mg/kg	4
Beryllium, total	-0.5	mg/kg	4
Cadmium, total	-0.5	mg/kg	4
Chromium, total	52.	mg/kg	4
Copper, total	51.	mg/kg	4
Lead, total	337.	mg/kg	4
Mercury, total	0.12	mg/kg	4
Nickel, total	42.	mg/kg	4
Selenium, total	-0.2	mg/kg	4
Silver, total	-1.	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	240.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/SH.

Frank E. Polniak, Inorganic Laboratory Supervisor/fk

Client : ReTec, Inc.
Address : 1011 SW Klickitat Way, Ste. 207
Seattle, WA 98134
Attn. : Lena Blais
Project : Skykomish, WA

Sample Matrix: Soil
Sample ID: B4-0
Sample Date Time: 09/28/93 12:17

Lab No. : 93-SI/01835
Date Received: 09/30/93

Parameters

Antimony, total	0.2	mg/kg	4
Arsenic, total	4.8	mg/kg	4
Beryllium, total	-0.5	mg/kg	4
Cadmium, total	-0.5	mg/kg	4
Chromium, total	20.	mg/kg	4
Copper, total	252.	mg/kg	4
Lead, total	125.	mg/kg	4
Mercury, total	0.04	mg/kg	4
Nickel, total	24.	mg/kg	4
Selenium, total	-0.2	mg/kg	4
Silver, total	-1.	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	58.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/SH

Frank E. Polniak, Inorganic Laboratory Supervisor/

Client : ReTec, Inc.
Address : 1011 SW Klickitat Way, Ste.207
Seattle, WA 98134
Attn. : Lena Blais
Project : Skykomish, WA

Sample Matrix: Soil
Sample ID: MW40-0 Lab No. : 93-SI/01836
Sample Date Time: 09/27/93 13:17 Date Received: 09/30/93

Parameters

Antimony, total	0.2	mg/kg	4
Arsenic, total	5.8	mg/kg	4
Beryllium, total	-0.5	mg/kg	4
Cadmium, total	0.5	mg/kg	4
Chromium, total	46.	mg/kg	4
Copper, total	57.	mg/kg	4
Lead, total	283.	mg/kg	4
Mercury, total	0.07	mg/kg	4
Nickel, total	34.	mg/kg	4
Selenium, total	-0.2	mg/kg	4
Silver, total	-1.	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	197.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/SH.

Frank E. Polniak, Inorganic Laboratory Supervisor/

Client : ReTec, Inc.
Address : 1011 SW Klickitat Way, Ste.207
Seattle, WA 98134
Attn. : Lena Blais
Project : Skykomish, WA

Sample Matrix: Soil
Sample ID: B11-0
Sample Date Time: 09/27/93 15:34

Lab No. : 93-SI/01837
Date Received: 09/30/93

Parameters			
Antimony, total	0.1	mg/kg	4
Arsenic, total	11.2	mg/kg	4
Beryllium, total	-0.5	mg/kg	4
Cadmium, total	-0.5	mg/kg	4
Chromium, total	43.	mg/kg	4
Copper, total	36.	mg/kg	4
Lead, total	1897.	mg/kg	4
Mercury, total	0.16	mg/kg	4
Nickel, total	37.	mg/kg	4
Selenium, total	0.3	mg/kg	4
Silver, total	-1.	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	187.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/S.H.

Frank E. Polniak, Inorganic Laboratory Supervisor/FP

Client : ReTec, Inc.
Address : 1011 SW Klickitat Way, Ste.207
Seattle, WA 98134
Attn. : Lena Blais
Project : Skykomish, WA

Sample Matrix: Soil
Sample ID: B110-0 Lab No. : 93-SI/01838
Sample Date Time: 09/27/93 15:43 Date Received: 09/30/93

Parameters

Antimony, total	-0.1	mg/kg	4
Arsenic, total	10.9	mg/kg	4
Beryllium, total	-0.5	mg/kg	4
Cadmium, total	-0.5	mg/kg	4
Chromium, total	41.	mg/kg	4
Copper, total	33.	mg/kg	4
Lead, total	967.	mg/kg	4
Mercury, total	0.13	mg/kg	4
Nickel, total	36.	mg/kg	4
Selenium, total	-0.2	mg/kg	4
Silver, total	-1.	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	147.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/S.H.

Frank E. Polniak, Inorganic Laboratory Supervisor/FP

Client : ReTec, Inc.
Address : 1011 SW Klickitat Way, Ste.207
Seattle, WA 98134
Attn. : Lena Blais
Project : Skykomish, WA

Sample Matrix: Soil
Sample ID: DW4-0
Sample Date Time: 09/27/93 16:44

Lab No. : 93-SI/01839
Date Received: 09/30/93

Parameters

Antimony, total	0.2	mg/kg	4
Arsenic, total	-0.2	mg/kg	4
Beryllium, total	-0.5	mg/kg	4
Cadmium, total	-0.5	mg/kg	4
Chromium, total	29.	mg/kg	4
Copper, total	37.	mg/kg	4
Lead, total	29.	mg/kg	4
Mercury, total	-0.02	mg/kg	4
Nickel, total	27.	mg/kg	4
Selenium, total	0.2	mg/kg	4
Silver, total	-1.	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	60.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/S.H.

Frank E. Polniak, Inorganic Laboratory Supervisor/

Client : ReTec, Inc.
Address : 1011 SW Klickitat Way, Ste.207
Seattle, WA 98134
Attn. : Lena Blais
Project : Skykomish, WA

Sample Matrix: Soil
Sample ID: DW1-0
Sample Date Time: 09/28/93 08:15

Lab No. : 93-SI/01840
Date Received: 09/30/93

Parameters

Antimony, total	-0.1	mg/kg	4
Arsenic, total	6.1	mg/kg	4
Beryllium, total	-0.5	mg/kg	4
Cadmium, total	-0.5	mg/kg	4
Chromium, total	42.	mg/kg	4
Copper, total	39.	mg/kg	4
Lead, total	79.	mg/kg	4
Mercury, total	-0.02	mg/kg	4
Nickel, total	27.	mg/kg	4
Selenium, total	-0.2	mg/kg	4
Silver, total	-1.	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	76.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/SH.

Frank E. Polniak, Inorganic Laboratory Supervisor/

Client : ReTec, Inc.
Address : 1011 SW Klickitat Way, Ste.207
Seattle, WA 98134
Attn. : Lena Blais
Project : Skykomish, WA

Sample Matrix: Soil
Sample ID: MW34-0 Lab No. : 93-SI/01841
Sample Date Time: 09/28/93 13:40 Date Received: 09/30/93

Parameters			
Antimony, total	-0.5	mg/kg	4
Arsenic, total	8.4	mg/kg	4
Beryllium, total	-0.5	mg/kg	4
Cadmium, total	-0.5	mg/kg	4
Chromium, total	40.	mg/kg	4
Copper, total	23.	mg/kg	4
Lead, total	9.	mg/kg	4
Mercury, total	-0.02	mg/kg	4
Nickel, total	34.	mg/kg	4
Selenium, total	-0.2	mg/kg	4
Silver, total	-1.	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	49.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/SH.

Frank E. Polniak, Inorganic Laboratory Supervisor/FP

Client : ReTec, Inc.
Address : 1011 SW Klickitat Way, Ste.207
Seattle, WA 98134
Attn. : Lena Blais
Project : Skykomish, WA

Sample Matrix: Soil
Sample ID: MW33-0
Sample Date Time: 09/28/93 14:46

Lab No. : 93-SI/01842
Date Received: 09/30/93

Parameters

Antimony, total	1.0	mg/kg	4
Arsenic, total	3.0	mg/kg	4
Beryllium, total	-0.5	mg/kg	4
Cadmium, total	-0.5	mg/kg	4
Chromium, total	21.	mg/kg	4
Copper, total	110.	mg/kg	4
Lead, total	211.	mg/kg	4
Mercury, total	0.17	mg/kg	4
Nickel, total	41.	mg/kg	4
Selenium, total	-0.2	mg/kg	4
Silver, total	-1.	mg/kg	4
Thallium, total	-0.2	mg/kg	4
Zinc, total	76.	mg/kg	4

4 EPA SW846, Method 3051 Digestion.

Remarks:

Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/S.H.

Frank E. Polniak, Inorganic Laboratory Supervisor /FP

APPENDIX E

PREVIOUS SOIL AND GROUNDWATER ANALYTICAL DATA

TABLE 2
SUMMARY OF FIELD MEASUREMENTS AND ANALYTES DETECTED IN GROUND WATER SAMPLES FROM MONITOR WELLS

Well Number	Analytical Results: Aromatic Volatile Organics (EPA 8020) Benzene (ug/l)	Ethylbenzene (ug/l)	Toluene (ug/l)	Xylenes (ug/l)	TPH (mg/l)	Field Measurements/Screening: Temperature (Degrees F)	pH	Conductivity (micromohs/sec)	Sheen	Hydrocarbons Vapors (ppm)
MW-1	ND	ND	ND	ND	ND	48.5	6.18	89.7	MS	<100
MW-2	ND(n)	ND(n)	ND(n)	ND(n)	ND	47.2	8.72	110.2	MS	2,500
MW-3	ND	ND	ND	ND	ND	50.2	7.23	99.0	MS	200
MW-4	1.1	ND(n)	ND(n)	ND(n)	14	48.7	7.25	150.0	Trace	<100
MW-5	ND(n)	ND(n)	ND(n)	ND(n)	ND	50.0	7.25	148.48	SS	>10,000
MW-6	ND(n)	ND(n)	ND(n)	ND(n)	45	—	—	—	—	1,000
MW-6A(1)	ND(n)	ND(n)	ND(n)	ND(n)	13	—	—	—	Trace	<100
MW-7	ND(n)	ND(n)	ND(n)	1.6(n)	240	51.0	6.03	122.7	Trace	<100
MW-8	ND(n)	ND(n)	ND(n)	2.0(n)	38	—	—	—	Product (2)	<100
MW-9	ND(n)	ND(n)	ND(n)	ND(n)	200	49.3	6.01	156.8	Trace	<100
MW-10	0.5	ND	ND	ND	3	48.3	6.04	84.0	HS	<100
MW-11	0.5	ND	ND	4.4	6	50.4	5.86	206.0	HS	100
MW-12	ND(n)	ND(n)	ND(n)	ND(n)	210	49.8	6.05	82.4	Trace	<100
MW-13	ND	ND	ND	ND	1	50.4	6.27	87.8	HS	<100
MW-14	ND(n)	ND(n)	ND(n)	ND(n)	3	50.1	6.19	78.3	HS	<100
MW-15	ND(n)	ND(n)	ND(n)	ND(n)	100	48.5	6.26	82.6	Trace	<100
MW-16	ND(n)	ND(n)	ND(n)	ND(n)	ND	50.3	5.98	101.3	SS	<100
MW-17	ND(n)	ND(n)	ND(n)	ND(n)	ND	51.3	6.10	139.4	Trace	<100
MW-18	ND(n)	ND(n)	ND(n)	ND(n)	ND	49.3	5.85	235.0	SS	<100
MW-19	ND(n)	ND(n)	ND(n)	ND(n)	ND	51.4	6.00	75.0	SS	<100
MW-20	ND(n)	ND(n)	ND(n)	ND(n)	53	53.3	6.03	185.7	Trace	800
MW-21	ND(n)	ND(n)	ND(n)	ND(n)	100	51.6	6.04	111.3	Trace	<100
MW-22	ND(n)	ND(n)	ND(n)	ND(n)	47	53.5	6.05	116.5	Trace	100
MW-23	ND(n)	ND(n)	ND(n)	ND(n)	8	51.8	6.14	103.0	HS	<100
MW-24	ND(n)	ND(n)	ND(n)	ND(n)	42	53.5	5.95	198.8	Trace	<100
MW-25	ND(n)	ND(n)	ND(n)	ND(n)	24	52.7	6.13	182.8	Trace	<100
MW-26	ND(n)	ND(n)	ND(n)	ND(n)	55	53.1	5.95	145.3	Trace	100
MW-27	ND(n)	ND(n)	ND(n)	ND(n)	200	52.8	5.90	369.0	Trace	<100
Trip Blank	ND	ND	ND	ND	—	—	—	—	—	—
MTCA(3)	5.0	20.0	40.0	20.0	1					

Notes:
All water samples were collected and field measurements taken on 10/02/90
TPH = total petroleum hydrocarbons (EPA Method 418.1)
ug/l = micrograms per liter
mg/l = milligrams per liter
ppm = parts per million
"—" = not tested
(n) = sample analyzed after holding time
ND = Not Detected; see laboratory dta sheets in Appendix B for analyte detection limits.
(1) Sample MW-6A is a duplicate sample obtained from Monitor Well MW-6
(2) A sample of free product obtained from Monitor Well MW-8 was submitted to Analytical Technology, Incorporated for analysis of fuel hydrocarbons by modified EPA Method 8015. The product was identified as diesel and heavier petroleum products (C8–C25) at a concentration of 650,000 mg/l.
(3) Model Toxics Control Act Method A Cleanup Level (February 28, 1991)

SS = slight sheen
MS = moderate sheen
HS = heavy sheen
Trace = product is present in droplet form but not measureable thickness

TABLE 3 (Page 1 of 2)

SUMMARY OF ANALYTICAL DATA FOR SOIL SAMPLES OBTAINED FROM EXPLORATORY BORINGS

	SAMPLE NUMBER (Depth)															
Compound (EPA Method)	MW-1-1 (3.5 ft)	MW-2-2 (9.5 ft)	MW-3-2 (9.5 ft)	MW-4-2 (9.5 ft)	MW-5-1 (4.0 ft)	MW-6-2 (9.0 ft)	MW-6-3 (14.0 ft)	MW-7-1 (9.0 ft)	MW-8-1 (2.0 ft)	MW-9-1 (4.0 ft)	MW-10-1 (9.0 ft)	MW-11-2 (9.0 ft)	MW-12-1 (9.5 ft)	MW-13-2 (9.5 ft)	MW-14-1 (4.0 ft)	MTCA (1) LEVELS
Purgeable Aromatics (EPA 8020)						—							—	—		
Benzene	ND	ND	ND	ND	ND		ND	ND	0.093	ND	ND	ND			ND	0.5
Ethylbenzene	ND	ND	ND	ND	ND		7.8	ND	0.098	ND	0.65	ND			ND	20
Toluene	ND	ND	ND	ND	ND		2.0	ND	0.54	ND	ND	ND			ND	40
Total Xylenes	ND	ND	ND	ND	0.36		9.6	ND	0.93	ND	ND	ND			ND	20
TPH	1,400	25	23	1,900	4,000	17,000	8,600	1,700	2,100	22	4,000	4,600	2,200	1,100	26	200
Fuel Hydrocarbons (Modified 8015)	96	ND	ND	4,900	5,000	—	4,600	250	850	ND	4,100	5,200	800	600	ND	200
Hydrocarbons identified	C14-C24			C10-C24+	C10-C24		C8-C24+	C14-C24+	C8-C24+		C10-C24	C8-C24+	C10-C24	C10-C24		
PCBs	—	—	—	—	—	—	—	ND	—	—	—	—	—	—	ND	1.0
Polynuclear Aromatics (8310)*	—	—	—	—	—	—		—	—	—			—	—	—	
Naphthalene							0.40				ND	0.12				NA
Acenaphthene							2.5				ND	1.7				NA
Fluorene							0.93				1.3	6.1				NA
Phenanthrene							1.6				1.8	14				NA
Anthracene							ND				ND	0.69				1.0
Fluoranthene							5.4				5.0	39				NA
Pyrene							0.52				ND	1.2				NA
Field Screening																
Sheen	MS	SS	SS	HS	HS	HS	HS	SS	HS	SS	SS	HS	HS	SS	SS	—
Headspace vapors	<100	<100	200	180	110	180	120	<100	<100	<100	100	<100	140	<100	<100	—

Notes:
All units are milligrams per kilogram except headspace vapor concentrations (parts per million)
ND = not detected; see laboratory data sheets in Appendix B for analyte detection limits.
"—" = not analyzed
NA = MTCA Cleanup Level not available
(*) Only compounds detected are listed in table
(1) Model Toxics Control Act Method A Cleanup Level (February 28, 1991)

NS = no sheen
SS = slight sheen
MS = moderate sheen
HS = heavy sheen

TABLE 3 (Page 2 of 2)

Compound (EPA Method)	SAMPLE NUMBER (Depth)															MTCA (1)
	MW-14-2 (9.5 ft)	MW-15-1 (4.0 ft)	MW-15-2 (9.5 ft)	MW-16-1 (4.5 ft)	MW-17-2 (9.5 ft)	MW-18-1 (4.0 ft)	MW-19-1 (4.0 ft)	MW-20-1 (5.5 ft)	MW-21-2 (9.0 ft)	MW-22-1 (4.5 ft)	MW-23-1 (4.0 ft)	MW-24-1 (4.5 ft)	MW-25-1 (4.5 ft)	MW-26-2 (9.5 ft)	MW-27-1 (4.5 ft)	LEVELS
Purgeable Aromatics	—	—			—				—		—			—	—	
Benzene			ND	ND		ND	ND	ND		ND		ND	0.051			0.5
Ethylbenzene			ND	ND		ND	ND	ND		ND		ND	ND			20
Toluene			ND	ND		ND	ND	ND		ND		ND	ND			40
Total Xylenes			ND	ND		ND	ND	ND		ND		ND	0.035			20
TPH (418.1)	—	850	320	12	1,100	64	24	43	320	1,200	1,200	1,000	2,000	250	75	200
Fuel Hydrocarbons (Modified 8015)	—	ND	170	ND	450	ND	ND	ND	88	180	340	69	17	74	ND	200
Hydrocarbons Identified			C10-C24		C10-C24+				C12-C24	C14-C24+	C8-C24+	C14-C24	C14-C24	C12-C24+		
PCBs (8080)	ND	ND	ND	—	—	—	—	—	—	—	—	—	—	—	—	1.0
Polynuclear Aromatics (8310)	—	—	—	ND	—	—	—	—	—	—	—	ND	ND	—	—	
Field Screening																
Sheen	SS	SS	SS	SS	HS	NS	MS	SS	MS	NS	HS	MS	NS	SS	SS	
Headspace vapors	<100	—	120	<100	100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	

Notes:
All units are milligrams per kilogram except headspace vapor concentrations (parts per million)
ND = not detected; see laboratory data sheets in Appendix B for analyte detection limits.
"—" = not analyzed
NA = MTCA Cleanup Level not available
(*) Only compounds detected are listed in table
(1) Model Toxics Control Act Method A Cleanup Level (February 28, 1991)

NS = no sheen
SS = slight sheen
MS = moderate sheen
HS = heavy sheen

TABLE 4
SUMMARY OF ANALYTICAL DATA FOR SURFICIAL SOIL SAMPLES

Compound (EPA Method)	(Units)	SAMPLE NUMBER SS-1 (Out)	SS-2 (Out)	SS-3 (Out)	SS-4 (In)	SS-5 (In)	SKY-1	MTCA (1) LEVELS	TCLP LEVELS
TPH (418.1)	(mg/kg)	4,000	7,800	810	—	—	72,000	200	
Fuel Hydrocarbons (Modified 8015)	(mg/kg)	—	—	—	—	—	26,000	200	
Hydrocarbon Identified							C8–C24+		
PCBs (8080)	(mg/kg)		ND		—	—	—	1.0	
PCB 1254		0.18		0.15					
TCLP Metals	(mg/l)	—	—	—			—		
Arsenic					ND	ND			5
Barium					0.66	0.48			100
Cadimum					0.01	ND			1
Chromium					<0.02	0.02			5
Lead					5.7	7.6			5
Mercury					ND	ND			0.2
Selenium					ND	ND			1
Silver					ND	ND			5
Priority Pollutant Metals	(mg/kg)	—	—	—			—		
Antimony					ND	ND		—	
Arsenic					6.2	2.5		20	
Beryllium					ND	ND		—	
Cadmium					ND	ND		—	
Chromium					24	24		100	
Copper					31	17		130(2)	
Lead					900	1,300		250	
Mercury					ND	ND		—	
Nickel					20	23		28,000(3)	
Selenium					ND	ND		—	
Silver					ND	ND		—	
Thallium					ND	ND		—	
Zinc					350	120		500(3)	

Notes:
mg/kg = milligrams per kilogram
mg/l = milligrams per liter
ND = not detected; see laboratory data sheets in Appendix B for analyte detection limits.
"—" = not analyzed
TCLP = Toxicity Characteristic Leaching Potential
(1) Model Toxics Control Act Method A Cleanup Level (February 28, 1991)
(2) Based on 100 times the EPA's Drinking Water Equivalent Level
(3) Model Toxics Control Act Method B Cleanup Level (February 28, 1991)

TABLE 4(page 1 of 2)
SUMMARY OF SOIL FIELD SCREENING RESULTS AND CHEMICAL ANALYTICAL DATA[1] FROM EXPLORATORY BORINGS

Sample Number	Date Sampled	Depth of Sample (feet)	Field Screening Results[2]		Purgeable Aromatic Hydrocarbons (EPA Method 8020) (mg/kg)				TPH (EPA Method) 418.1 (mg/kg)	Fuel Hydrocarbons (Modified EPA Method) 8015[3] (mg/kg)	PCBs (EPA Method) 8080 (mg/kg)
			Sheen	Vapor Concentration (ppm)	Benzene	Ethylbenzene	Toluene	Xylenes			
MW-1-1	09/17/90	3.5 ft	MS	<100	<0.025	<0.025	<0.025	<0.025	1,400	96 (C14-C24)	--
MW-2-2	09/18/90	9.5	SS	<100	<0.025	<0.025	<0.025	<0.025	25	<5	--
MW-3-2	09/18/90	9.5	SS	200	<0.025	<0.025	<0.025	<0.025	23	<5	--
MW-4-2	09/18/90	9.5	HS	180	<0.036	<0.036	<0.036	<0.036	1,900	4,900 (C10-C24+)	--
MW-5-1	09/19/90	4.0	HS	110	<0.025	<0.025	<0.025	0.36	4,000	5,000 (C10-C24)	--
MW-6-2	09/19/90	9.0	HS	180	--	--	--	--	17,000	--	--
MW-6-3[4]	09/19/90	14.0	HS	120	<0.50	7.8	2.0	9.6	8,600	4,600 (C8-C24+)	--
MW-7-1	09/19/90	9.0	SS	<100	<0.025	<0.025	<0.025	<0.025	1,700	250 (C14-C24+)	ND
MW-8-1	09/19/90	2.0	HS	<100	0.093	0.098	0.54	0.93	2,100	850 (C8-C24+)	--
MW-9-1	09/20/90	4.0	SS	<100	<0.025	<0.025	<0.025	<0.025	22	<5	--
MW-10-1[5]	09/20/90	9.0	SS	100	<0.50	0.65	<0.50	<0.50	4,000	4,100 (C10-C24)	--
MW-11-2[6]	09/20/90	9.0	HS	<100	<0.50	<0.50	<0.50	<0.50	4,600	5,200 (C8-C24+)	--
MW-12-1	09/20/90	9.5	HS	140	--	--	--	--	2,200	800 (C10-C24)	--
MW-13-2	09/20/90	9.5	SS	<100	--	--	--	--	1,100	600 (C10-C24)	--
MW-14-1	09/21/90	4.0	SS	<100	<0.025	<0.025	<0.025	<0.025	26	<5	ND
MW-14-2	09/21/90	9.5	SS	<100	--	--	--	--	--	--	ND
MW-15-1	09/21/90	4.0	SS	--	--	--	--	--	850	<5	ND
MW-15-2	09/21/90	9.5	SS	120	<0.025	<0.025	<0.025	<0.025	320	170 (C14-C24)	ND
MW-16-1[7]	09/21/90	4.0	SS	<100	<0.025	<0.025	<0.025	<0.025	12	<5	--
MW-17-2	09/24/90	9.5	SS	--	--	--	--	--	1,100	450 (C10-C24)	--
MW-18-1	09/24/90	4.0	SS	120	<0.025	<0.025	<0.025	<0.025	64	<5	--
MW-22-1	09/24/90	4.5	NS	<100	<0.025	<0.025	<0.025	<0.025	1,200	180 (C14-C24+)	--
MW-21-2	09/25/90	9.0	SS	120	--	--	--	--	320	170 (C10-C24)	--
MW-23-1	09/25/90	4.0	HS	<100	--	--	--	--	1,200	340 (C8-C24+)	--
MW-24-1[7]	09/25/90	4.5	MS	<100	<0.025	<0.025	<0.025	<0.025	1,000	69 (C14-C24)	--
MW-25-1[7]	09/25/90	4.0	NS	<100	0.051	<0.025	<0.025	0.035	2,000	17 (C14-C24)	--

Notes appear on page 2 of 2.

TABLE 4 (page 2 of 2)

Sample Number	Date Sampled	Depth of Sample (feet)	Field Screening Results[2] Sheen	Field Screening Results[2] Vapor Concentration (ppm)	Purgeable Aromatic Hydrocarbons (EPA Method 8020) (mg/kg) Benzene	Ethylbenzene	Toluene	Xylenes	TPH (EPA Method) 418.1 (mg/kg)	Fuel Hydrocarbons (Modified EPA Method) 8015[3] (mg/kg)	PCBs (EPA Method) 8080 (mg/kg)
MW-19-1	09/26/90	4.0	SS	<100	<0.042	<0.042	<0.042	<0.042	24	<5	--
MW-20-1	09/26/90	4.0	SS	--	<0.025	<0.025	<0.025	<0.025	43	<5	--
MW-26-2	09/26/90	9.5	SS	<100	--	--	--	--	250	74 (C12-C24+)	--
MW-27-1	09/26/90	4.5	SS	<100	--	--	--	--	75	<5	--
SS-6	04/11/91	--	--	--	--	--	--	--	--	--	ND
SS-7	04/11/91	--	--	--	--	--	--	--	--	--	PCB 1254 (0.33)
SS-8	04/11/91	--	--	--	--	--	--	--	--	--	PCB 1260 (0.081)
SS-9	04/11/91	--	--	--	--	--	--	--	--	--	PCB 1260 (0.036)
B-1	11/04/91	3.5	HS	<100	--	--	--	--	40,000	12,000 (C12-C24)[8]	--
B-2	11/05/91	9.5	SS	<100	--	--	--	--	<5	<5	--
B-3	11/05/91	9.5	SS	<100	--	--	--	--	<5	<5	--
MW-29	11/05/91	9.5	SS	<100	--	--	--	--	<5	<5	--
MW-30	11/06/91	4.0	NS	<100	--	--	--	--	<5	<5	--
MW-31	11/06/91	9.0	NS	<100	--	--	--	--	<5	<5	--
MW-31	11/06/91	14.0	NS	<100	--	--	--	--	<5	<5	--
TP-1-4	11/08/91	8.0	SS	<100	--	--	--	--	77	--	--
TP-2-5	11/08/91	10.0	SS	<100	--	--	--	--	17	--	--

Notes:
[1]Chemical analyses conducted by Analytical Technologies, Inc. Laboratory reports for analyses are included in Appendices B and C.
[2]A description of the field screening methods are included in Appendix A.
[3]Carbon range is shown in parantheses.
[4]Sample was also analyzed for PAHs (polynuclear aromatic hydrocarbons) by EPA Method 8310. The PAHs naphthalene (0.40 mg/kg), acenaphthene (2.5 mg/kg), fluorene (0.93 mg/kg), phenanthrene (1.6 mg/kg), fluoranthene (5.4 mg/kg) and pyrene (0.52 mg/kg) were detected in the sample.
[5]Sample was also analyzed for PAHs by EPA Method 8310. The PAHs fluorene (1.3 mg/kg), phenanthrene (1.8 mg/kg) and fluoranthene (5 mg/kg) were detected in the sample.
[6]Sample was also analyzed for PAHs by EPA Method 8310. The PAHs naphthalene (0.12 mg/kg), acenaphthene (1.7 mg/kg), fluorene (6.1 mg/kg), phenanthrene (14 mg/kg), anthracene (0.69 mg/kg), fluoranthene (39 mg/kg) and pyrene (1.2 mg/kg) were detected in the sample.
[7]Sample was also analyzed for PAHs by EPA Method 8310. PAHs were not detected in the sample.
[8]Modified EPA Method 8015 also detected hydrocarbons in the C7-C12 range at a concentration of 240 mg/kg.
mg/kg = milligrams per kilogram
ppm = parts per million
ND = not detected
'--' = not tested
NS = no sheen, SS = slight sheen, MS = moderate sheen, HS = heavy sheen

TABLE 5
SUMMARY OF METALS ANALYSIS[1]
SOIL SAMPLES

Sample ID Date Collected	SS-4 10/04/90	SS-5 10/04/90	SS-10[2] 04/11/91	SS-11[3] 04/11/91	B-1 11/07/91	B-2 11/07/91	B-3 11/07/91	MW-29 11/07/91	MW-30 11/07/91	MW-31 11/07/91	TP-1-1[4] 11/08/91	TP-2-1[5] 11/08/91
Antimony	<0.5	<0.5	--	--	<3.5	<5.0	<3.0	<2.7	<3.6	18	<4.4	<3.3
Arsenic	6.2	2.5	--	--	4.0	7.2	3.7	3.9	2.6	27	12	8.3
Beryllium	<1	<1	--	--	0.26	0.27	0.29	0.16	<0.15	0.71	0.26	0.16
Cadmium	<1	<1	--	--	0.38	0.30	0.51	0.45	0.69	3.7	<0.18	<0.13
Chromium	24	24	--	--	38	49	56	35	24	17	32	29
Copper	31	17	--	--	41	37	33	31	30	170	39	66
Lead	900	1,300	1,800	710	9.1	7.9	7.6	11	3.8	1,100[8]	51	64
Mercury	<0.15	<0.15	--	--	<0.10	0.30	<0.10	<0.10	<0.10	<0.10	<0.15	<0.10
Nickel	20	23	--	--	38	43	37	28	16	15	28	27
Selenium	<0.5	<0.5	--	--	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.36	<0.38
Silver	<2	<2	--	--	<0.35	<0.50	<0.30	<0.27	<0.36	<0.49	<0.44	<0.33
Thallium	<0.5	<0.5	--	--	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.36	<0.38
Zinc	350	120	--	--	63	68	72	54	53	210	110	73

Notes:
[1] Chemical analyses conducted by Analytical Technologies Inc. Laboratory reports are presented in Appendices B and C.
[2] Duplicate sample (SS-3) collected by Ecology and Environment during Site Hazard Assessment. Duplicate sample result for lead was 1,220 mg/kg.
[3] Duplicate sample (SS-4) collected by Ecology and Environment during Site Hazard Assessment. Duplicate sample result for lead was 597 mg/kg.
[4] Test pit 1 is shown on attached site plan as MW-32 (monitor well was installed in test pit).
[5] Test pit 2 is located 40 feet east of test pit 1 (MW-32).
'--' = not tested
All units are milligrams per kilogram.

TABLE 6(page 1 of 2)
SUMMARY OF GROUND WATER ANALYTICAL DATA[1]
MONITORING WELLS MW-1 THROUGH 27

Monitoring Well Number	Date Sampled	BETX (EPA Method 8020)				TPH[2]
		Benzene	Ethylbenzene	Toluene	Xylenes	
MW-1	10/02/90	<0.0005	<0.0005	<0.0005	<0.0005	<1
	03/20/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
	10/02/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
MW-2	10/02/90[3]	<0.0005	<0.0005	<0.0005	<0.0005	<1
	03/20/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
	10/02/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
MW-3	10/02/90	0.0011	<0.0005	<0.0005	<0.0005	<1
	03/20/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
	10/02/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
MW-4	10/02/90	<0.0005	<0.0005	<0.0005	<0.0005	14
	03/20/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
	10/02/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
MW-5	10/02/90[3]	<0.0005	<0.0005	<0.0005	<0.0005	<1
	03/20/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
	10/02/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
MW-6	10/02/90[3]	<0.0005	<0.0005	<0.0005	<0.0005	45
MW-6A[4]	10/02/90[3]	<0.005	<0.005	<0.005	<0.005	13
	03/20/91	--	--	--	--	--
	10/02/91	--	--	--	--	--
MW-7	10/02/90[3]	<0.0005	<0.0005	<0.0005	0.0016	240
	03/20/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
	10/02/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
MW-8	10/02/90[3]	<0.0005	<0.0005	<0.0005	0.002	36
	03/20/91	--	--	--	--	--
	10/02/91	--	--	--	--	--
MW-9	10/02/90[3]	<0.0005	<0.0005	<0.0005	<0.0005	200
	03/20/91	<0.0005	<0.0005	<0.0005	<0.0005	6
	10/02/91	<0.0005	<0.0005	<0.0005	<0.0005	1.6
MW-10	10/02/90	0.0005	<0.0005	<0.0005	<0.0005	3
	03/20/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
	10/02/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
MW-11	10/02/90	0.0005	<0.0005	<0.0005	0.0044	6
	03/20/91	<0.0005	0.0083	<0.0005	0.013	2
	10/02/91	<0.0005	0.0005	<0.0005	0.0005	2.2
MW-12	10/02/90[3]	<0.005	<0.005	<0.005	<0.005	210
	03/20/91	<0.0005	<0.0005	<0.0005	<0.0005	4
	10/02/91	<0.0005	<0.0005	<0.0005	<0.0005	1.9
MW-13[5]	10/02/90	<0.0005	<0.0005	<0.0005	<0.0005	1
	03/20/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
	10/02/91	0.0008	<0.0005	0.035	0.0028	<1
MW-14[5]	10/02/90[3]	<0.0005	<0.0005	<0.0005	<0.0005	3
	03/20/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
	10/02/91	<0.0005	<0.0005	0.0009	0.0008	<1
MW-15[5]	10/02/90[3]	<0.005	<0.005	<0.005	<0.005	100
	03/20/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
	10/02/91	--	--	--	--	--

Notes appear on page 2 of 2.

TABLE 6(page 2 of 2)

Monitoring Well Number	Date Sampled	BETX (EPA Method 8020)				TPH[2]
		Benzene	Ethylbenzene	Toluene	Xylenes	
MW-16	10/02/90[3]	<0.0005	<0.0005	<0.0005	<0.0005	<1
	03/20/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
	10/02/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
MW-17	10/02/90[3]	<0.0005	<0.0005	<0.0005	<0.0005	<1
	03/20/91	--	--	--	--	--
	10/02/91	--	--	--	--	--
MW-18	10/02/90[3]	<0.0005	<0.0005	<0.0005	<0.0005	<1
	03/20/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
	10/02/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
MW-19	10/02/90[3]	<0.0005	<0.0005	<0.0005	<0.0005	<1
	03/20/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
	10/02/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
MW-20	10/02/90[3]	<0.005	<0.005	<0.005	<0.005	53
	03/20/91	0.0008	0.0018	<0.0005	0.0012	12
	10/02/91	<0.0005	0.0038	<0.0005	0.0049	4.7
MW-21	10/02/90[3]	<0.005	<0.005	<0.005	<0.005	100
	03/20/91	--	--	--	--	--
	10/02/91	--	--	--	--	--
MW-22	10/02/90[3]	<0.005	<0.005	<0.005	<0.005	47
	03/20/91	--	--	--	--	--
	10/02/91	--	--	--	--	--
MW-23	10/02/90[3]	<0.0005	<0.0005	<0.0005	<0.0005	8
	03/20/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
	10/02/91	<0.0005	<0.0005	<0.0005	<0.0005	1.2
MW-23A[6]	10/02/91	0.001	<0.0005	<0.0005	<0.0005	1.1
MW-23R[7]	10/02/91	<0.0005	<0.0005	<0.0005	<0.0005	--
MW-24	10/02/90[3]	<0.005	<0.005	<0.005	<0.005	42
	03/20/91	<0.0005	<0.0005	<0.0005	<0.0005	<1
	10/02/91	<0.0005	<0.0005	<0.0005	<0.0005	1.2
MW-25	10/02/90[3]	<0.005	<0.005	<0.005	<0.005	24
	03/20/91	--	--	--	--	--
	10/02/91	--	--	--	--	--
MW-26	10/02/90[3]	<0.005	<0.005	<0.005	<0.005	65
	03/20/91	<0.0005	<0.0005	<0.0005	<0.0005	38
	10/02/91	0.0008	0.0019	0.0011	0.0055	7.6
MW-27	10/02/90[3]	<0.005	<0.005	<0.005	<0.005	200
	03/20/91	--	--	-	--	--
	10/02/91	--	--	--	--	--
Trip Blank	10/02/90	<0.0005	<0.0005	<0.0005	<0.0005	

Notes:
1 Chemical analysis conducted by Analytical Technologies Inc. Laboratory reports are presented in Appendices B and C.
2 TPH = total petroleum hydrocarbons by EPA Method 418.1.
3 BETX samples were analyzed past holding times.
4 Duplicate of sample MW-6.
5 Sample was also analyzed for PCBs. PCBs were not detected in the sample.
6 Duplicate of sample MW-23.
7 Rinseate sample from bailer used during sampling MW-23.
All units are in milligrams per liter
"--" = not tested due to presence of free product

TABLE 7
SUMMARY OF METALS ANALYSIS[1]
GROUND WATER SAMPLES FROM MONITORING WELLS

Monitoring Well Number	Date Sampled	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
MW-28	11/07/91	<0.050	0.074	<0.002	<0.010	<0.0030	<0.00040	<0.050	<0.005
MW-28A[2]	11/07/91	0.058	0.078	<0.002	<0.010	0.0054	<0.00040	<0.050	<0.005
MW-29	11/07/91	<0.050	0.024	<0.002	<0.010	0.0036	<0.00040	<0.050	<0.005
MW-30	11/07/91	<0.050	0.015	<0.002	<0.010	<0.0030	<0.00040	<0.050	<0.005
MW-31	11/07/91	<0.050	0.023	<0.002	<0.010	0.011	<0.00040	<0.050	<0.005
MW-32	11/14/91	<0.010	0.060	<0.0040	<0.020	<0.0060	<0.00040	<0.010	<0.010

Notes:
[1] Chemical analyses conducted by Analytical Technologies, Inc. Laboratory reports are presented in Appendix C.
[2] Duplicate of sample MW-28.
All units are in milligrams per liter.

TABLE 8
SUMMARY OF ANALYTICAL DATA[1] IN GROUND WATER SAMPLES FROM MONITORING WELLS MW-28 THROUGH MW-32

Monitoring Well Number	Date Sampled	Analytes Detected[2] Volatile Organic Compounds (EPA Method 8240)	Results (mg/l)	Analytes Detected[2] Semivolatile Organic Compounds (EPA Method 8270)	Results (mg/l)	Fuel Hydrocarbons (Modified EPA Method 8015) (mg/l)		TPH (EPA Method 418.1) (mg/l)
						Gasoline	Diesel	
MW-28	11/07/91	ND	ND	2-Methylnaphthalene	0.052	7	170	130
				Phenanthrene	0.026[4]			
MW-28A[3]	11/07/91	ND	ND	2-Methylnaphthalene	0.057	6	150	170
				Phenanthrene	0.024[4]			
MW-29	11/07/91	Chloroform	0.003					
MW-30	11/07/91	ND	ND	ND	ND	<1	<1	<1
MW-31	11/07/91	Methylene Chloride[5]	0.004	ND	ND	<1	<1	<1
MW-32	11/14/91	Acetone	0.018	ND	ND	<1	<1	<1
		Methylene Chloride[5]	0.005	ND	ND	<1	<1	<1
Rinse Blank	11/14/91	Chloroform	0.002	ND	ND	<1	<1	<1
		Methylene Chloride[5]	0.007					

Notes:
[1] Chemical analyses conducted by Analytical Technologies, Inc. Laboratory reports for analyses conducted after March 1991 are included in Appendix C.
[2] Only analytes detected are listed.
[3] Duplicate of sample MW-28.
[4] Estimated value.
[5] Analyte also found in method blank.
All samples were analyzed for PCBs by EPA Method 8080. PCBs were not detected with one exception. PCB 1254 (0.00011 mg/l) was detected in MW-32.
Only analytes detected are listed.
mg/l = milligrams per liter
ND = not detected

APPENDIX F

SLUG TEST RECOVERY DATA

November 7, 1994

REMEDIATION TECHNOLOGIES INCORPORATED (RETEC)
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349
FAX (206) 624-2839

Ms. Barbara Trejo
Hydrogeologist, Toxics Cleanup Program
Washington Department of Ecology
3190 160th Ave SE
Bellevue, WA 98008-5452

RE: Slug Test Results for the Burlington Northern Railroad (BNRR) Maintenance and Fueling Facility, Skykomish, Washington

Dear Barbara:

This letter summarizes the slug test data collected from wells located at the BNRR Maintenance and Fueling Facility in Skykomish, Washington. Three shallow wells (MW5, MW36, MW40) and three deep wells (DW1, DW2, DW4) were identified in the *Sampling and Analysis Plan for the BNRR Maintenance and Fueling Facility* (SAP) for slug testing. Rising head slug tests were performed July 13 and 14, 1994 in these six wells to estimate the hydraulic conductivity of the unconfined aquifer. Data evaluation indicated that well MW40 did contain enough water to fully cover the slug, so the data was not used for the hydraulic conductivity calculations.

Each slug test was set up in the following manner. First, the pressure transducer was placed in the well. After transducer placement, the slug was lowered into the well and the water was allowed to equilibrate (equilibration was determined based on the transducer readings). After equilibration, the transducer was setup to record water levels and the slug was quickly removed from the well. This procedure was repeated several times in each well.

The recovery in each well was very rapid, as a result, limited data points were recorded for each slug test. Several test were conducted in each well and the best recovery data (i.e. most data points and best fit line) from each well was analyzed using Geraghty & Miller's AQTESOLV program. AQTESOLV uses Bouwer and Rice's method (1976) for evaluating slug tests. The program constructs a recovery plot of groundwater elevation change versus time on a semi-log graph and a straight line is fitted to the plotted points. Table 1 presents the slug test transducer data used for constructing the recovery plots. Based on input parameters and the recovery data the hydraulic conductivity is calculated. Table 2 presents the input parameters for the hydraulic conductivity calculations and Table 3 presents the calculated hydraulic conductivity for each well.

The recovery plots (Figures 1 through 5) generated by AQTESOLV indicate that the best fit data were collected from wells DW1, DW2 and MW5. Literature values for the corresponding aquifer material (gravel with sand or gravelly sand) support these results. Conversely, the plots for wells DW4 and MW36 were not the ideal straight line plots for slug tests, nor do the literature values agree with the values calculated from these plots.

The data from well DW4 were very erratic and a line does not fit well through the data points. The calculated hydraulic conductivity of 9.4 feet/day is low for the aquifer material, a gravelly sand. One potential explanation for the erratic data is that the slug was not able to clear the transducer wire in this well and the transducer was disturbed each time the slug was removed. Additionally, this well was a flush mount well and it was difficult to secure the transducer cord. The erratic response observed in Figure 3 was observed during all three tests performed on this well.

In the plot for well MW36, a double straight line effect was observed. Typically when this occurs, the first line is attributed to drainage of the gravel pack, while the second line is more indicative of the flow from the aquifer. Therefore, the second line is used to calculate the aquifer hydraulic conductivity. However, the calculated hydraulic conductivity of this well is lower than expected based on literature values for a fine sand with a layer of gravelly sand (as described in the well log). This result may be a local heterogeneity of the aquifer.

Based on the data from wells DW1, DW2 and MW5 the calculated hydraulic conductivity of the aquifer ranged from 41 to 84 feet/day with an average hydraulic conductivity of 64 feet/day.

If you have any questions or comments please contact Lena Blais or myself at (206) 624-9349 or Mr. David Seep, BNRR, at (913) 661-7015.

Sincerely,

REMEDIATION TECHNOLOGIES, INC.

Shelly S. Birch

Shelly S. Birch
Hydrogeologist

cc: D. Seep, BNRR
L. Blais, RETEC
H. Voges, RETEC
File No. 3-1161

TABLE 1
SLUG TEST TRANSDUCER DATA
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Well	Time[1] (minutes)	Depth[2] (feet)	Weighting Factor[3]
DW1	0.117	1.277	1
	0.133	0.812	1
	0.150	0.519	1
	0.187	0.173	1
	0.198	0.119	1
	0.208	0.086	1
	0.223	0.054	1
	0.235	0.043	1
	0.270	0.021	1
	0.282	0.021	1
	0.433	0.021	1
	0.633	0.021	1
DW2	0.065	2.598	1
	0.075	2.014	1
	0.090	1.624	1
	0.102	1.386	1
	0.137	0.844	1
	0.148	0.714	1
	0.160	0.617	1
	0.173	0.498	1
	0.185	0.422	1
	0.220	0.238	1
	0.232	0.205	1
	0.243	0.173	1
	0.258	0.140	1
	0.270	0.119	1
	0.305	0.065	1
	0.317	0.054	1
	0.328	0.043	1
	0.342	0.043	1
	0.353	0.032	1
	0.388	0.021	1
	0.400	0.021	1
	0.412	0.021	1
	0.427	0.021	1
	0.437	0.010	1
	0.603	0.010	1

TABLE 1 (Continued)
SLUG TEST TRANSDUCER DATA
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Well	Time[1] (minutes)	Depth[2] (feet)	Weighting Factor[3]
DW4	0.063	0.054	1
	0.075	0.173	1
	0.147	0.140	1
	0.158	0.194	1
	0.170	0.162	1
	0.185	0.054	1
	0.253	0.043	1
	0.268	0.086	1
	0.280	0.065	1
	0.363	0.021	1
	0.378	0.032	1
	0.393	0.032	1
MW5	0.073	1.147	1
	0.085	0.216	1
	0.098	0.075	1
	0.110	0.043	1
	0.145	0.021	1
	0.157	0.021	1
	0.168	0.010	1
	0.183	0.010	1
	0.195	0.010	1
	0.230	0.010	1
	0.242	0.010	1
MW36	0.068	2.999	0
	0.085	0.671	0
	0.120	0.184	1
	0.132	0.151	1
	0.147	0.140	1
	0.158	0.119	1
	0.170	0.108	1
	0.202	0.097	1
	0.237	0.086	1
	0.268	0.076	1
	0.320	0.065	1
	0.405	0.054	1
	0.537	0.043	1
	0.622	0.032	1
	0.772	0.021	1
	1.035	0.021	1

[1] Time after slug withdrawl.
[2] Difference between static water level and water level at that time.
[3] Weighting factor given to point in AQTESOLV (zero indicates that point was not considered in calculations).

TABLE 2
HYDRAULIC CONDUCTIVITY ESTIMATION – AQTESOLV (1989)
PARAMETERS FOR BOUWER–RICE METHOD
BNRR MAINTENANCE AND FUELING FACILITY – SKYKOMISH, WASHINGTON

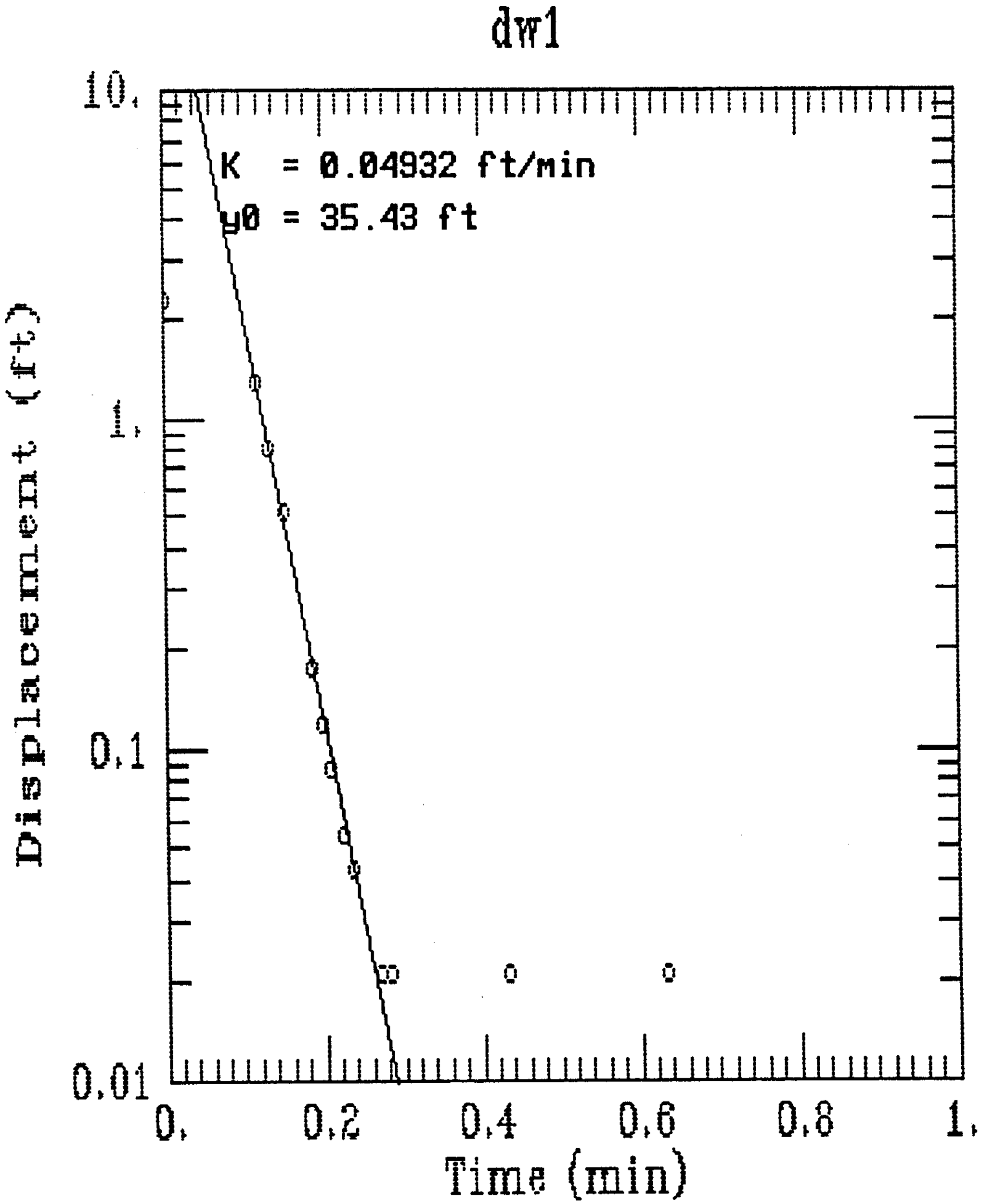
Parameter (feet)	DW1	DW2	DW4	MW5	MW36
Ho	2.274	2.663	0.194	2.055	4.429
Rc	0.083	0.083	0.083	0.083	0.083
Rw	0.25	0.25	0.25	0.25	0.25
D	50.0	50.0	50.0	50.0	50.0
L	5.0	5.0	5.0	10	15
H	23.68	33.01	37.58	7.76	15.54

Ho = Initial drawdown in well
Rc = Radius of well casing
Rw = Radius of well
D = Saturated thickness
L = Screen length
H = Height of water in well

TABLE 3
HYDRAULIC CONDUCTIVITY RESULTS
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH – WASHINGTON

Well	Hydraulic Conductivity feet/minute	feet/day
DW1	0.049	71
DW2	0.028	41
DW4	0.0066	9.4
MW5	0.058	84
MW36	0.0027	3.9

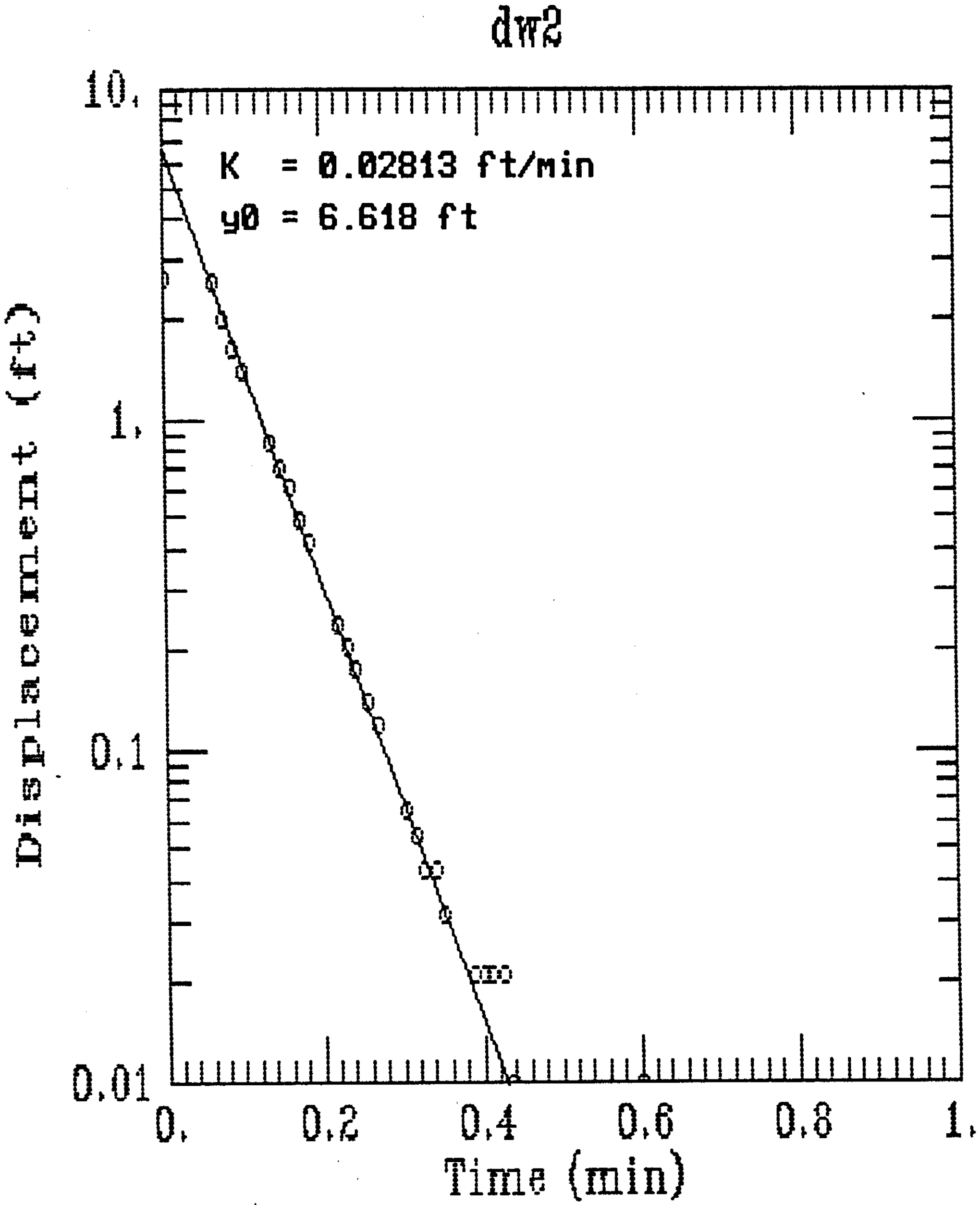
REIEC



AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

FIGURE 1

REIEC



AQTESOLV

GERAGHTY & MILLER, INC.

Modeling Group

FIGURE 2

REIEC

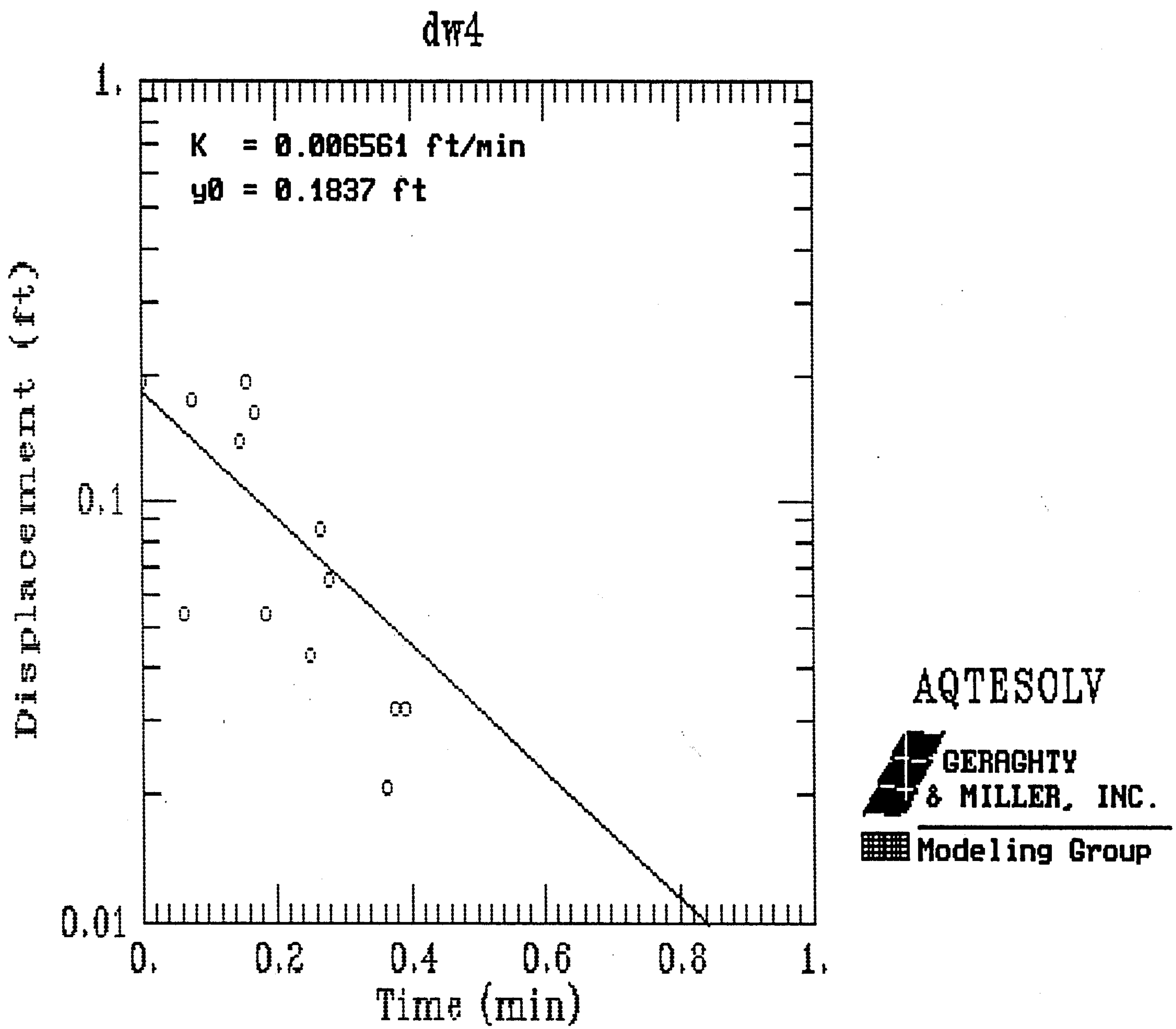
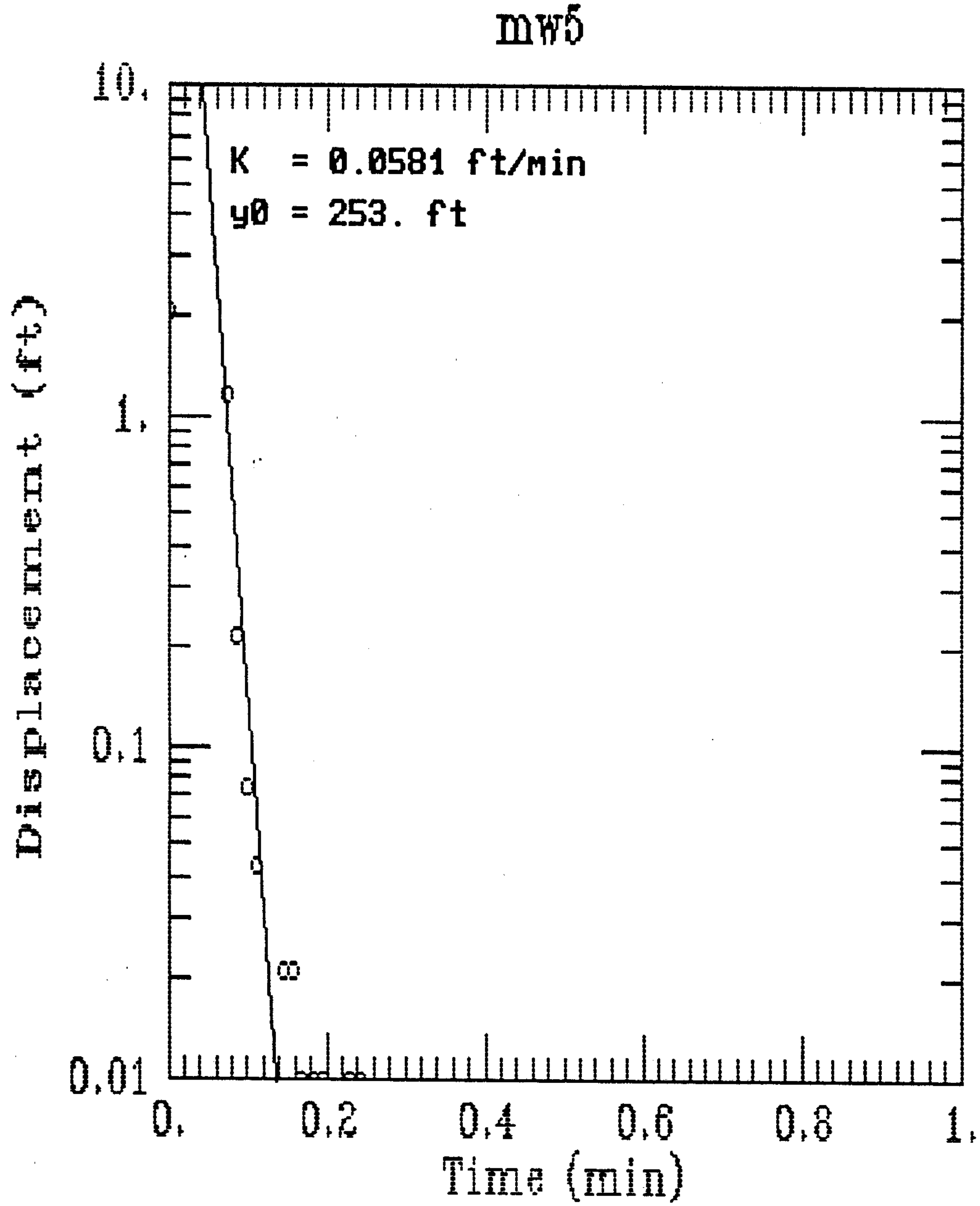


FIGURE 3

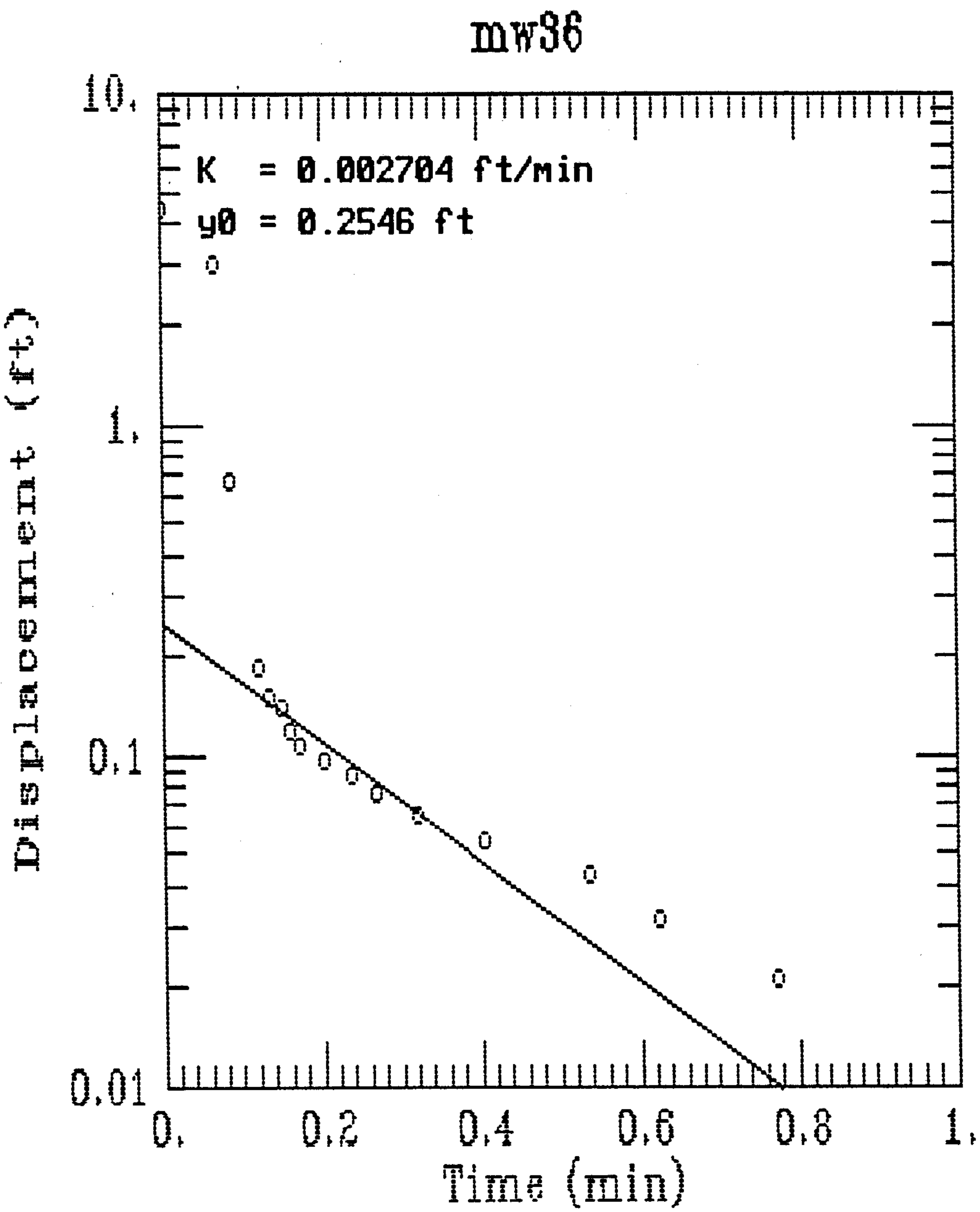
REIEC



AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

FIGURE 4

REIEC



AQTESOLV

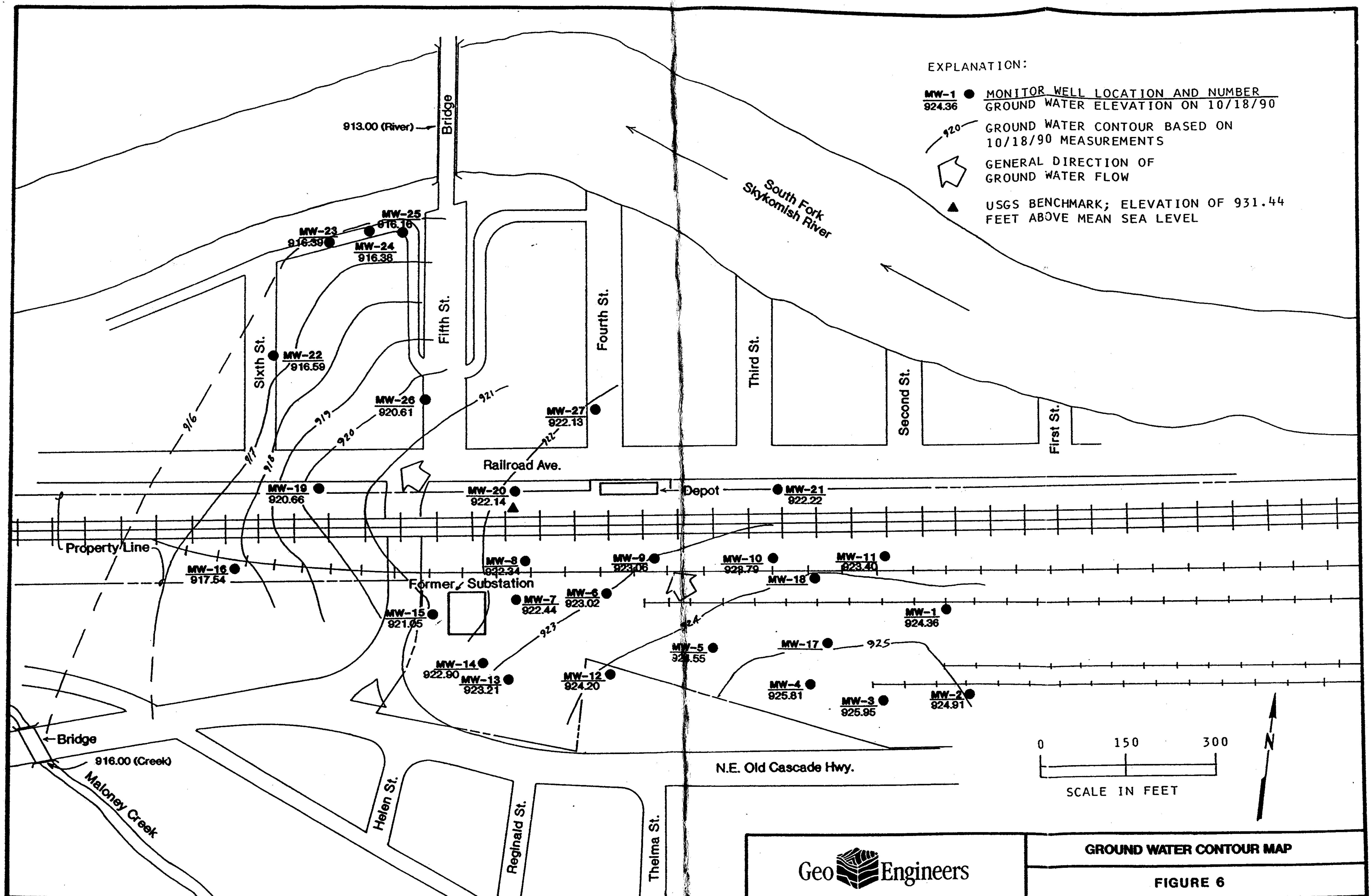
GERAGHTY & MILLER, INC.

Modeling Group

FIGURE 5

APPENDIX G

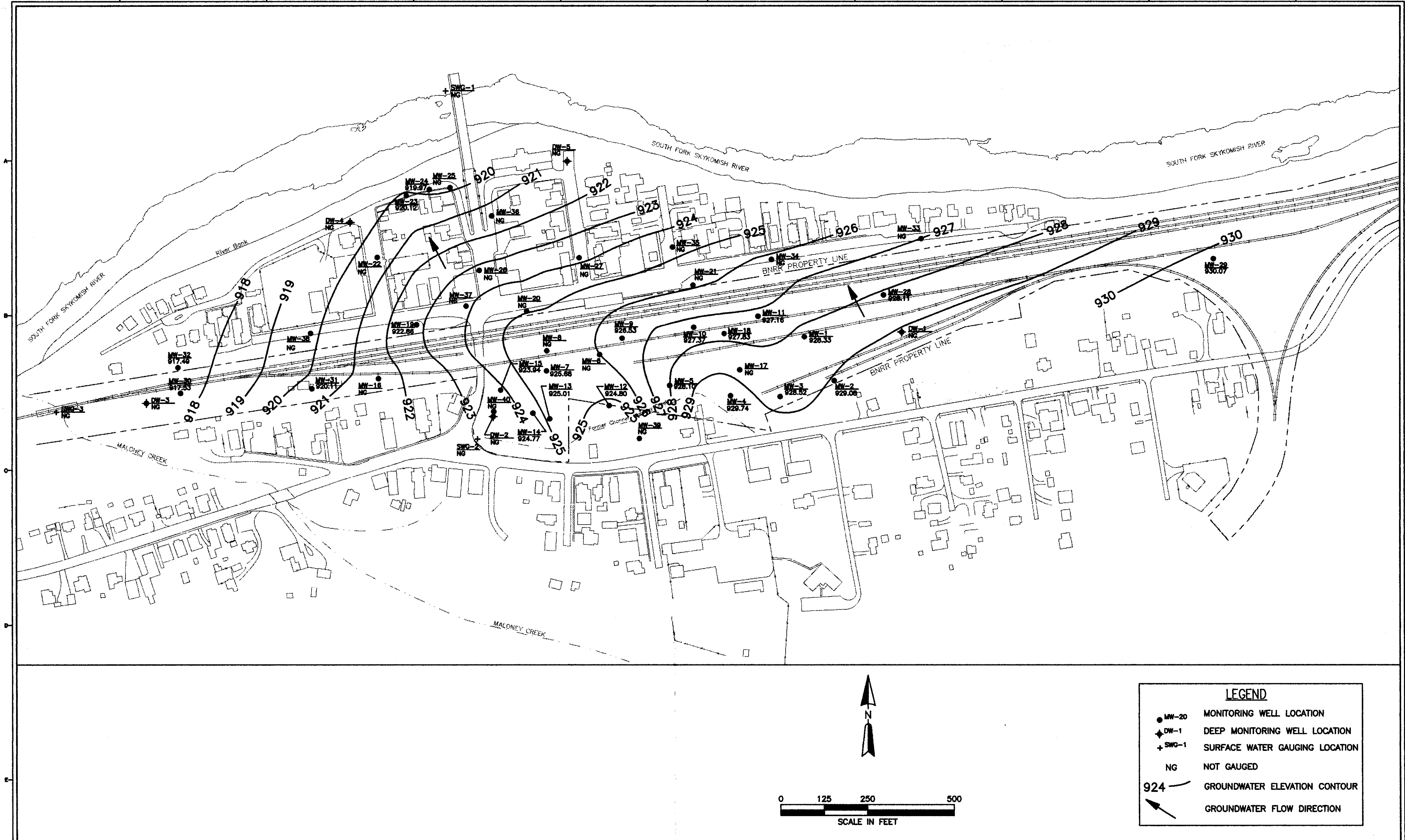
GROUNDWATER CONTOUR MAPS



GROUND WATER CONTOUR MAP

FIGURE 6

0506-16-B14 CRW:RRR 11-20-90



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		5							
		4							
		3							
		2							
		1							
		0	E.F.	2/16/95	INITIAL ISSUE				

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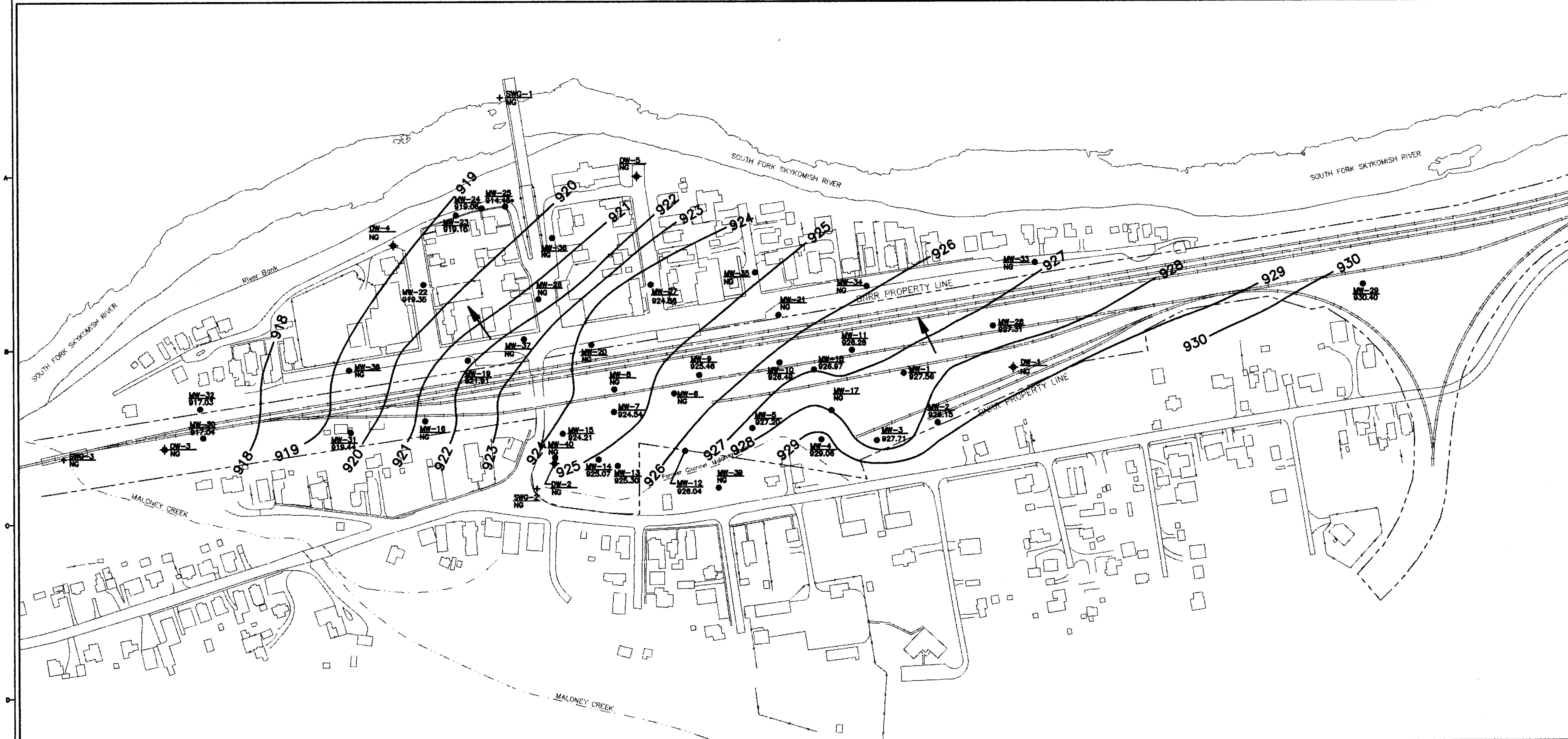
CURRENT DATE: 2/16/95 | CAD FILE 1161S44S

GROUNDWATER CONTOUR MAP
MAY 10, 1993

RETEC
REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE | REV 0



LEGEND

- ● MW-20 — MONITORING WELL LOCATION
- ✦ DW-1 — DEEP MONITORING WELL LOCATION
- + SWG-1 — SURFACE WATER GAUGING LOCATION
- NG — NOT GAUGED
- 924 — GROUNDWATER ELEVATION CONTOUR
- ↖ — GROUNDWATER FLOW DIRECTION

* WELLS WITH FREE PRODUCT AND ANOMALOUS WATER TABLE DATA. DATA NOT USED FOR DETERMINATION OF CONTOURS.

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
6							
5							
4							
3							
2							
1							
0	E.F.	2/16/96	INITIAL ISSUE				

REFERENCE DWG | DESCRIPTION

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GROUNDWATER CONTOUR MAP
JUNE 16, 1993

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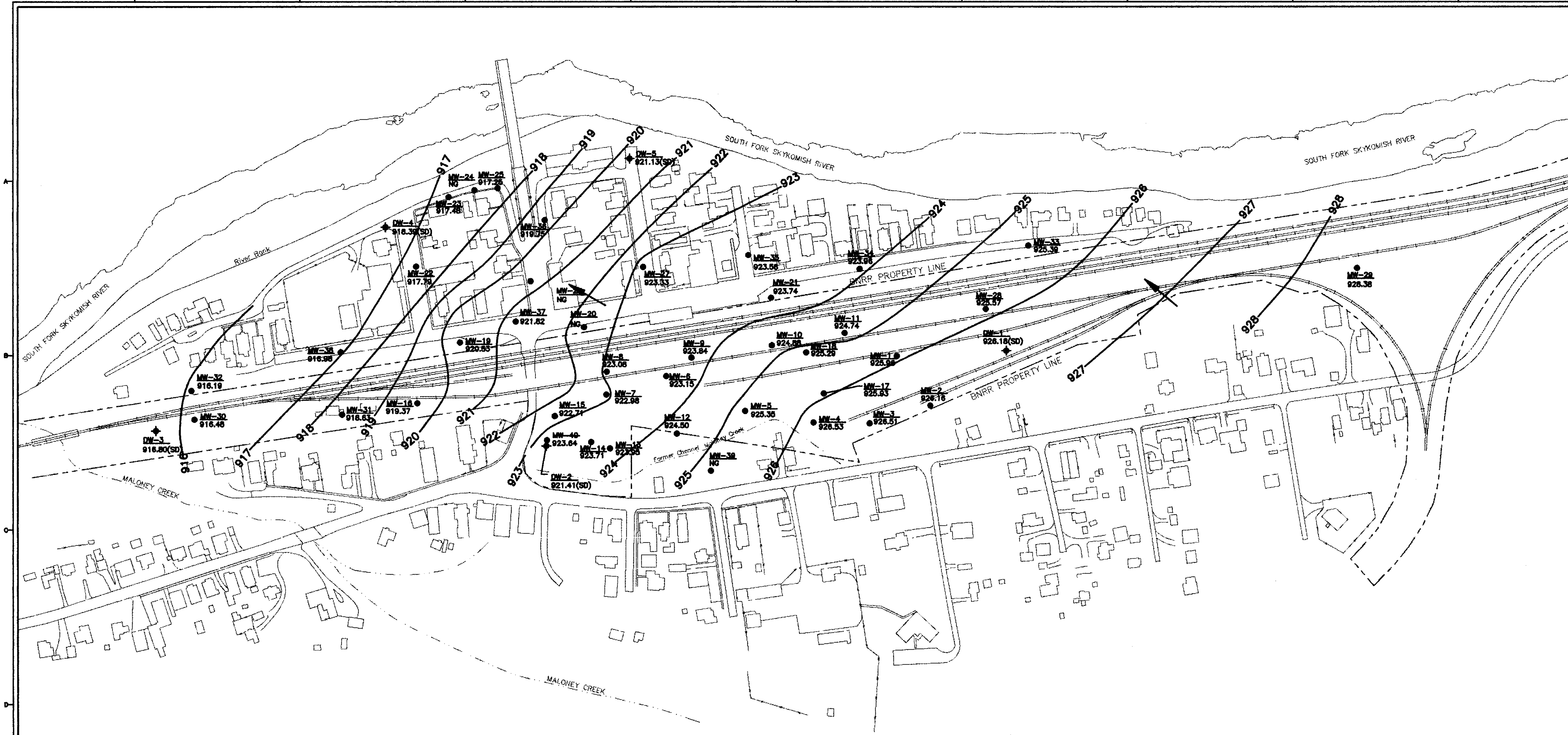

N

0 125 250 500
SCALE IN FEET

LEGEND

- MW-20 MONITORING WELL LOCATION
- DW-1 DEEP MONITORING WELL LOCATION
- (SD) WELL SCREENED DEEP–NOT USED FOR DETERMINATION OF CONTOURS
- NG NOT GAUGED
- 924 GROUNDWATER ELEVATION CONTOUR
- GROUNDWATER FLOW DIRECTION

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
6							
5							
4							
3							
2							
1							
0	E.F.	2/16/95	INITIAL ISSUE				

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GROUNDWATER CONTOUR MAP
NOVEMBER 1–3, 1993

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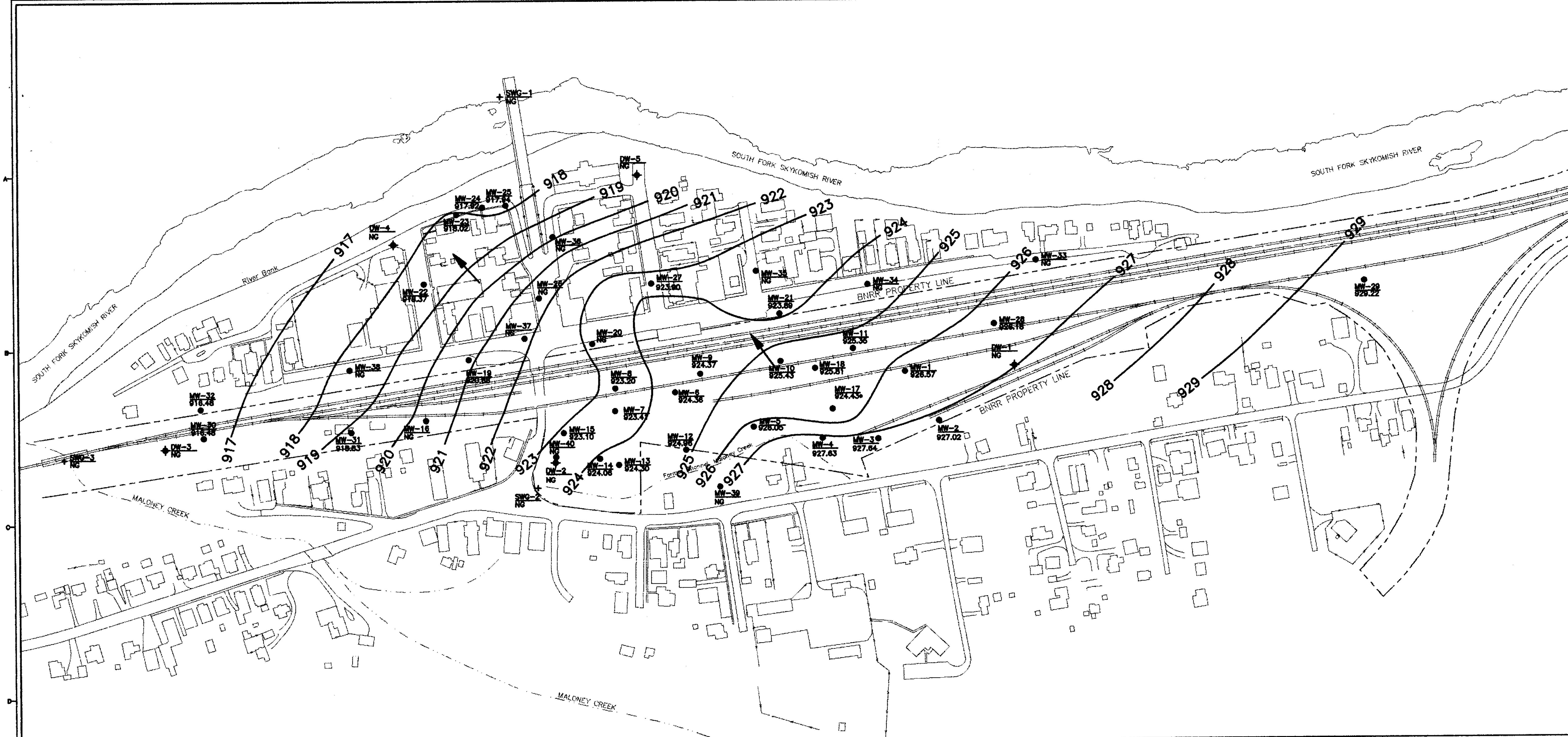

LEGEND

- ● MW-20 — MONITORING WELL LOCATION
- ✦ DW-1 — DEEP MONITORING WELL LOCATION
- + SWG-1 — SURFACE WATER GAUGING LOCATION
- NG — NOT GAUGED
- 924 — GROUNDWATER ELEVATION CONTOUR
- ↖ — GROUNDWATER FLOW DIRECTION

* WELLS WITH FREE PRODUCT AND ANOMALOUS WATER TABLE DATA. DATA NOT USED FOR DETERMINATION OF CONTOURS.

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
6							
5							
4							
3							
2							
1							
0	E.F.	2/16/95	INITIAL ISSUE				

REFERENCE DWG | DESCRIPTION

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GROUNDWATER CONTOUR MAP
JULY 15, 1993

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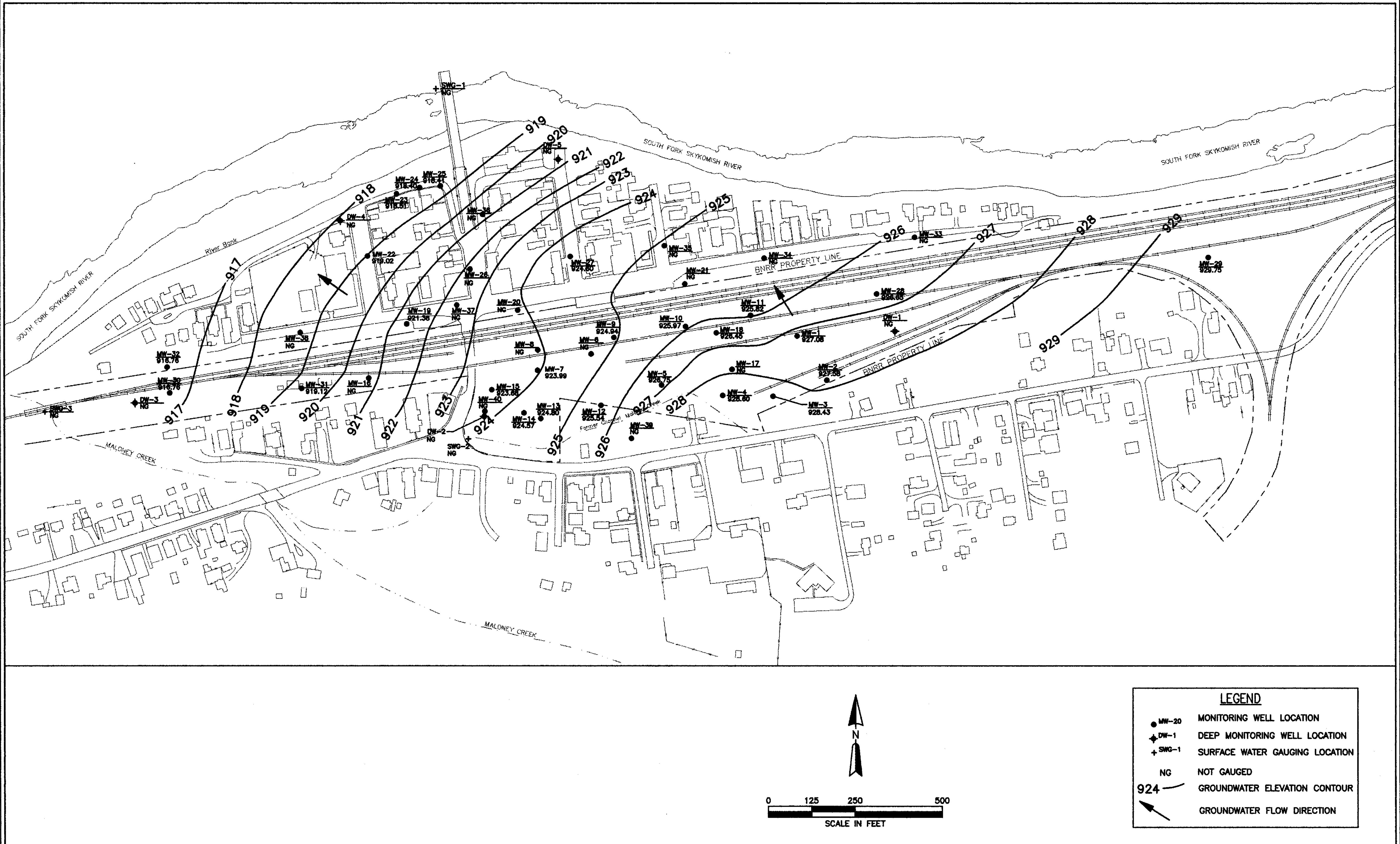
DRAWING NO. FIGURE | REV 0



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		5							
		4							
		3							
		2							
		1							
		0	E.F.	2/16/96	INITIAL ISSUE				

BNRR SKYKOMISH, WASHINGTON

3-1161-350

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CURRENT DATE: 2/16/96 | CAD FILE 1161S46S

GROUNDWATER CONTOUR MAP
JUNE 30, 1993

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE | REV. 0

APPENDIX H

RI GROUND AND SURFACE WATER LABORATORY AND QA/QC REPORTS

RETEC

1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349
FAX (206) 624-2839

DATA VALIDATION REPORT

TO: Shelly Birch
FROM: Kim Lofgren
DATE: September 8, 1994
RE: Review of Analytical Data

1.0 GENERAL

PROJECT:	BNRR Skykomish #3-1611-340
DATE SAMPLED:	08/02/94
RECEIVING LAB	Analytical Resources Inc.
ANALYTICAL METHODS:	Polynuclear Aromatic Hydrocarbons: SW846-8310
NUMBER OF SAMPLES:	11
MATRIX:	water
DATE(S) EXTRACTED:	all samples were extracted within the holding time limits
DATE(S) ANALYZED:	all samples were analyzed within the holding time limits

- Data validation summary tables are given as Attachment 1.
- Laboratory results with qualifiers are given as Attachment 2.
- All the samples and all of the Quality Assurance/Quality Control (QA/QC) in this data set have been reviewed with respect to holding times, method blanks, surrogate recoveries, matrix spikes, sample results, and any other QC measures (field blanks, lab blank spikes, field duplicates, etc.).

2.0 VALIDITY AND COMMENTS

This section summarizes only those instances where acceptance criteria were not met or a discussion of the data were warranted.

2.1 GENERAL COMMENTS

The objectives of this review were to determine the quality of the analytical data by examining the level of precision, accuracy, and completeness. The accuracy of data is the degree of agreement of a measurement with an accepted reference or true value. The level of accuracy is determined by examination of laboratory matrix spike analyses. Precision is a measure of the mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is determined through analysis of duplicate samples. Completeness is a determined by assessing the number of samples where valid results are reported versus the number of samples which were submitted to the laboratory for analysis. The overall measure of completeness will be the ratio of valid analyses received compared to the expected amount of data to be obtained under correct or normal conditions.

Quality Assurance/Quality Control (QA/QC) for this project included specific criteria by which precision, accuracy, and completeness were evaluated. Precision, is measured through the evaluation of field QA/QC including duplicate analysis and analysis of field and trip blanks. Evaluation of duplicate samples for precision was done using the relative percent difference (RPD). RPD is defined as the difference between two duplicate samples divided by the mean and expressed as a percent. The criteria for acceptable RPD is 0-20% for water samples.

Laboratory QC, which evaluates accuracy, involves using a method blank (reagent blank) for approximately 20 actual samples, a matrix spike/matrix spike duplicate (MS/MSD) for approximately one out of every 20 samples, and analysis of surrogate standards for organic analyses. Method blanks are analyzed to identify compounds which are introduced during the laboratory extraction or analysis phase (i.e. laboratory contaminants). MS/MSD percent recoveries and relative percent differences (RPD) reported are compared to published QC limits. Surrogates are compounds that are "like" the compounds requested for analysis, but not structurally the same. They are analyzed to demonstrate that structurally similar compounds can be recovered and quantified by the lab. The completeness goal is set at 90%. The laboratory data showing the raw analytical data, the sample data results and all QA/QC backup data is found in Attachment 2.

All appropriate data were found in the raw data, the forms provided, or the narrative part of the report from Analytical Resources, Inc. (ARI). The amount extracted, dilution factor and amount analyzed was included for all of the samples in this data set. Table 1-1 provides a summary of the groundwater data. Parameters identified in the QA/QC review as outside the control limits are shaded.

2.2 HOLDING TIMES

The times and dates for sampling were taken from RETEC's Chain of Custody (COC). The dates for extraction and analyses were taken from the ARI organic analysis data sheets.

For the purpose of this review, the holding times stated in SW-846 were used to qualify data. All samples met the holding time requirements for the preparation type requirements unless otherwise stated in the appropriate analysis section of the report.

2.3 POLYNUCLEAR AROMATIC HYDROCARBONS - ANALYSIS OF WATER

Eleven water samples were reviewed for polynuclear aromatic hydrocarbons (PAH) validity in this data set.

2.3.1 Method Blank and Field Blank

Method Blank - One method blank was extracted and analyzed with the PAH samples. Target analytes were not detected in the method blank associated with these samples.

Field Blank - One field blank (MW-100) was extracted and analyzed with the PAH samples. Table 2-1 summaries the results of the field blank. No target analytes were detected in the field blank.

2.3.2 Surrogate Recovery

Percent surrogate Recoveries (%R) for diphenyl and terphenyl were reported with each sample on the Organic Analysis Data Sheet. Sample MW-11 had one surrogate recovery for diphenyl below the acceptable control limit of 43%. The %R for diphenyl was 7.4%. The positive results for MW-11 have been qualified with a "J" qualifier (the associate numerical value is an estimated quantity) based on the poor surrogate recovery. All other samples were within the acceptable control limits of 43-144% for diphenyl and 54-160% for terphenyl.

2.3.3 Blank Spike (BS)

One blank spike (BS) report was submitted with this data set. The BS recoveries values were within control limits 32-121% for acenaphthene, 48-125% for flouranthene, and 55-115% for benzo(a)anthracene.

2.3.4 Field and Laboratory Duplicates

One field duplicate was included in this data set; however, was not labelled as such by RETEC personnel. Sample MW-23B is a field duplicate of MW-23. Table 2-2 summarizes the Relative Percent Difference (RPD) for this sample and the corresponding duplicate.

Laboratory duplicates were not included in this sample set.

2.3.5 Overall Assessment of Data

The quantity of water extracted, the amounts analyzed and the dilution factors were included in this data set for all of the samples. All compounds were reviewed based on the detection limits, the method blank, the field blank, the field duplicate, the surrogate recoveries, and the BS recoveries. All data were found to be accurate based on the information given.

Field accuracy and precision have been determined acceptable based on the field blank and the field duplicate.

Laboratory accuracy and precision have been determined acceptable based on the method blank, the surrogate recoveries, and the BS recoveries.

2.4 CONCLUSION

Completeness is determined by assessing the number of samples where valid results were reported versus the number of samples which were submitted to the laboratory for analysis. The overall completeness goal is to achieve 90% valid data. All samples were considered usable therefore a completeness goal of 100% was met for the polynuclear aromatic hydrocarbon analysis.

For field QA/QC, a completeness goal of 100% was also obtain for the duplicate analysis and the field blank. One field duplicate and one field blank sample was included with the eleven samples submitted for analysis. Since, disposable bailers were used instead of non disposable bailers decontamination blanks were not warranted.

For laboratory QA/QC, a completeness goal 90% was achieved for the method blank, the surrogate recoveries, and the BS recoveries. A Method blank and blank spike was extracted and analyzed for the 11 samples for PAH analysis. All BS recoveries were within control limits for all analyses. Analytes not were detected in the method blank. Surrogate recoveries were analyzed with every sample. Only one surrogate recovery was outside control limits.

Explanation of qualifiers:

"J" = The associated numerical value is an estimated quantity.

References

EPA,1988. laboratory Data Validation Functional Guidelines For Evaluating Organics Analyses.
Prepared by The USEPA Data Review Work Group.

TABLE 1-1

BNRR SKYKOMISH
WATER DATA VALIDATION
THIRD QUARTER - AUGUST 1994
ARI LABORATORY

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
MW-11	08/02/94	PAH (8310)	1 Surrogate below QC limits, %R for diphenyl = 7.4% All positive results qualified with "J" qualifier
MW-12	08/02/94	PAH (8310)	Surrogates w/in QC limits
MW-28	08/02/94	PAH (8310)	Surrogates w/in QC limits
MW-5	08/02/94	PAH (8310)	Surrogates w/in QC limits
MW-9	08/02/94	PAH (8310)	Surrogates w/in QC limits
MW-37	08/02/94	PAH (8310)	Surrogates w/in QC limits
MW-100 Field Blank	08/02/94	PAH (8310)	Surrogates w/in QC limits
MW-23	08/02/94	PAH (8310)	Surrogates w/in QC limits
MW-23B Duplicate of MW-23	08/02/94	PAH (8310)	Surrogates w/in QC limits
MW-36	08/02/94	PAH (8310)	Surrogates w/in QC limits
SW-5	08/02/94	PAH (8310)	Surrogates w/in QC limits
Method Blank	08/08/94	PAH (8310)	Surrogates w/in QC limits
BS	08/08/94	PAH (8310)	Surrogates w/in QC limits BS - %Rs within QC limits

BS - Blank Spike
%R - Percent recovery
PAH - Polynuclear aromatic hydrocarbons
QA - Quality assurance
QC - Quality control

TABLE 2-1

THIRD QUARTER
PAH QA/QC ANALYTICAL RESULTS – WATER
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Sample ID: Lab Sample ID: Sample Date:		MW-23 H968H 08/02/94	MW-23B (MW-23 Dup) H968I 08/02/94	RPD [1] MW-23 MW-23B 08/02/94	MW-100 Field Blank H968G 08/02/94	Method Blank H968MB NA
<u>PAH (EPA 8310)</u>						
Naphthalene	µg/L	< 1.8	< 1.8	NC	< 1.8	< 1.8
Acenaphthylene	µg/L	< 2.3	< 2.3	NC	< 2.3	< 2.3
Acenaphthene	µg/L	< 1.8	< 1.8	NC	< 1.8	< 1.8
Fluorene	µg/L	< 0.21	< 0.21	NC	< 0.21	< 0.21
Phenanthrene	µg/L	< 0.64	< 0.64	NC	< 0.64	< 0.64
Anthracene	µg/L	< 0.66	< 0.66	NC	< 0.66	< 0.66
Fluoranthene	µg/L	< 0.21	< 0.21	NC	< 0.21	< 0.21
Pyrene	µg/L	< 0.27	< 0.27	NC	< 0.27	< 0.27
Benzo(a)anthracene	µg/L	< 0.020	< 0.020	NC	< 0.020	< 0.020
Chrysene	µg/L	< 0.15	< 0.15	NC	< 0.15	< 0.15
Benzo(b)fluoranthene	µg/L	< 0.020	< 0.020	NC	< 0.020	< 0.020
Benzo(k)fluoranthene	µg/L	< 0.020	< 0.020	NC	< 0.020	< 0.020
Benzo(a)pyrene	µg/L	< 0.030	< 0.030	NC	< 0.030	< 0.030
Dibenz(a,h)anthracene	µg/L	< 0.030	< 0.030	NC	< 0.030	< 0.030
Benzo(g,h,i)perylene	µg/L	< 0.080	< 0.080	NC	< 0.080	< 0.080
Indeno(1,2,3-cd)pyrene	µg/L	< 0.050	< 0.050	NC	< 0.050	< 0.050

PAH – Polynuclear aromatic hydrocarbon compounds
QA – Quality assurance
QC – Quality control
NC – Not calculated
1. Relative percent difference = absolute value of $((X_1 - X_2)/(X_1 + {}_2)*1/2)*100$
where X_1 is the concentration of the orginal sample, and X_2 is the concentration of the duplicate sample.

ATTACHMENT 1

ORGANIC DATA ASSESSMENT

LABORATORY: ARI
SITE: BN-SKYKOMISH
NO. OF SAMPLE/MATRIX: 11 Groundwater
REVIEWER'S NAME: Kim Lofgren

DATA ASSESSMENT SUMMARY

	PAH (8310)
HOLDING TIMES	O
CALIBRATIONS	NA
BLANKS	O
SURROGATES	O — mw-11 %R for diphenyl 7.4%
MATRIX SPIKE/DUP	O
OTHER QC	O
INTERNAL STANDARDS	NA
COMPOUND IDENTIFICATION	O
SYSTEM PERFORMANCE	NA
OVERALL ASSESSMENT	O

O=DATA HAD NO PROBLEMS/OR QUALIFIED DUE TO MINOR PROBLEMS.
M=DATA QUALIFIED DUE TO MAJOR PROBLEMS.
Z=DATA UNACCEPTABLE.
X=PROBLEMS, BUT DO NOT AFFECT DATA.
NA= NOT AVAILABLE

ACTION ITEMS: mw-11 all positive results qualified with "J" qualified due to poor surrogate recovery.

AREAS OF CONCERN:

NOTABLE PERFORMANCE:

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

ANALYSIS AND EXTRACTION DATE/HOLDING TIMES

PROJECT: BN Skykomish
PROJECT #: 3-11612
SAMPLE MATRIX: Groundwater
PAGE 1 **of** 1

			PAH (8310)	
Sample Number	**Lab Number**	**Sample Date**	**Extract**	**Analyzed**
MW-11	H968A	08/02/94	08/08/94	08/19/94
MW-12	H968B	08/02/94	08/08/94	08/22/94
MW-8B	H968C	08/02/94	08/08/94	08/22/94
MW-5	H968D	08/02/94	08/08/94	08/19/94
MW-9	H968E	08/02/94	08/08/94	08/19/94
MW-37	H968F	08/02/94	08/08/94	08/19/94
MW-100	H968G	08/02/94	08/08/94	08/19/94
MW-23	H968H	08/02/94	08/08/94	08/19/94
MW-23B	H968I	08/02/94	08/08/94	08/20/94
MW-36	H968J	08/02/94	08/08/94	08/22/94
SW-5	H968K	08/02/94	08/08/94	08/19/94

ATTACHMENT 2

Analytical Resources, Incorporated
Analytical Chemists and Consultants

07 September 1994

Shelly Birch
Remediation Technologies Inc.
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134

RE: Client Project: 3-1161-320 BN-Skykomish;
ARI Project: #H968

Dear Ms. Birch,

Please find enclosed the original chain-of-custody record (COC) and results for the above referenced project. Eleven water samples were received on 8/3/94, in good condition. There were no discrepancies between the COC and sample containers, and the analysis was initiated without incident of note. These reports were faxed to you earlier today.

Samples **28** and **9** required analysis at dilution based on results of a pre-extraction screen. Note that there are compounds with raised detection limits on the reports for samples **11**, **12**, and **9**, denoted with the "Y" qualifier. These compounds are undetected at the levels shown; the limits had to be raised due to matrix interferences.

There were no samples designated, nor was any extra volume supplied, to perform QC analyses. Sample **11** was extracted as a three-way split for a matrix spike and matrix spike duplicate (MS/MSD), however the surrogate recoveries were extremely variable due to the oily nature of the matrix. Only the unspiked sample results are reported, as they are most representative of the sample. Note that the surrogate recoveries are low for this sample; there was no sample volume remaining to perform a re-extraction. A Laboratory Control Sample was extracted and analyzed with these samples, and the recoverys reported, to provide QC documentation for the project.

A copy of this package will be kept on file with ARI should you require any further information or copies of additional documentation. If you have any questions please feel free to call any time.

Sincerely,
ANALYTICAL RESOURCES, INC.

Kate Stegemoeller

Kate Stegemoeller
Project Manager
206-340-2866, ext. 117

Enclosures
cc: file #H968

333 Ninth Avenue North • Seattle WA 98109-5187 • **206-621-6490** • **206-621-7523** fax

7212

CHAIN OF CUSTODY RECORD

H968

PROJ. NO.: 3-1161

PROJECT NAME: BN - Skykomish

SAMPLERS: D. Kinney

RECEIVING LABORATORY: ARI

SEND RESULTS TO: Shelly Birch

Cooler Temps: 7.0, 7.5°C

LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS	PAH (Method 8310)						REMARKS
	8/2/94	1130	11	1	X						
	↓	1155	12	1	X						
	↓	1400	28	1	X						
	↓	1450	5	1	X						
	↓	1520	9	1	X						
	↓	1640	37	1	X						
	↓	1655	100	1	X						
	↓	1720	23	1	X						
	↓	1725	23 B	1	X						
	↓	1820	36	1	X						
	↓	1830	SW-5	1	X						

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
D. W. Kinney	8/3/94 / 1715				

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time
		Shelby Miller	8/3/94 / 17:15

Shipper Information

RETEC
REMEDIATION TECHNOLOGIES INC

REMEDIATION TECHNOLOGIES
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PINK COPY - Sampler   YELLOW COPY - Laboratory   WHITE COPY - ReTeC

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Facsimile

Date of transmittal:	09/19/94	Time:	11:15
Addressee:	**Kim Lofgren**	Fax No:	(206) 624-2839
Company:	Retec	Phone No:	(206) 624-9349
From:	Kate Stegemoeller	Fax No:	(206) 621-7523
Number of pages: (including this cover page)	1	Phone No:	(206) 621-6490

If you do not receive the number of pages indicated, please contact sender at ARI immediately.

Message

Kim,

Here are the PQL's for 8310 PNAs. Note that for a few compounds the PQLs and reporting limits are the same.

Naphthalene	5.0
Acenaphthylene	6.0
Acenaphthene	5.0
Phenanthrene	0.64
Anthracene	0.66
Fluoranthene	0.21
Pyrene	0.27
Benzo(a)anthracene	0.050
Chrysene	0.15
Benzo(b)fluoranthene	0.060
Benzo(k)fluoranthene	0.060
Benzo(a)pyrene	0.070
Dibenzo(a,h)anthracene	0.090
Benzo(ghi)perylene	0.20
Indeno(123-cd)pyrene	0.15

0.64? Fluorene?

Mark:
Kate sent this yesterday, however no PQL for Fluorene. Please let me know PQL value
Thanks
Kim

333 Ninth Avenue North • Seattle WA 98109-5187 • **206-621-6490** • **206-621-7523** fax

ANALYTICAL RESOURCES INCORPORATED

Analytical Chemists & Consultants

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Seattle, WA 98109-5187
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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: Method Blank

Lab Sample ID: H968MB
LIMS ID: 94-12760
Matrix: Water

QC Report No: H968-Remediation Technologies, Inc.
Project: BN-Skykomish
3-1161
Date Sampled: NA
Date Received: NA

Data Release Authorized: Sheri L Brown
Reported: 09/06/94

Date extracted: 08/08/94
Date analyzed: 08/19/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L
91-20-3	Naphthalene	1.8 U
83-32-9	Acenaphthylene	2.3 U
208-96-8	Acenaphthene	1.8 U
86-73-7	Fluorene	0.21 U
85-01-8	Phenanthrene	0.64 U
120-12-7	Anthracene	0.66 U
206-44-0	Fluoranthene	0.21 U
129-00-0	Pyrene	0.27 U
56-55-3	Benzo(a)anthracene	0.020 U
218-01-9	Chrysene	0.15 U
205-99-2	Benzo(b)fluoranthene	0.020 U
207-08-9	Benzo(k)fluoranthene	0.020 U
50-32-8	Benzo(a)pyrene	0.030 U
53-70-3	Dibenzo(a,h)anthracene	0.030 U
191-24-2	Benzo(g,h,i)perylene	0.080 U
193-39-5	Indeno(1,2,3-cd)pyrene	0.050 U

Surrogate Recoveries

Diphenyl	60.1%
Terphenyl	71.9%

Data Qualifiers

U	Indicates compound was analyzed for, but not detected at the given detection limit.
J	Indicates an estimated value when that result is less than the calculated detection limit.
E	Indicates a value above the linear range of the detector. Dilution Required
S	Indicates no value reported due to saturation of the detector.
D	Indicates the surrogate was diluted out.
B	Found in associated method blank.
Y	Indicates a raised detection limit due to matrix interference.
NA	Indicates compound was not analyzed.
NR	Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 11

Lab Sample ID: H968A
LIMS ID: 94-12760
Matrix: Water

QC Report No: H968-Remediation Technologies, Inc.
Project: BN-Skykomish
3-1161
Date Sampled: 08/02/94
Date Received: 08/03/94

Data Release Authorized: Sherri L Brown
Reported: 09/06/94

Date extracted: 08/08/94
Date analyzed: 08/19/94
Sample Amount: 330 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L	
91-20-3	Naphthalene	5.5	U
83-32-9	Acenaphthylene	7.0	U
208-96-8	Acenaphthene	5.5	U
86-73-7	Fluorene	1.2	Y J
85-01-8	Phenanthrene	3.8	Y J
120-12-7	**Anthracene**	**1.2**	**J** J
206-44-0	**Fluoranthene**	**52**	J
129-00-0	Pyrene	3.0	Y J
56-55-3	**Benzo(a)anthracene**	**0.61**	J
218-01-9	Chrysene	0.45	U
205-99-2	Benzo(b)fluoranthene	0.061	U
207-08-9	Benzo(k)fluoranthene	0.061	U
50-32-8	Benzo(a)pyrene	0.091	U
53-70-3	Dibenzo(a,h)anthracene	0.091	U
191-24-2	Benzo(g,h,i)perylene	0.24	U
193-39-5	Indeno(1,2,3-cd)pyrene	0.15	U

Surrogate Recoveries

Diphenyl	7.4%
Terphenyl	34.1%

Data Qualifiers

U Indicates compound was analyzed for, but not detected at the given detection limit.
J Indicates an estimated value when that result is less than the calculated detection limit.
E Indicates a value above the linear range of the detector. Dilution Required
S Indicates no value reported due to saturation of the detector.
D Indicates the surrogate was diluted out.
B Found in associated method blank.
Y Indicates a raised detection limit due to matrix interference.
NA Indicates compound was not analyzed.
NR Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 12

Lab Sample ID: H968B
LIMS ID: 94-12761
Matrix: Water

QC Report No: H968-Remediation Technologies, Inc.
Project: BN-Skykomish
3-1161
Date Sampled: 08/02/94
Date Received: 08/03/94

Data Release Authorized: Sherri L Brown
Reported: 09/06/94

Date extracted: 08/08/94
Date analyzed: 08/22/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L	
91-20-3	Naphthalene	1.8	U
83-32-9	Acenaphthylene	2.3	U
208-96-8	Acenaphthene	1.8	U
86-73-7	Fluorene	0.21	U
85-01-8	Phenanthrene	0.64	U
120-12-7	Anthracene	0.66	U
206-44-0	Fluoranthene	0.50	Y
129-00-0	Pyrene	0.27	U
56-55-3	**Benzo(a)anthracene**	**0.10**	
218-01-9	Chrysene	0.15	U
205-99-2	Benzo(b)fluoranthene	0.20	Y
207-08-9	Benzo(k)fluoranthene	0.020	U
50-32-8	Benzo(a)pyrene	0.20	Y
53-70-3	**Dibenzo(a,h)anthracene**	**0.080**	
191-24-2	Benzo(g,h,i)perylene	0.080	U
193-39-5	**Indeno(1,2,3-cd)pyrene**	**0.20**	

Surrogate Recoveries

Diphenyl	56.4%
Terphenyl	67.5%

Data Qualifiers

U	Indicates compound was analyzed for, but not detected at the given detection limit.
J	Indicates an estimated value when that result is less than the calculated detection limit.
E	Indicates a value above the linear range of the detector. Dilution Required
S	Indicates no value reported due to saturation of the detector.
D	Indicates the surrogate was diluted out.
B	Found in associated method blank.
Y	Indicates a raised detection limit due to matrix interference.
NA	Indicates compound was not analyzed.
NR	Indicates no recovery due to interferences.

ANALYTICAL RESOURCES INCORPORATED

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 28

Lab Sample ID: H968C
LIMS ID: 94-12762
Matrix: Water

QC Report No: H968-Remediation Technologies, Inc.
Project: BN-Skykomish
3-1161
Date Sampled: 08/02/94
Date Received: 08/03/94

Data Release Authorized: Sheri L Brown
Reported: 09/06/94

Date extracted: 08/08/94
Date analyzed: 08/22/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:10

CAS Number	Analyte	ug/L	
91-20-3	Naphthalene	18	U
83-32-9	Acenaphthylene	23	U
208-96-8	Acenaphthene	18	U
86-73-7	Fluorene	2.1	U
85-01-8	Phenanthrene	6.4	U
120-12-7	Anthracene	6.6	U
206-44-0	**Fluoranthene**	**16**	
129-00-0	Pyrene	2.7	U
56-55-3	**Benzo(a)anthracene**	**2.0**	
218-01-9	Chrysene	1.5	U
205-99-2	Benzo(b)fluoranthene	0.20	U
207-08-9	Benzo(k)fluoranthene	0.20	U
50-32-8	Benzo(a)pyrene	0.30	U
53-70-3	Dibenzo(a,h)anthracene	0.30	U
191-24-2	Benzo(g,h,i)perylene	0.80	U
193-39-5	Indeno(1,2,3-cd)pyrene	0.50	U

Surrogate Recoveries

Diphenyl	62.0%
Terphenyl	123%

Data Qualifiers

U Indicates compound was analyzed for, but not detected at the given detection limit.
J Indicates an estimated value when that result is less than the calculated detection limit.
E Indicates a value above the linear range of the detector. Dilution Required
S Indicates no value reported due to saturation of the detector.
D Indicates the surrogate was diluted out.
B Found in associated method blank.
Y Indicates a raised detection limit due to matrix interference.
NA Indicates compound was not analyzed.
NR Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 5

Lab Sample ID: H968D
LIMS ID: 94-12763
Matrix: Water

QC Report No: H968-Remediation Technologies, Inc.
Project: BN-Skykomish
3-1161
Date Sampled: 08/02/94
Date Received: 08/03/94

Data Release Authorized: Sheri L Brown
Reported: 09/06/94

Date extracted: 08/08/94
Date analyzed: 08/19/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L	
91-20-3	Naphthalene	1.8	U
83-32-9	Acenaphthylene	2.3	U
208-96-8	Acenaphthene	1.8	U
86-73-7	**Fluorene**	**0.20**	**J**
85-01-8	Phenanthrene	0.64	U
120-12-7	**Anthracene**	**0.50**	**J**
206-44-0	**Fluoranthene**	**0.15**	**J**
129-00-0	Pyrene	0.27	U
56-55-3	**Benzo(a)anthracene**	**0.10**	
218-01-9	Chrysene	0.15	U
205-99-2	Benzo(b)fluoranthene	0.020	U
207-08-9	Benzo(k)fluoranthene	0.020	U
50-32-8	Benzo(a)pyrene	0.030	U
53-70-3	Dibenzo(a,h)anthracene	0.030	U
191-24-2	Benzo(g,h,i)perylene	0.080	U
193-39-5	Indeno(1,2,3-cd)pyrene	0.050	U

Surrogate Recoveries

Diphenyl	64.9%
Terphenyl	74.8%

Data Qualifiers

U Indicates compound was analyzed for, but not detected at the given detection limit.
J Indicates an estimated value when that result is less than the calculated detection limit.
E Indicates a value above the linear range of the detector. Dilution Required
S Indicates no value reported due to saturation of the detector.
D Indicates the surrogate was diluted out.
B Found in associated method blank.
Y Indicates a raised detection limit due to matrix interference.
NA Indicates compound was not analyzed.
NR Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 9

Lab Sample ID: H968E
LIMS ID: 94-12764
Matrix: Water

QC Report No: H968-Remediation Technologies, Inc.
Project: BN-Skykomish
3-1161
Date Sampled: 08/02/94
Date Received: 08/03/94

Data Release Authorized: Sheri L Brown
Reported: 09/06/94

Date extracted: 08/08/94
Date analyzed: 08/19/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:10

CAS Number	Analyte	ug/L	
91-20-3	Naphthalene	18	U
83-32-9	Acenaphthylene	23	U
208-96-8	Acenaphthene	18	U
86-73-7	Fluorene	2.1	U
85-01-8	Phenanthrene	6.4	U
120-12-7	Anthracene	6.6	U
206-44-0	Fluoranthene	2.1	U
129-00-0	Pyrene	2.7	U
56-55-3	**Benzo(a)anthracene**	**3.0**	
218-01-9	**Chrysene**	**2.0**	
205-99-2	Benzo(b)fluoranthene	0.20	U
207-08-9	Benzo(k)fluoranthene	0.20	U
50-32-8	Benzo(a)pyrene	0.30	U
53-70-3	Dibenzo(a,h)anthracene	0.30	U
191-24-2	Benzo(g,h,i)perylene	0.80	U
193-39-5	Indeno(1,2,3-cd)pyrene	0.50	Y

Surrogate Recoveries

Diphenyl	79.1%
Terphenyl	129%

Data Qualifiers

- U Indicates compound was analyzed for, but not detected at the given detection limit.
- J Indicates an estimated value when that result is less than the calculated detection limit.
- E Indicates a value above the linear range of the detector. Dilution Required
- S Indicates no value reported due to saturation of the detector.
- D Indicates the surrogate was diluted out.
- B Found in associated method blank.
- Y Indicates a raised detection limit due to matrix interference.
- NA Indicates compound was not analyzed.
- NR Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 37

Lab Sample ID: H968F
LIMS ID: 94-12765
Matrix: Water

QC Report No: H968-Remediation Technologies, Inc.
Project: BN-Skykomish
3-1161
Date Sampled: 08/02/94
Date Received: 08/03/94

Data Release Authorized: Sheri L Brown
Reported: 09/06/94

Date extracted: 08/08/94
Date analyzed: 08/19/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L	
91-20-3	Naphthalene	1.8	U
83-32-9	Acenaphthylene	2.3	U
208-96-8	**Acenaphthene**	**1.3**	**J**
86-73-7	**Fluorene**	**2.1**	
85-01-8	**Phenanthrene**	**0.40**	**J**
120-12-7	**Anthracene**	**0.70**	
206-44-0	**Fluoranthene**	**8.9**	
129-00-0	Pyrene	0.27	U
56-55-3	**Benzo(a)anthracene**	**0.10**	
218-01-9	Chrysene	0.15	U
205-99-2	Benzo(b)fluoranthene	0.020	U
207-08-9	Benzo(k)fluoranthene	0.020	U
50-32-8	Benzo(a)pyrene	0.030	U
53-70-3	Dibenzo(a,h)anthracene	0.030	U
191-24-2	Benzo(g,h,i)perylene	0.080	U
193-39-5	Indeno(1,2,3-cd)pyrene	0.050	U

Surrogate Recoveries

Diphenyl	123%
Terphenyl	88.6%

Data Qualifiers

- U Indicates compound was analyzed for, but not detected at the given detection limit.
- J Indicates an estimated value when that result is less than the calculated detection limit.
- E Indicates a value above the linear range of the detector. Dilution Required
- S Indicates no value reported due to saturation of the detector.
- D Indicates the surrogate was diluted out.
- B Found in associated method blank.
- Y Indicates a raised detection limit due to matrix interference.
- NA Indicates compound was not analyzed.
- NR Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 100

Lab Sample ID: H968G
LIMS ID: 94-12766
Matrix: Water

QC Report No: H968-Remediation Technologies, Inc.
Project: BN-Skykomish
3-1161
Date Sampled: 08/02/94
Date Received: 08/03/94

Data Release Authorized: Sheri L Brown
Reported: 09/06/94

Date extracted: 08/08/94
Date analyzed: 08/19/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L
91-20-3	Naphthalene	1.8 U
83-32-9	Acenaphthylene	2.3 U
208-96-8	Acenaphthene	1.8 U
86-73-7	Fluorene	0.21 U
85-01-8	Phenanthrene	0.64 U
120-12-7	Anthracene	0.66 U
206-44-0	Fluoranthene	0.21 U
129-00-0	Pyrene	0.27 U
56-55-3	Benzo(a)anthracene	0.020 U
218-01-9	Chrysene	0.15 U
205-99-2	Benzo(b)fluoranthene	0.020 U
207-08-9	Benzo(k)fluoranthene	0.020 U
50-32-8	Benzo(a)pyrene	0.030 U
53-70-3	Dibenzo(a,h)anthracene	0.030 U
191-24-2	Benzo(g,h,i)perylene	0.080 U
193-39-5	Indeno(1,2,3-cd)pyrene	0.050 U

Surrogate Recoveries

Diphenyl	61.0%
Terphenyl	69.3%

Data Qualifiers

U Indicates compound was analyzed for, but not detected at the given detection limit.
J Indicates an estimated value when that result is less than the calculated detection limit.
E Indicates a value above the linear range of the detector. Dilution Required
S Indicates no value reported due to saturation of the detector.
D Indicates the surrogate was diluted out.
B Found in associated method blank.
Y Indicates a raised detection limit due to matrix interference.
NA Indicates compound was not analyzed.
NR Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 23

Lab Sample ID: H968H
LIMS ID: 94-12767
Matrix: Water

QC Report No: H968-Remediation Technologies, Inc.
Project: BN-Skykomish
3-1161
Date Sampled: 08/02/94
Date Received: 08/03/94

Data Release Authorized: Sheri L Brown
Reported: 09/06/94

Date extracted: 08/08/94
Date analyzed: 08/19/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L
91-20-3	Naphthalene	1.8 U
83-32-9	Acenaphthylene	2.3 U
208-96-8	Acenaphthene	1.8 U
86-73-7	Fluorene	0.21 U
85-01-8	Phenanthrene	0.64 U
120-12-7	Anthracene	0.66 U
206-44-0	Fluoranthene	0.21 U
129-00-0	Pyrene	0.27 U
56-55-3	Benzo(a)anthracene	0.020 U
218-01-9	Chrysene	0.15 U
205-99-2	Benzo(b)fluoranthene	0.020 U
207-08-9	Benzo(k)fluoranthene	0.020 U
50-32-8	Benzo(a)pyrene	0.030 U
53-70-3	Dibenzo(a,h)anthracene	0.030 U
191-24-2	Benzo(g,h,i)perylene	0.080 U
193-39-5	Indeno(1,2,3-cd)pyrene	0.050 U

Surrogate Recoveries

Diphenyl	66.1%
Terphenyl	66.0%

Data Qualifiers

U Indicates compound was analyzed for, but not detected at the given detection limit.
J Indicates an estimated value when that result is less than the calculated detection limit.
E Indicates a value above the linear range of the detector. Dilution Required
S Indicates no value reported due to saturation of the detector.
D Indicates the surrogate was diluted out.
B Found in associated method blank.
Y Indicates a raised detection limit due to matrix interference.
NA Indicates compound was not analyzed.
NR Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 23B

Lab Sample ID: H968I
LIMS ID: 94-12768
Matrix: Water

QC Report No: H968-Remediation Technologies, Inc.
Project: BN-Skykomish
3-1161
Date Sampled: 08/02/94
Date Received: 08/03/94

Data Release Authorized: Sheri L Brown
Reported: 09/06/94

Date extracted: 08/08/94
Date analyzed: 08/20/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L	
91-20-3	Naphthalene	1.8	U
83-32-9	Acenaphthylene	2.3	U
208-96-8	Acenaphthene	1.8	U
86-73-7	Fluorene	0.21	U
85-01-8	Phenanthrene	0.64	U
120-12-7	Anthracene	0.66	U
206-44-0	Fluoranthene	0.21	U
129-00-0	Pyrene	0.27	U
56-55-3	Benzo(a)anthracene	0.020	U
218-01-9	Chrysene	0.15	U
205-99-2	Benzo(b)fluoranthene	0.020	U
207-08-9	Benzo(k)fluoranthene	0.020	U
50-32-8	Benzo(a)pyrene	0.030	U
53-70-3	Dibenzo(a,h)anthracene	0.030	U
191-24-2	Benzo(g,h,i)perylene	0.080	U
193-39-5	Indeno(1,2,3-cd)pyrene	0.050	U

Surrogate Recoveries

Diphenyl	56.1%
Terphenyl	59.4%

Data Qualifiers

U Indicates compound was analyzed for, but not detected at the given detection limit.
J Indicates an estimated value when that result is less than the calculated detection limit.
E Indicates a value above the linear range of the detector. Dilution Required
S Indicates no value reported due to saturation of the detector.
D Indicates the surrogate was diluted out.
B Found in associated method blank.
Y Indicates a raised detection limit due to matrix interference.
NA Indicates compound was not analyzed.
NR Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 36

Lab Sample ID: H968J
LIMS ID: 94-12769
Matrix: Water

QC Report No: H968-Remediation Technologies, Inc.
Project: BN-Skykomish
3-1161
Date Sampled: 08/02/94
Date Received: 08/03/94

Data Release Authorized: Sheri L Brown
Reported: 09/06/94

Date extracted: 08/08/94
Date analyzed: 08/22/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L
91-20-3	Naphthalene	1.8 U
83-32-9	Acenaphthylene	2.3 U
208-96-8	Acenaphthene	1.8 U
86-73-7	**Fluorene**	**1.5**
85-01-8	Phenanthrene	0.64 U
120-12-7	**Anthracene**	**1.5**
206-44-0	**Fluoranthene**	**1.1**
129-00-0	**Pyrene**	**0.40**
56-55-3	**Benzo(a)anthracene**	**0.090**
218-01-9	**Chrysene**	**0.30**
205-99-2	**Benzo(b)fluoranthene**	**0.060**
207-08-9	**Benzo(k)fluoranthene**	**0.030**
50-32-8	Benzo(a)pyrene	0.030 U
53-70-3	Dibenzo(a,h)anthracene	0.030 U
191-24-2	Benzo(g,h,i)perylene	0.080 U
193-39-5	Indeno(1,2,3-cd)pyrene	0.050 U

Surrogate Recoveries

Diphenyl	84.9%
Terphenyl	90.4%

Data Qualifiers

- U Indicates compound was analyzed for, but not detected at the given detection limit.
- J Indicates an estimated value when that result is less than the calculated detection limit.
- E Indicates a value above the linear range of the detector. Dilution Required
- S Indicates no value reported due to saturation of the detector.
- D Indicates the surrogate was diluted out.
- B Found in associated method blank.
- Y Indicates a raised detection limit due to matrix interference.
- NA Indicates compound was not analyzed.
- NR Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: SW-5

Lab Sample ID: H968K
LIMS ID: 94-12770
Matrix: Water

QC Report No: H968-Remediation Technologies, Inc.
Project: BN-Skykomish
3-1161
Date Sampled: 08/02/94
Date Received: 08/03/94

Data Release Authorized: Sheri L Brown
Reported: 09/06/94

Date extracted: 08/08/94
Date analyzed: 08/19/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L	
91-20-3	Naphthalene	1.8	U
83-32-9	Acenaphthylene	2.3	U
208-96-8	Acenaphthene	1.8	U
86-73-7	Fluorene	0.21	U
85-01-8	Phenanthrene	0.64	U
120-12-7	Anthracene	0.66	U
206-44-0	**Fluoranthene**	**0.40**	
129-00-0	Pyrene	0.27	U
56-55-3	Benzo(a)anthracene	0.020	U
218-01-9	Chrysene	0.15	U
205-99-2	Benzo(b)fluoranthene	0.020	U
207-08-9	Benzo(k)fluoranthene	0.020	U
50-32-8	Benzo(a)pyrene	0.030	U
53-70-3	Dibenzo(a,h)anthracene	0.030	U
191-24-2	Benzo(g,h,i)perylene	0.080	U
193-39-5	Indeno(1,2,3-cd)pyrene	0.050	U

Surrogate Recoveries

Diphenyl	62.7%
Terphenyl	82.8%

Data Qualifiers

U	Indicates compound was analyzed for, but not detected at the given detection limit.
J	Indicates an estimated value when that result is less than the calculated detection limit.
E	Indicates a value above the linear range of the detector. Dilution Required
S	Indicates no value reported due to saturation of the detector.
D	Indicates the surrogate was diluted out.
B	Found in associated method blank.
Y	Indicates a raised detection limit due to matrix interference.
NA	Indicates compound was not analyzed.
NR	Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Principle Hazardous Constituents by Method 8310

Lab Sample ID: H968SB
LIMS ID: 94-12760
Matrix: Water

QC Report No: H968-Remediation Technologies, Inc.
Project: BN-Skykomish
3-1161

Data Release Authorized: [signature]
Reported: 09/06/94

BLANK SPIKE RECOVERY CONSTITUENT	SPIKE VALUE	SPIKE ADDED	% RECOVERY
Acenaphthene	1.2	2.00	60.0%
Fluoranthene	1.3	2.00	65.0%
Benzo(a)anthracene	1.3	2.00	65.0%

Spike Blank Surrogate Recovery

Diphenyl	55.4%
Terphenyl	67.7%

Values reported in ug/L

FORM-III PNA

RETEC
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349
FAX (206) 624-2839

DATA VALIDATION REPORT

TO: Shelly Birch
FROM: Kim Lofgren
DATE: September 28, 1994
RE: Review of Analytical Data

1.0 GENERAL

PROJECT:	BNRR Skykomish #3-1611-340
DATE SAMPLED:	08/02-04/1994
RECEIVING LAB	ACZ Laboratories, Inc.
ANALYTICAL METHODS:	Polychlorinated Biphenyl Compounds: SW846-8080 Washington Total Petroleum Hydrocarbons-Diesel: SW846-8015 (Extended) Total Metals: SW846-6010, 7061, or 7421 Dissolved Metals: SW846-6010, 7061, or 7421 Total Suspended Solids: EPA 160.2
NUMBER OF SAMPLES:	33
MATRIX:	water
DATE(S) EXTRACTED:	all samples were extracted within the holding time limits
DATE(S) ANALYZED:	all samples were analyzed within the holding time limits

- Data validation summary tables are given as Attachment 1.
- Laboratory results with qualifiers are given as Attachment 2.
- All the samples and all of the Quality Assurance/Quality Control (QA/QC) in this data set have been reviewed with respect to holding times, method blanks, surrogate recoveries, matrix spikes, sample results, and any other QC measures (field blanks, lab blank spikes, field duplicates, etc.).

2.0 VALIDITY AND COMMENTS

This section summarizes only those instances where acceptance criteria were not met or a discussion of the data were warranted.

2.1 GENERAL COMMENTS

The objectives of this review were to determine the quality of the analytical data by examining the level of precision, accuracy, and completeness. The accuracy of data is the degree of agreement of a measurement with an accepted reference or true value. The level of accuracy is determined by examination of laboratory matrix spike analyses. Precision is a measure of the mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is determined through analysis of duplicate samples. Completeness is determined by assessing the number of samples where valid results are reported versus the number of samples which were submitted to the laboratory for analysis. The overall measure of completeness will be the ratio of valid analyses received compared to the expected amount of data to be obtained under correct or normal conditions.

Quality Assurance/Quality Control (QA/QC) for this project included specific criteria by which precision, accuracy, and completeness were evaluated. Precision, is measured through the evaluation of field QA/QC including duplicate analysis and analysis of field blanks. Evaluation of duplicate samples for precision was done using the relative percent difference (RPD). RPD is defined as the difference between two duplicate samples divided by the mean and expressed as a percent. The criteria for acceptable RPD values are 0-30% for water samples.

Laboratory QC, which evaluates accuracy, involves using a method blank (reagent blank) for approximately 20 actual samples, a matrix spike/matrix spike duplicate (MS/MSD) for approximately one out of every 20 samples, and analysis of surrogate standards for organic analyses. Method blanks are analyzed to identify compounds which are introduced during the laboratory extraction or analysis phase (i.e. laboratory contaminants). MS/MSD percent recoveries (%Rs) and RPD values reported are compared to published QC limits. Surrogates are compounds that are "like" the compounds requested for analysis, but not structurally the same. They are analyzed to demonstrate that structurally similar compounds can be recovered and quantified by the lab. The completeness goal is set at 90%. The laboratory data showing the raw analytical data, the sample data results and all QA/QC backup data is found in Attachment 2.

All appropriate data were found in the raw data, the forms provided, or the narrative part of the report from ACZ Laboratories. The amount extracted, dilution factor and amount analyzed was included for all of the samples in this data set. Table 1-1 provides a summary of the groundwater data. Parameters identified in the QA/QC review as outside the control limits are shaded. Not all water samples were analyzed for each parameter, refer to Table 1-1 for exact analyses of each sample.

2.2 HOLDING TIMES

The times and dates for sampling were taken from RETEC's Chain of Custody (COC). The dates for extraction and analyses were taken from the ACZ organic analysis data sheets.

For the purpose of this review, the holding times stated in SW-846 were used to qualify data. All samples met the holding time requirements for the preparation type requirements unless otherwise stated in the appropriate analysis section of the report.

2.3 POLYCHLORINATED BIPHENYLS - ANALYSIS OF WATER

Four water samples were reviewed for polychlorinated biphenyls (PCB) compounds validity in this data set.

2.3.1 Method Blanks and Field Blank

Method Blanks - One method blank was extracted and analyzed with the PCB samples. Target analytes were not detected in the method blank.

Field Blank - One field blank (MW-100) was extracted and analyzed with the PCB samples. Table 2-1 summarizes the results of the field blank. Target analytes were not detected in the field blank.

2.3.2 Surrogate Recovery

Surrogate %Rs for tetrachloro-m-xylene and decachlorobiphenyl were reported on the Quality Control Data Summary forms. All %Rs were within control limits for decachlorobiphenyl and for tetrachloro-m-xylene. No qualifiers were warranted based on surrogate recoveries.

2.3.3 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

One MS/MSD summary report was not submitted with this data set.

One Blank Spike/Blank Spike Duplicate (BS/BSD) summary report was not submitted with this data set.

2.3.4 Field Duplicate

One field duplicate was included in this data set; however, was not labelled as such by RETEC personnel. Sample MW-19B is a field duplicate of sample MW-19. Table 2-1 summarizes the RPD values for the sample and its corresponding duplicate. No analytes were detected in the sample or its corresponding duplicate sample, indicating field sampling techniques were acceptable.

2.3.5 Overall Assessment of Data

The quantity of water extracted, the amounts analyzed and the dilution factors were included in this data set for all of the samples. All compounds were reviewed based on the holding time limits, the detection limits, the method blank, the field blank, the surrogate %Rs, and the field duplicate. All data were found to be accurate based on the information given.

Field accuracy and precision have been determined acceptable based on the field blank and the field duplicate.

Laboratory accuracy and precision could not be determined acceptable because on a MS/MSD or BS/BSD was not submitted with this data set.

2.4 WASHINGTON TOTAL PETROLEUM HYDROCARBON - ANALYSIS OF WATER

Twenty-six water samples were reviewed for Washington total petroleum hydrocarbon for diesel (WTPH-D Extended) validity in this data set.

2.4.1 Method Blanks and Field Blanks

Method Blanks - Four method blanks were extracted and analyzed with the fuel hydrocarbon samples. Diesel was detected in two out of the four the method blanks. Samples DW-4, DW-5, DW-1, MW-40, MW-40B, MW-102, and DW-2, which are associated with these two method blanks have been qualified with a "U" qualifier (the material was analyzed for, but was not detected, and the associated numerical value is the sample quantitation limit).

Field Blanks - Three field blanks (MW-100, MW-101, and MW-102) were submitted with this data set. Table 2-2 summarizes the results of the field blanks. Diesel was detected in sample MW-102 at a concentration of 0.2 ug/l. The positive result has been qualified with a "U" qualifier based on the positive result in the method blank. Diesel was not detected in the other two field blanks.

2.4.2 Surrogate Recovery

Surrogate %Rs for o-terphenyl were reported on the Quality Control Data Summary forms. The %R for ortho-terphenyl diluted out in sample MW-13. The positive result for sample MW-13 has been qualified with a "J" qualifier (the associated numerical value is an estimated quantity), based on the poor surrogate recovery. All other surrogate %Rs were within the control limits of 50-150% for o-terphenyl.

2.4.3 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

A MS/MSD summary report was not submitted with this data set.

One Blank Spike/Blank Spike Duplicate (BS/BSD) was reported with this data set. The BS %R was 92%, and the BSD %R was 88% for fuel carbons (diesel), which were within control limits of 68-144%. The RPD value was 4.4%, which was also within the control limits of 0-30%.

2.4.4 Field Duplicates

Three field duplicates were included in this data set; however, were not labelled as such by RETEC personnel. Sample MW-23B is a field duplicate of sample MW-23, sample MW-4B is a field duplicate of sample MW-4, and sample MW-4B is a field duplicate of sample MW-4. Table 2-2 summarizes the RPD values for these samples and their corresponding duplicates. Two of the three RPD values were calculated for the diesel analysis. The RPD value was 0% for MW-23/MW-23B, which is within acceptable control limits of 0-20%; and 50% for MW-4/MW-40B, which exceeds the acceptable control limit of 20%. The concentration of diesel in samples MW-4 and MW-4B were very low, which accounts for the high RPD value. Field sampling techniques are considered to be acceptable based on the field duplicate analyses.

2.4.5 Overall Assessment of Data

The quantity of water extracted, the amounts analyzed and the dilution factors were included in this data set for all of the samples. All compounds were reviewed based on the holding time limits, the detection limits, the method blanks, the field blanks, the surrogate

%Rs, the BS/BSD %Rs, the BS/BSD RPD value, and the field duplicates. The positive results for diesel in samples DW-4, DW-5, DW-1, MW-40, MW-40B, MW-102, and DW-2 have been qualified with a "U" qualifier; and the positive result for diesel in sample MW-13 has been qualified with a "J" qualifier. All other data were found to be accurate based on the information given.

Field accuracy and precision have been determined acceptable based on the field blanks and the field duplicates.

Laboratory accuracy and precision could not be determined acceptable based on the method blanks and only one BS/BSD %R and BS/BSD RPD value was submitted for the twenty-six water samples.

2.5 METALS - ANALYSIS OF WATER

Eighteen water samples were reviewed for dissolved metals (i.e., arsenic, copper and lead) and three water samples for total metals (i.e., arsenic, chromium, and lead) validity in this data set.

2.5.1 Method Blank and Field Blanks

Method Blank - One method blank was extracted and analyzed for total and dissolved arsenic and copper, and dissolved lead. Two method blanks were extracted and analyzed for dissolved lead.

Field Blanks - Three field blanks (MW-100, MW-101 and MW-102) were submitted with the dissolved metals. Table 2-2 summarizes the results of the field blanks. Target analytes were not detected in the field blanks.

2.5.2 Matrix Spike (MS) and Analytical Spikes (AS)

One MS was extracted and analyzed for total chromium; and two MSs were extracted and analyzed for dissolved chromium and lead. A MS was not extracted and analyzed for total and dissolved arsenic and total lead. All MS/MSD %Rs were within control limits for total and dissolved metals.

One analytical spike (AS) was extracted and analyzed for total and dissolved arsenic, copper, total lead and two Ass for dissolved lead. All AS %Rs were within acceptable control limits.

2.5.3 Field and Laboratory Duplicates

Two field duplicates were included with the dissolved metals in this data set; however, were not labelled as such by RETEC personnel. Sample MW-23B is a field duplicate of sample MW-23, and sample MW-40B is a field duplicate of sample MW-40. Table 2-2 summarizes the RPD values for these samples and their corresponding duplicates. No RPD values were calculated for the field duplicate metal analysis. Field sampling techniques are considered to be acceptable based on the field duplicate analyses.

Five laboratory duplicates were extracted and analyzed with the total and dissolved metals. The RPD values ranged from 0.6-14.1%, Which are within the acceptable control limits of 0-20% for laboratory duplicate samples.

2.5.4 Overall Assessment of Data

The quantity of water extracted, the amounts analyzed and the dilution factors were included in this data set for all of the samples. All compounds were reviewed based on the holding time limits, the detection limits, the method blanks, the field blank, the surrogate %Rs, the MS %Rs, the analytical spike recoveries, and the field duplicates.

Field accuracy and precision have been determined acceptable based on the field blanks and the field duplicates.

Laboratory accuracy and precision have been determined acceptable based on the method blanks, the MS %Rs, and the analytical spike recoveries.

2.6 CONCLUSION

Completeness is determined by assessing the number of samples where valid results were reported versus the number of samples which were submitted to the laboratory for analysis. The overall completeness goal is to achieve 90% valid data. A completeness goal of 90% was met for the water samples.

For field QA/QC, a completeness goal of 90% was also obtain for duplicate analyses, field blanks and trip blanks. At least one duplicate sample was submitted for every ten samples. Since, disposable bailers were used instead of non disposable bailers decontamination blanks were not warranted.

For laboratory QA/QC, a completeness goal of 90% was achieved for the method blanks, laboratory duplicates, and the surrogate %Rs.

Matrix Spikes/Matrix Spike Duplicates or Blank Spike/Blank Spike Duplicates were not exacted and analyzed for every 20 samples for each analyses. One MS/MSD or BS/BSD should of been extracted and analyzed with the PCB analysis; and two MS/MSD or BS/BSD should have been extracted and analyzed with the WTPH-D data set. All MS/MSD recoveries were within control limits for all analyses. Surrogate %Rs were analyzed with every sample for PCBs, WTPH-D, and metals. Only one surrogate %R was outside control limits for WTPH-D.

Explanation of qualifiers:

"J" = The associated numerical value is an estimated quantity.

"U" = The material was analyzed for, but was not detected. The associated numerical value is the sample quantitation limit.

References

EPA,1988. laboratory Data Validation Functional Guidelines For Evaluating Organics Analyses. Prepared by The USEPA Data Review Work Group.

TABLE 1-1

BNRR SKYKOMISH
WATER DATA VALIDATION
THIRD QUARTER - AUGUST, 1994
ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
SW-5	08/02/94	WTPH-D (8015 ext.) TSS Total Metals	Surrogate w/in QC limits
SW-3	08/03/94	TSS Total Metals	
SW-6	08/03/94	WTPH-D (8015 ext.) TSS Total Metals	Surrogate w/in QC limits
DW-1	08/04/94	WTPH-D (8015 ext.)	Surrogate w/in QC limits **Diesel detected in Method Blank qualified w/"U"**
DW-2	08/04/94	WTPH-D (8015 ext.) TSS Dissolved Metals	Surrogate w/in QC limits **Diesel detected in Method Blank qualified w/"U"**
DW-3	08/04/94	TSS Dissolved Metals	
DW-4	08/04/94	WTPH-D (8015 ext.)	Surrogate w/in QC limits **Diesel detected in Method Blank qualified w/"U"**
DW-5	08/04/94	WTPH-D (8015 ext.)	Surrogate w/in QC limits **Diesel detected in Method Blank qualified w/"U"**
MW-28	08/02/94	WTPH-D (8015 ext.)	Surrogate w/in QC limits
MW-5	08/02/94	WTPH-D (8015 ext.) TSS Dissolved Metals	Surrogate w/in QC limits
MW-9	08/02/94	TSS Dissolved Metals PCB (8080)	Surrogates w/in QC limits

TABLE 1-1

BNRR SKYKOMISH
WATER DATA VALIDATION
THIRD QUARTER - AUGUST, 1994
ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
MW-19	08/02/94	WTPH-D (8015 ext.)	Surrogate w/in QC limits
		PCB (8080)	Surrogates w/in QC limits
MW-19B	08/02/94	PCB (8080)	Surrogates w/in QC limits
MW-100	08/02/94	WTPH-D (8015 ext.)	Surrogate w/in QC limits
		TSS	
		Dissolved Metals	
		PCB (8080)	Surrogates w/in QC limits
MW-1	08/02/94	WTPH-D (8015 ext.)	Surrogate w/in QC limits
MW-36	08/02/94	WTPH-D (8015 ext.)	Surrogate w/in QC limits
		TSS	
		Dissolved Metals	
MW-37	08/02/94	WTPH-D (8015 ext.)	Surrogate w/in QC limits
		TSS	
		Dissolved Metals	
MW-23	08/02/94	WTPH-D (8015 ext.)	Surrogate w/in QC limits
		TSS	
		Dissolved Metals	
MW-23B	08/02/94	WTPH-D (8015 ext.)	Surrogate w/in QC limits
		TSS	
		Dissolved Metals	
MW-3	08/03/94	WTPH-D (8015 ext.)	Surrogate w/in QC limits
MW-4	08/03/94	WTPH-D (8015 ext.)	Surrogate w/in QC limits

TABLE 1-1

BNRR SKYKOMISH
WATER DATA VALIDATION
THIRD QUARTER - AUGUST, 1994
ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
MW-4B	08/03/94	WTPH-D (8015 ext.)	Surrogate w/in QC limits
MW-13	08/03/94	WTPH-D (8015 ext.)	**Surrogate outside QC limits, %R for Ortho-terphenyl = DO, qualified w/"J"**
MW-101 **Field Blank**	08/03/94	WTPH-D (8015 ext.) TSS Dissolved Metals	Surrogate w/in QC limits
MW-34	08/03/94	WTPH-D (8015 ext.)	Surrogate w/in QC limits
MW-2	08/03/94	TSS Dissolved Metals	
MW-16	08/03/94	TSS Dissolved Metals	
MW-31	08/03/94	TSS Dissolved Metals	
MW-35	08/03/94	WTPH-D (8015 ext.) TSS Dissolved Metals	Surrogate w/in QC limits
MW-38	08/03/94	WTPH-D (8015 ext.) TSS Dissolved Metals	Surrogate w/in QC limits
MW-40	08/04/94	WTPH-D (8015 ext.) TSS Dissolved Metals	Surrogate w/in QC limits **Diesel detected in Method Blank qualified w/"U"**
MW-40B	08/04/94	WTPH-D (8015 ext.) TSS Dissolved Metals	Surrogate w/in QC limits **Diesel detected in Method Blank qualified w/"U"**
MW-102 **Field Blank**	08/03/94	WTPH-D (8015 ext.)	Surrogate w/in QC limits **Diesel detected in Method Blank qualified w/"U"**

TABLE 1-1

BNRR SKYKOMISH
WATER DATA VALIDATION
THIRD QUARTER - AUGUST, 1994
ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
Prep Blank BLK 8/15		WTPH-D (8015)	Surrogate w/in QC limits Diesel detected @ 0.2 ug/l
Prep Blank BLK 8/18		WTPH-D (8015)	Surrogate w/in QC limits Diesel detected @ 0.2 ug/l
Prep Blank BLK 8/17		WTPH-D (8015)	Surrogate w/in QC limits
Prep Blank BLK 8/19		WTPH-D (8015)	Surrogate w/in QC limits
Prep Blank	08/10/94	PCB (8080)	Surrogate w/in QC limits
BS/BSD	L2723	PCB (8080)	No BS/BSD included in data set No MS/MSD included in data set
MS/MSD	L2730	WTPH-D (8015)	No MS/MSD included in data set No BS/BSD included in data set
BS/BSD	L2723	WTPH-D (8015)	BS - %R w/in QC limits BSD - %R w/in QC limits RPD - w/in QC limits
MS/MSD		PCB (8080)	No MS/MSD included in data set
Laboratory Control Checks	08/09/94	Total Arsenic (7061)	%R within QC limits
	08/10/94	Diss. Arsenic (7061)	%R within QC limits
	08/09/94	Total Chromium (6010)	%R within QC limits
	08/17/94	Diss. Chromium (6010)	%R within QC limits
	08/11/94	Total Lead (7241)	%R within QC limits
	08/11/94	Diss. Lead (7421)	%R within QC limits
	08/15/94	Diss. Lead (7421)	%R within QC limits
	08/08/94	TSS (160.2)	%R within QC limits
MS	08/09/94	Total Arsenic (7061)	NA
	08/10/94	Diss. Arsenic (7061)	ND
	08/17/94	Total Chromium (6010)	Sample SW-3 - %R within QC limits
	08/09/94	Diss. Chromium (6010)	Sample MW-23 - %R within QC limits
		Diss. Chromium (6010)	Sample DW-3 - %R within QC limits
	08/11/94	Total Lead (7421)	NA
	08/11/94	Diss. Lead (7421)	Sample MW-5 - %R within QC limits
	08/15/94	Diss. Lead (7421)	Sample MW-36 - %R within QC limits

TABLE 1-1

BNRR SKYKOMISH
WATER DATA VALIDATION
THIRD QUARTER - AUGUST, 1994
ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	PARAMETERS ANALYZED	COMMENTS
DUPLICATE	08/09/94	Total Arsenic (7061)	NA
	08/10/94	Diss. Arsenic (7061)	NA
	08/17/94	Diss. Arsenic (7061)	Sample MW-36 RPD w/in QC limits
	08/17/94	Total Chromium (6010)	Sample SW-3 RPD w/in QC limits
	08/09/94	Diss. Chromium (6010)	Sample MW-36 RPD w/in QC limits
	08/09/94	Diss. Chromium (6010)	Sample DW-3 RPD w/in QC limits
	08/11/94	Total Lead (7421)	NA
	04/11/94	Diss. Lead (7421)	Sample MW-5 - RPD w/in QC limits
DUPLICATE	08/08/94	TSS (160.2)	Sample MW-40 RPD w/in QC limits
PREP BLANKS	08/09/94	Total Arsenic (7061)	
	08/10/94	Diss. Arsenic (7061)	
	08/09/94	Total Chromium (6010)	
	08/17/94	Diss. Chromium (6010)	
	08/11/94	Total Lead (7421)	
	08/11/94	Diss. Lead (7421)	
	08/15/94	Diss. Lead (7421)	
	08/08/94	TSS (160.2)	

MS - Matrix spike
MSD - Matrix spike duplicate
BS - Blank Spike
BSD - Blank Spike Duplicate
%R - Percent recovery
PCB - Polychlorinated biphenyls
WTPH-D - Washington total petroluem hydrocarbon-diesel
QA - Quality assurance
QC - Quality control
Diss. - Dissolved
Tot. - Total
TSS - Total suspended solids

TABLE 2–1

THIRD QUARTER
POLYCHLORINATED BIPENYLS
QA/QC ANALYTICAL RESULTS – WATER
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Sample ID:		MW–19	MW–19B (MW–19 Dup)	RPD [1] MW–19 MW–19B	MW–100 Field Blank	Method Blank
Sample Date:		08/02/94	08/02/94	08/02/94	08/02/94	NA
PCB (8080)						
Aroclor–1016	ug/L	< 0.50	< 0.50	NC	< 0.50	< 0.50
Aroclor–1221	ug/L	< 0.50	< 0.50	NC	< 0.50	< 0.50
Aroclor–1232	ug/L	< 0.50	< 0.50	NC	< 0.50	< 0.50
Aroclor–1242	ug/L	< 0.50	< 0.50	NC	< 0.50	< 0.50
Aroclor–1248	ug/L	< 0.50	< 0.50	NC	< 0.50	< 0.50
Aroclor–1254	ug/L	< 1.00	< 1.00	NC	< 1.00	< 1.00
Aroclor–1260	ug/L	< 1.00	< 1.00	NC	< 1.00	< 1.00

PCB – Polychlorinated biphenyls
QA – Quality assurance
QC – Quality control
NA – Not applicable
NC – Not calculated
1. Relative percent difference = absolute value of $((X_1 - X_2)/(X_1 + {}_2)*1/2)*100$
where X_1 is the concentration of the orginal sample, and X_2 is the concentration of the duplicate sample.

TABLE 2-2

THIRD QUARTER
TOTAL PETROLEUM HYDRCARBONS, DISSOLVED METALS, AND TOTAL SUSPENDED SOLIDS
QA/QC ANALYTICAL RESULTS – WATER
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Sample ID: / Sample Date:		MW-23 08/02/94	MW-23B (MW-23 Dup) 08/02/94	RPD [1] MW-23 MW-23B 08/02/94	MW-4 08/03/94	MW-4B (MW-4 Dup) 08/03/94	RPD [1] MW-4 MW-4B 08/03/94
WTPH-D	mg/L	0.3	0.3	0	0.6	1	50
Dissolved Metals							
Arsenic	mg/L	< 0.001	< 0.001	NC	NA	NA	NA
Chromium	mg/L	< 0.01	< 0.01	NC	NA	NA	NA
Lead	mg/L	< 0.001	< 0.001	NC	NA	NA	NA
Total Suspended Solids	mg/L	1566	1246	23	NA	NA	NA

WTPH-D – Washington total petroleum hydrocarbons; analyzed using EPA 8015 modified method.
Dissolved Metals analyzed using EPA 6000 and 7000 series.
Total Suspended Solids measured using EPA
QA – Quality assurance
QC – Quality control
NA – Not applicable
NC – Not calculated
1. Relative percent difference = absolute value of $((X_1 - X_2)/(X_1 + {}_2)*1/2)*100$
where X_1 is the concentration of the orginal sample, and X_2 is the concentration of the duplicate sample.

TABLE 2–2 (Continued)

THIRD QUARTER
TOTAL PETROLEUM HYDRCARBONS, DISSOLVED METALS, AND TOTAL SUSPENDED SOLIDS
QA/QC ANALYTICAL RESULTS – WATER
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Sample ID:		MW–40	MW–40B (MW–40 Dup)	RPD [1] MW–40 MW–40B	MW–100 Field Blank	MW–101 Field Blank	MW–102 Field Blank	Method Blank
Sample Date:		08/04/94	08/04/94	08/04/94	08/02/94	08/03/94	08/04/94	NA
WTPH–D	mg/L	< 0.2 U	< 0.2 U	NC	< 0.2	< 0.2	< 0.2 U	< 0.2
Dissolved Metals								
Arsenic	mg/L	< 0.001	< 0.001	NC	< 0.001	< 0.001	< 0.001	< 0.001
Chromium	mg/L	< 0.01	< 0.01	NC	< 0.01	< 0.01	< 0.01	< 0.01
Lead	mg/L	< 0.001	< 0.001	NC	< 0.001	< 0.001	< 0.001	< 0.001
Total Suspended Solids	mg/L	4910	2893	52	< 2	< 2	10	< 2

WTPH–D – Washington total petroleum hydrocarbons; analyzed using EPA 8015 modified method.
Dissolved Metals analyzed using EPA 6000 and 7000 series.
Total Suspended Solids measured using EPA
QA – Quality assurance
QC – Quality control
NA – Not applicable
NC – Not calculated
1. Relative percent difference = absolute value of $((X_1 - X_2)/(X_1 + {}_2)*1/2)*100$
where X_1 is the concentration of the orginal sample, and X_2 is the concentration of the duplicate sample.

ATTACHMENT 1

ORGANIC DATA ASSESSMENT

LABORATORY: ACZ
SITE: BNRR SKYKOMISH
NO. OF SAMPLE/MATRIX: Water
REVIEWER'S NAME: Kim Wetgren

DATA ASSESSMENT SUMMARY

	WTPH−D (8015−M)	PCB (8080)	Dis. Metals	Tot. Metals
HOLDING TIMES	O	O	O	O
CALIBRATIONS	O	O	O	O
BLANKS	O	O	O	O
SURROGATES	O	O	O	O
MATRIX SPIKE/DUP	NA	NA	NA	NA
OTHER QC	O	O	O	O
INTERNAL STANDARDS	O	O	O	O
COMPOUND IDENTIFICATION	O	O	O	O
SYSTEM PERFORMANCE	O	O	O	O
OVERALL ASSESSMENT	O	O	O	O

O=DATA HAD NO PROBLEMS/OR QUALIFIED DUE TO MINOR PROBLEMS.
M=DATA QUALIFIED DUE TO MAJOR PROBLEMS.
Z=DATA UNACCEPTABLE.
X=PROBLEMS, BUT DO NOT AFFECT DATA.
NA= NOT AVAILABLE

ACTION ITEMS: No MS/MSD or BS/BSD Submitted w/ WTPH-D + PCB, called lab will send data

AREAS OF CONCERN: samples DW2, DW-4, DW-5, DW-1, MW-40, MW-102, MW-4AB qualified w/ "U" due to analyte found in Blank
TPH MW-13 qualified w/ J qualifier due to surrogate R = DO

NOTABLE PERFORMANCE:

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

PROJECT: BN Skykomish
PROJECT #: 3-1161-
SAMPLE MATRIX: Groundwater
PAGE 1 of ____

ANALYSIS AND EXTRACTION DATE/HOLDING TIMES

Sample Number	Lab Number	Sample Date	TSS	Dissolved Metals
MW-40	94-WI/07036	08/04/94	08/22/94	08/22/94
MW-40B	94-WI/07037	08/04/94	08/22/94	08/22/94
MW-102	94-WI/07038	08/04/94	08/22/94	08/22/94
DW-2	94-WI/07039	08/04/94	08/22/94	08/22/94
DW-3	94-WI/07040	08/04/94	08/22/94	08/22/94
MW-101	94-WI/06996	08/03/94	08/22/94	08/22/94
MW-35	94-WI/06997	08/03/94	08/22/94	08/22/94
MW-38	94-WI/06998	08/03/94	08/22/94	08/22/94
MW-5	94-WI/06999	08/03/94	08/22/94	08/22/94
MW-34	94-WI/07000	08/03/94	08/22/94	08/22/94
MW-37	94-WI/07001	08/03/94	08/22/94	08/22/94
MW-23	94-WI/07002	08/02/94	08/22/94	08/22/94
MW-23B	94-WI/07003	08/02/94	08/22/94	08/22/94
MW-2	94-WI/07004	08/02/94	08/22/94	08/22/94
MW-16	94-WI/07005	08/03/94	08/22/94	08/22/94
MW-31	94-WI/07006	08/03/94	08/22/94	08/22/94
MW-9	94-WI/07007	08/03/94	08/22/94	08/22/94
MW-100	94-WI/07008	08/02/94	08/22/94	08/22/94
SW-5	94-WI/07009	08/03/94	08/22/94	
SW-6	94-WI/07010	08/02/94	08/22/94	
SW-3	94-WI/07011	08/03/94	08/22/94	

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

PROJECT: BN-Skykomish
PROJECT #: 3-1161-
SAMPLE MATRIX: Groundwater
PAGE 2 of ____

ANALYSIS AND EXTRACTION DATE/HOLDING TIMES

Sample Number	Lab Number	Sample Date	PCP (8080) Extract	PCP (8080) Analyze	WTPH–D (modified 8015)	Total Metals
SW-5	94-W1/07009	08/02/94				08/22/94 Cr
SW-6	94-W1/07010	08/02/94				08/22/94 Cr
SW-3	94-W1/07011	08/02/94				08/22/94 Cr
DW-4	L2730-01	08/04/94			08/15/94	
DW-5	L2730-02	08/04/94			08/15/94	
MW-40	L2730-04	08/04/94			08/15/94	
DW-1	L2730-03	08/04/94			08/15/94	
MW-40B	L2730-05	08/04/94			08/18/94	
MW-102	L2730-06	08/04/94			08/18/94	
DW-2	L2730-07	08/04/94			08/18/94	
MW-3	L2723-01	08/03/94			08/09/94	
MW-4	L2723-02	08/03/94			08/09/94	
MW-4B	L2723-03	08/03/94			08/10/94	
MW-13	L2723-04	08/03/94			08/10/94	
MW-34	L2723-05	08/03/94			08/10/94	
MW-28	L2723-06	08/03/94			08/10/94	
MW-1	L2723-07	08/02/94			08/10/94	
MW-101	L2723-08	08/03/94			08/10/94	
MW-35	L2723-09	08/03/94			08/10/94	
MW-38	L2723-10	08/03/94			08/10/94	
MW-5	L2723-11	08/02/94			08/10/94	
MW-36	L2723-12	08/02/94			08/10/94	
MW-37	L2723-13	08/02/94			08/10/94	
MW-23	L2723-14	08/02/94			08/10/94	
MW-23B	L2723-15	08/02/94			08/10/94	
MW-19	L2723-20	08/02/94			08/10/94	
MW-100	L2723-22	08/02/94			08/15/94	
SW-5	L2723-23	08/02/94			08/15/94	
SW-6	L2723-24	08/02/94			08/15/94	

REVIEW OF HOLDING TIMES
ORGANIC AND INORGANIC ANALYSIS

PROJECT: BN Skykomish
PROJECT #: 3-1161
SAMPLE MATRIX: Groundwater
PAGE ____ of ____

ANALYSIS AND EXTRACTION DATE/HOLDING TIMES

Sample Number	Lab Number	Sample Date	PCP (8080) Extract	PCP (8080) Analyze	WTPH-D (modified 8015)	Total Metals
MW-9	L2723-19	08/02/94	08/08/94	08/10/94		
MW-19	L2723-20	08/02/94	08/08/94	08/10/94		
MW-19B	L2723-21	08/03/94	08/08/94	08/10/94		
MW-100	L2723-22	08/02/94	08/08/94	08/11/94		

WTPH-D 19+7=26
DIS. met. 18
T. met 3
TSS 2

ATTACHMENT 2

ACZ Laboratories, Inc.

Inorganic Analyses Data Package

COVER PAGE

Client:	ReTec, Inc - Seattle	Report Date:	9/19/1994
Project:	Skykomish - 3-1161	Date Received:	08/04-05/94
ACZ SDG No.:	L2723, L2730	Lab Nos.:	94-WI/06996 through 94-WI/07011 94-WI/07036 through 94-WI/07040
Matrix:	Water		

	Sample Identification	Sample Date	Lab Number
1	101	08/03/94	94-WI/6996
2	35	08/03/94	94-WI/6997
3	38	08/03/94	94-WI/6998
4	5	08/02/94	94-WI/6999
5	36	08/02/94	94-WI/7000
6	37	08/02/94	94-WI/7001
7	23	08/02/94	94-WI/7002
8	23B	08/02/94	94-WI/7003
9	2	08/03/94	94-WI/7004
10	16	08/03/94	94-WI/7005
11	31	08/03/94	94-WI/7006
12	9	08/02/94	94-WI/7007
13	100	08/02/94	94-WI/7008
14	SW-5	08/02/94	94-WI/7009
15	SW-6	08/03/94	94-WI/7010
16	SW-3	08/03/94	94-WI/7011
17	40	08/04/94	94-WI/7036
18	40B	08/04/94	94-WI/7037
19	102	08/04/94	94-WI/7038
20	DW-2	08/04/94	94-WI/7039
21	DW-3	08/04/94	94-WI/7040

Comments:

Name: Scott Habermehl Signature: S. Habermehl

Title: Project Manager Date: 9/20/94

7213

CHAIN OF CUSTODY RECORD

2/3

PROJ. NO.	PROJECT NAME	SEND RESULTS TO:
3-1161	BN - Skykomish	Shelly Birch

SAMPLERS: D. Kinney

RECEIVING LABORATORY: ACZ

LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS	WTPH-D ext	Dissolved Metals - As, Pb, Cr	TSS	PCB (Method 8080)				REMARKS
	8/2/94	1400	28	1	X							
	↓	1450	5	3	X	X	X					
	↓	1520	9	3		X	X	X				
	↓	1605	19	2	X			X				
	↓	1610	19B	1				X				
	↓	1655	100	4	X	X	X	X				

~~Condition of Samples Upon Receipt~~
By ACZ Laboratories, Inc:
Temperature of Contents: 1 °C
Sample Containers: intact
Custody Seals: intact

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
[signature] Kinney	8/3/94 1500	Fed Ex			

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time
		[signature]	8.4.94 0940

Shipper Information
Fed Ex Airbill # 837 7360316

RETEC
REMEDIATION TECHNOLOGIES INC

REMEDIATION TECHNOLOGIES
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

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7070

CHAIN OF CUSTODY RECORD

3/3

PROJ. NO.	PROJECT NAME	SEND RESULTS TO:
3-1161	BN - Skykomish	Shelly Birch

SAMPLERS: D. Kinney

RECEIVING LABORATORY: ACZ

LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS	WTPH-D ext.	Dissolved Metals - As, Pb & Cr	TSS	Total Metals - As, Pb & Cr				REMARKS
	8/2/94	1425	1	1	X							
	↓	1820	36	3	X	X	X					
	↓	1640	37	3	X	X	X					
	↓	1720	23	3	X	X	X					
	↓	1725	23B	3	X	X	X					
	↓	1830	SW-5	3	X		X	X				
	8/3/94	1145	SW-3	2			X	X				
	11	1155	SW-6	3	X		X	X				

~~Condition of Samples Upon Receipt~~
By ACZ Laboratories, Inc:
Temperature of Contents: 7 °C
Sample Containers: intact
Custody Seals: intact

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
D. W. Kinney	8/3/94 1500	Fed Ex			B. [illegible]

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time
		B. [illegible]	8.4.94 0940

Shipper Information: Fed Ex Airbill # 8377360316

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7221 L2723 **CHAIN OF CUSTODY RECORD** (6996-7016) 1/3

PROJ. NO.	PROJECT NAME	SEND RESULTS TO:
3-1161	BN-Skykomish	Shelly Birch
SAMPLERS: D. Kinney		
RECEIVING LABORATORY: ACZ		

LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS	WTPH-D ext	Dissolved Metals As/Pb&Cr	TSS					REMARKS
	8/3/94	0825	3	1	X							
	↓	0850	4	1	X							
		0855	4B	1	X							
		0920	13	1	X							
		0945	101	3	X	X	X					
		1000	34	1	X							
		1030	2	2		X	X					
		1055	16	2		X	X					
		1120	21	2		X	X					
		1220	35	3	X	X	X					
		1250	38	3	X	X	X					

~~Condition of Samples Upon Receipt~~
By ACZ Laboratories, Inc:
Temperature of Contents: 1 °C
~~Sample Containers:~~ intact
Custody Seals: intact

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Dex W. Kinney	8/3/94 1500	Fed Ex			

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time
		B. [illegible]	8.4.94 0940

Shipper Information
Fed Ex Airbill # 8377360316

RETEC
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7214 L2730 (WI170036-7040

CHAIN OF CUSTODY RECORD

PROJ. NO.: 3-1161
PROJECT NAME: BN - Skykomish
SAMPLERS: D. Kinney
RECEIVING LABORATORY: ACZ
SEND RESULTS TO: Shelly Birch

LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS	WTPH-D ext	Dissolved Metals As, Pb, Cd	TSS				REMARKS
	8/4/94	0905	DW-4	1	X						
	↓	0955	DW-5	1	X						
	↓	1025	40	3	X	X	X				
	↓	1035	40B	3	X	X	X				
	↓	1045	10Z	3	X	X	X				
	↓	1115	DW-Z	3	X	X	X				
	↓	1200	DW-3	2		X	X				
	↓	1235	DW-1	1	X						

~~Condition of Samples Upon Receipt~~
By ACZ Laboratories, Inc:
Temperature of Contents: 3 °C
~~Sample Containers:~~ intact
Custody Seals: intact

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
D. Kinney	8/4/94 1430	Fed Ex			

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time
		B. A[illegible]	8.5.94 0920

Shipper Information: Fed Ex Airbill # 8377360320

RETEC
REMEDIATION TECHNOLOGIES INC
REMEDIATION TECHNOLOGIES
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Seattle, WA 98134
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ACZ Laboratories, Inc.

Inorganic Analyses Data Package

PREP BLANK & LABORATORY CONTROL SAMPLE

Client:	ReTec, Inc - Seattle	Report Date:	9/19/1994
Project:	Skykomish - 3-1161	Date Received:	08/04-05/94
ACZ SDG No.:	L2723, L2730	Lab Nos.:	94-WI/06996 through 94-WI/07011 94-WI/07036 through 94-WI/07040
Matrix:	Water		

Concentration Units mg/l

Analyte	Method (PQL in ug/l)	Analysis Date	Preparation Blank	C	Laboratory Control Sample or ICV LCS / ICV Source	True Value	Observed Value	C	R%
Arsenic, dissolved	GFAA (5)	08/10/94	0.001	U	Spex	0.030	0.032		106.0
Chromium, dissolved	ICP (50)	08/09/94	0.01	U	Spex	1.00	1.00		99.6
Lead, dissolved	GFAA (5)	08/11/94	0.001	U	Spex	0.030	0.030		101.3
Arsenic, total	GFAA (5)	08/09/94	0.001	U	Spex	0.100	0.100		100.0
Chromium, total	ICP (50)	08/17/94	0.010	U	Spex	1.00	1.05		105.0
Lead, total	GFAA (5)	08/11/94	0.001	U	Spex	0.100	0.102		102.0
Suspended Solids	GRAV (10)	08/08/94	2	U	ERA	289	268		92.7

ACZ Laboratories, Inc.

Inorganic Analyses Data Package

PREP BLANK & LABORATORY CONTROL SAMPLE

Client:	ReTec, Inc - Seattle	Report Date:	9/19/1994
Project:	Skykomish - 3-1161	Date Received:	08/04-05/94
ACZ SDG No.:	L2723, L2730	Lab Nos.:	94-WI/06996 throug
			94-WI/07036 throug
Matrix:	Water		

Concentration Units mg/l

Analyte	Method (PQL in ug/l)	Analysis Date	Preparation Blank	C	Laboratory Control Sample or ICV: LCS / ICV Source	True Value	Observed Value	C	R%
Arsenic, dissolved	GFAA (5)								
Chromium, dissolved	ICP (50)								
Lead, dissolved	GFAA (5)	08/15/94	0.001	U	Spex	0.030	0.029		97.0
Arsenic, total	GFAA (5)								
Chromium, total	ICP (50)								
Lead, total	GFAA (5)								
Suspended Solids	GRAV (10)								

ACZ Laboratories, Inc.
Inorganic Analyses Data Package

SPIKE SAMPLE RECOVERY

Client:	ReTec, Inc - Seattle	Report Date:	9/19/1994
Project:	Skykomish - 3-1161	Date Received:	08/04-05/94
ACZ SDG No.:	L2723, L2730	Lab Nos.:	94-WI/06996 through 94-WI/07011 94-WI/07036 through 94-WI/07040
Matrix:	Water		

Concentration Units mg/l

Analyte	Method (PQL in mg/l)	Analysis Date	Sample No.	Spiked Sample Value	C	Sample Value	C	Spike Added	R%	Q
Arsenic, dissolved	GFAA (5)	08/10/94	*							
Chromium, dissolved	ICP (50)	08/09/94	94-WI/7002	0.50		0.01	U	0.50	100.0	
Lead, dissolved	GFAA (5)	08/11/94	94-WI/6999	0.024		0.001	U	0.020	120.0	
Arsenic, total	GFAA (5)	08/09/94	NA							
Chromium, total	ICP (50)	08/17/94	94-WI/7011	0.52		0.01	U	0.50	104.0	
Lead, total	GFAA (5)	08/11/94	NA							
Suspended Solids	GRAV (10)	08/08/94	NA							

ACZ Laboratories, Inc.

Inorganic Analyses Data Package

SPIKE SAMPLE RECOVERY

Client:	ReTec, Inc - Seattle	Report Date:	9/19/1994
Project:	Skykomish - 3-1161	Date Received:	08/04-05/94
ACZ SDG No.:	L2723, L2730	Lab Nos.:	94-WI/06996 through 94-WI/07011 94-WI/07036 through 94-WI/07040
Matrix:	Water		

Concentration Units mg/l

Analyte	Method (PQL in mg/l)	Analysis Date	Sample No.	Spiked Sample Value	C	Sample Value	C	Spike Added	R%	Q
Arsenic, dissolved	GFAA (5)	08/10/94								
Chromium, dissolved	ICP (50)	08/09/94	94-WI/7040	0.50		0.01	U	0.50	98.6	
Lead, dissolved	GFAA (5)	08/15/94	94-WI/7000	0.020		0.001	U	0.020	95.0	
Arsenic, total	GFAA (5)	08/09/94								
Chromium, total	ICP (50)	08/17/94								
Lead, total	GFAA (5)	08/11/94								
Suspended Solids	GRAV (10)	08/08/94								

ACZ Laboratories, Inc.

Inorganic Analyses Data Package

DUPLICATE SAMPLE PRECISION

Client: ReTec, Inc - Seattle
Project: Skykomish - 3-1161
ACZ SDG No.: L2723, L2730

Report Date: 9/19/1994
Date Received: 08/04-05/94
Lab Nos.: 94-WI/06996 through 94-WI/07011
94-WI/07036 through 94-WI/07040

Matrix: Water

Concentration Units mg/l

Analyte	Method	Analysis Date	Sample No.	Control Limit %RPD	Control Limit 5xIDL	Sample Value	C	Duplicate Value	C	RPD %
Arsenic, dissolved	GFAA (5)	08/10/94	*	+/- 20	5					
Chromium, dissolved	ICP (50)	08/09/94	94-WI/7000S	+/- 20	50	0.50		0.50		0.6
Lead, dissolved	GFAA (5)	08/11/94	94-WI/6999S	+/- 20	5	0.024		0.022		5.2
Arsenic, total	GFAA (5)	08/09/94	NA	+/- 20	5					
Chromium, total	ICP (50)	08/17/94	94-WI/7011S	+/- 20	50	0.58		0.59		1.9
Lead, total	GFAA (5)	08/11/94	NA	+/- 20	5					
Suspended Solids	GRAV (10)	08/08/94	94-WI/7036	+/- 20	10	4910		4265		14.1

Note: "S" at the end of Lab No. indicates values are from Matrix Spike & Matrix Spike Duplicate analyses.

ACZ Laboratories, Inc.
Inorganic Analyses Data Package

DUPLICATE SAMPLE PRECISION

Client: ReTec, Inc - Seattle
Project: Skykomish - 3-1161
ACZ SDG No.: L2723, L2730

Report Date: 9/19/1994
Date Received: 08/04-05/94
Lab Nos.: 94-WI/06996 through 94-WI/07011
94-WI/07036 through 94-WI/07040

Matrix: Water

Concentration Units mg/l

Analyte	Method	Analysis Date	Sample No.	Control Limit %RPD	Control Limit 5xIDL	Sample Value	C	Duplicate Value	C	RPD %
Arsenic, dissolved	GFAA (5)			+/- 20	10					
Chromium, dissolved	ICP (50)	08/09/94	94-WI/7040S	+/- 20	1.0	0.50		0.52		3.1
Lead, dissolved	GFAA (5)	08/15/94	94-WI/7000S	+/- 20	5	0.020		0.020		1.5
Arsenic, total	GFAA (5)			+/- 20	0.5					
Chromium, total	ICP (50)			+/- 20	0.5					
Lead, total	GFAA (5)			+/- 20	5					
Suspended Solids	GRAV (10)			+/- 20	10					

Note: "S" at the end of Lab No. indicates values are from Matrix Spike & Matrix Spike Duplicate analyses.

ACZ LABORATORIES INC — DATA MANAGEMENT SYSTEM

08/22/94 — Water Analysis Report — 14:59

Client : ReTec, Inc.
Address : 1011 SW Klickitat Ste.207
Seattle, WA 98134
Attn. : Shelly Birch
Project : 3-1161 Skykomish
Sample Matrix:
Sample ID: 101 — Lab No. : 94-WI/06996
Sample Date Time: 08/03/94 09:45 — Date Received: 08/04/94

Parameters

Solids, total suspended	-2.	mg/l
Arsenic, dissolved	-0.001	mg/l
Chromium, dissolved	-0.01	mg/l
Lead, dissolved	-0.001	mg/l

Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager

Frank E. Polniak, Inorganic Laboratory Supervisor

Client : ReTec, Inc.
Address : 1011 SW Klickitat Ste.207
Seattle, WA 98134
Attn. : Shelly Birch
Project : 3-1161 Skykomish
Sample Matrix:
Sample ID: 35
Sample Date Time: 08/03/94 12:20

Lab No. : 94-WI/06997
Date Received: 08/04/94

Parameters

Solids, total suspended	2308.	mg/l
Arsenic, dissolved	0.005	mg/l
Chromium, dissolved	-0.01	mg/l
Lead, dissolved	-0.001	mg/l

Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager

Frank E. Polniak, Inorganic Laboratory Supervisor

| ACZ LABORATORIES INC   DATA MANAGEMENT SYSTEM |
| 08/22/94   Water Analysis Report   14:59 |
Page 1

Client : ReTec, Inc.
Address : 1011 SW Klickitat Ste.207
Seattle, WA 98134
Attn. : Shelly Birch
Project : 3-1161 Skykomish
Sample Matrix:
Sample ID: 38
Sample Date Time: 08/03/94 12:50

Lab No. : 94-WI/06998
Date Received: 08/04/94

Parameters

Solids, total suspended	1432.	mg/l
Arsenic, dissolved	-0.001	mg/l
Chromium, dissolved	-0.01	mg/l
Lead, dissolved	-0.001	mg/l

Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager

Frank E. Polniak, Inorganic Laboratory Supervisor/lp

| ACZ LABORATORIES INC DATA MANAGEMENT SYSTEM |
| 08/22/94 Water Analysis Report 15:00 |
Page 1

Client : ReTec, Inc.
Address : 1011 SW Klickitat Ste.207
Seattle, WA 98134
Attn. : Shelly Birch
Project : 3-1161 Skykomish
Sample Matrix:
Sample ID: 5
Sample Date Time: 08/02/94 14:50

Lab No. : 94-WI/06999
Date Received: 08/04/94

Parameters

Solids, total suspended	376.	mg/l
Arsenic, dissolved	0.005	mg/l
Chromium, dissolved	-0.01	mg/l
Lead, dissolved	-0.001	mg/l

Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager

Frank E. Polniak, Inorganic Laboratory Supervisor /

Client : ReTec, Inc.
Address : 1011 SW Klickitat Ste.207
Seattle, WA 98134
Attn. : Shelly Birch
Project : 3-1161 Skykomish
Sample Matrix:
Sample ID: 36
Sample Date Time: 08/02/94 18:20

Lab No. : 94-WI/07000
Date Received: 08/04/94

Parameters

Solids, total suspended	914.	mg/l
Arsenic, dissolved	0.011	mg/l
Chromium, dissolved	-0.01	mg/l
Lead, dissolved	-0.001	mg/l

Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager

Frank E. Polniak, Inorganic Laboratory Supervisor

Client : ReTec, Inc.
Address : 1011 SW Klickitat Ste.207
Seattle, WA 98134
Attn. : Shelly Birch
Project : 3-1161 Skykomish
Sample Matrix:
Sample ID: 37
Sample Date Time: 08/02/94 16:40

Lab No. : 94-WI/07001
Date Received: 08/04/94

Parameters

Solids, total suspended	28.	mg/l
Arsenic, dissolved	0.002	mg/l
Chromium, dissolved	-0.01	mg/l
Lead, dissolved	-0.001	mg/l

Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager

Frank E. Polniak, Inorganic Laboratory Supervisor

Client : ReTec, Inc.
Address : 1011 SW Klickitat Ste.207
Seattle, WA 98134
Attn. : Shelly Birch
Project : 3-1161 Skykomish
Sample Matrix:
Sample ID: 23
Sample Date Time: 08/02/94 17:20

Lab No. : 94-WI/07002
Date Received: 08/04/94

Parameters

Solids, total suspended	1566.	mg/l
Arsenic, dissolved	-0.001	mg/l
Chromium, dissolved	-0.01	mg/l
Lead, dissolved	-0.001	mg/l

Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager

Frank E. Polniak, Inorganic Laboratory Supervisor

Client : ReTec, Inc.
Address : 1011 SW Klickitat Ste.207
Seattle, WA 98134
Attn. : Shelly Birch
Project : 3-1161 Skykomish
Sample Matrix:
Sample ID: 23B
Sample Date Time: 08/02/94 17:25

Lab No. : 94-WI/07003
Date Received: 08/04/94

Parameters

Solids, total suspended	1246.	mg/l
Arsenic, dissolved	-0.001	mg/l
Chromium, dissolved	-0.01	mg/l
Lead, dissolved	-0.001	mg/l

Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager

Frank E. Polniak, Inorganic Laboratory Supervisor

Client : ReTec, Inc.
Address : 1011 SW Klickitat Ste.207
Seattle, WA 98134
Attn. : Shelly Birch
Project : 3-1161 Skykomish
Sample Matrix:
Sample ID: 2
Sample Date Time: 08/03/94 10:30

Lab No. : 94-WI/07004
Date Received: 08/04/94

Parameters

Solids, total suspended	394.	mg/l
Arsenic, dissolved	0.001	mg/l
Chromium, dissolved	-0.01	mg/l
Lead, dissolved	-0.001	mg/l

Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager

Frank E. Polniak, Inorganic Laboratory Supervisor

ACZ LABORATORIES INC	DATA MANAGEMENT SYSTEM
08/22/94 Water Analysis Report	15:01

Client : ReTec, Inc.
Address : 1011 SW Klickitat Ste.207
Seattle, WA 98134
Attn. : Shelly Birch
Project : 3-1161 Skykomish
Sample Matrix:
Sample ID: 16
Sample Date Time: 08/03/94 10:55

Lab No. : 94-WI/07005
Date Received: 08/04/94

Parameters

Solids, total suspended	1078.	mg/l
Arsenic, dissolved	-0.001	mg/l
Chromium, dissolved	-0.01	mg/l
Lead, dissolved	-0.001	mg/l

Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager

Frank E. Polniak, Inorganic Laboratory Supervisor

Client : ReTec, Inc.
Address : 1011 SW Klickitat Ste.207
Seattle, WA 98134
Attn. : Shelly Birch
Project : 3-1161 Skykomish
Sample Matrix:
Sample ID: 31
Sample Date Time: 08/03/94 11:20

Lab No. : 94-WI/07006
Date Received: 08/04/94

Parameters

Solids, total suspended	2504.	mg/l
Arsenic, dissolved	-0.001	mg/l
Chromium, dissolved	-0.01	mg/l
Lead, dissolved	-0.001	mg/l

Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager

Frank E. Polniak, Inorganic Laboratory Supervisor

Client : ReTec, Inc.
Address : 1011 SW Klickitat Ste.207
Seattle, WA 98134
Attn. : Shelly Birch
Project : 3-1161 Skykomish
Sample Matrix:
Sample ID: 9
Sample Date Time: 08/02/94 15:20

Lab No. : 94-WI/07007
Date Received: 08/04/94

Parameters

Solids, total suspended	514.	mg/l
Arsenic, dissolved	0.007	mg/l
Chromium, dissolved	-0.01	mg/l
Lead, dissolved	-0.001	mg/l

Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager

Frank E. Polniak, Inorganic Laboratory Supervisor/16

Client : ReTec, Inc.
Address : 1011 SW Klickitat Ste.207
Seattle, WA 98134
Attn. : Shelly Birch
Project : 3-1161 Skykomish
Sample Matrix:
Sample ID: 100
Sample Date Time: 08/02/94 16:55

Lab No. : 94-WI/07008
Date Received: 08/04/94

Parameters

Solids, total suspended	-2.	mg/l
Arsenic, dissolved	-0.001	mg/l
Chromium, dissolved	-0.01	mg/l
Lead, dissolved	-0.001	mg/l

Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager

Frank E. Polniak, Inorganic Laboratory Supervisor

Client : ReTec, Inc.
Address : 1011 SW Klickitat Ste.207
Seattle, WA 98134
Attn. : Shelly Birch
Project : 3-1161 Skykomish

Sample ID: SW-5
Sample Date Time: 08/02/94 18:30

Lab No. : 94-WI/07009
Date Received: 08/04/94

Parameters

Solids, total suspended	12.	mg/l
Arsenic, total	-0.001	mg/l
Chromium, total	-0.01	mg/l
Lead, total	-0.001	mg/l

Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/SH.

Client : ReTec, Inc.
Address : 1011 SW Klickitat Ste.207
Seattle, WA 98134
Attn. : Shelly Birch
Project : 3-1161 Skykomish

Sample ID: SW-6
Sample Date Time: 08/03/94 11:55

Lab No. : 94-WI/07010
Date Received: 08/04/94

Parameters

Solids, total suspended	2.	mg/l
Arsenic, total	-0.001	mg/l
Chromium, total	-0.01	mg/l
Lead, total	-0.001	mg/l

Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/SH.

Client : ReTec, Inc.
Address : 1011 SW Klickitat Ste.207
Seattle, WA 98134
Attn. : Shelly Birch
Project : 3-1161 Skykomish

Sample ID: SW-3
Sample Date Time: 08/03/94 11:45

Lab No. : 94-WI/07011
Date Received: 08/04/94

Parameters

Solids, total suspended	8.	mg/l
Arsenic, total	-0.001	mg/l
Chromium, total	-0.01	mg/l
Lead, total	-0.001	mg/l

Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager/S.H.

| ACZ LABORATORIES INC DATA MANAGEMENT SYSTEM |
| 08/22/94 Water Analysis Report 15:11 |
Page 1

Client : ReTec, Inc.
Address : 1011 SW Klickitat Ste.207
Seattle, WA 98134
Attn. : Shelly Birch
Project : 3-1161 BN Skykomish
Sample Matrix:
Sample ID: 40
Sample Date Time: 08/04/94 10:25

Lab No. : 94-WI/07036
Date Received: 08/05/94

Parameters

Solids, total suspended	4910.	mg/l
Arsenic, dissolved	-0.001	mg/l
Chromium, dissolved	-0.01	mg/l
Lead, dissolved	-0.001	mg/l

Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager

Frank E. Polniak, Inorganic Laboratory Supervisor

Client : ReTec, Inc.
Address : 1011 SW Klickitat Ste.207
Seattle, WA 98134
Attn. : Shelly Birch
Project : 3-1161 BN Skykomish
Sample Matrix:
Sample ID: 40B
Sample Date Time: 08/04/94 10:35

Lab No. : 94-WI/07037
Date Received: 08/05/94

Parameters

Solids, total suspended	2893.	mg/l
Arsenic, dissolved	-0.001	mg/l
Chromium, dissolved	-0.01	mg/l
Lead, dissolved	-0.001	mg/l

Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager

Frank E. Polniak, Inorganic Laboratory Supervisor/fp

Client : ReTec, Inc.
Address : 1011 SW Klickitat Ste.207
Seattle, WA 98134
Attn. : Shelly Birch
Project : 3-1161 BN Skykomish
Sample Matrix:
Sample ID: 102
Sample Date Time: 08/04/94 10:45

Lab No. : 94-WI/07038
Date Received: 08/05/94

Parameters

Solids, total suspended	10.	mg/l
Arsenic, dissolved	-0.001	mg/l
Chromium, dissolved	-0.01	mg/l
Lead, dissolved	-0.001	mg/l

Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager

Frank E. Polniak, Inorganic Laboratory Supervisor/fe

Client : ReTec, Inc.
Address : 1011 SW Klickitat Ste.207
Seattle, WA 98134
Attn. : Shelly Birch
Project : 3-1161 BN Skykomish
Sample Matrix:
Sample ID: DW-3
Sample Date Time: 08/04/94 12:00

Lab No. : 94-WI/07040
Date Received: 08/05/94

Parameters

Solids, total suspended	346.	mg/l
Arsenic, dissolved	-0.001	mg/l
Chromium, dissolved	-0.01	mg/l
Lead, dissolved	-0.001	mg/l

Remarks:
Note: Negative sign "-" denotes that the value is less than "<"

Scott Habermehl, Project Manager

Frank E. Polniak, Inorganic Laboratory Supervisor

ACZ Laboratories, Inc.
Organic Quality Control Data Summary

COVER PAGE

Client:	RETEC Inc.	Report Date:	9/20/94
Project:		Date Received:	8/5/94
ACZ SDG No.:	L2730	Lab Nos.:	L2730-1 through 7
Matrix:	Water Samples WTPH-D by GC/FID, Deisel in Water		

	Sample Identification	Sample Date	Lab Number
1	DW-4	08/04/94	L2730-1
2	DW-5	08/04/94	L2730-2
3	DW-1	08/04/94	L2730-3
4	40	08/04/94	L2730-4
5	40B	08/04/94	L2730-5
6	102	08/04/94	L2730-6
7	DW-2	08/04/94	L2730-7

Comments:

Name: D. Eric Woodland   Signature: [signature]

Title: Organic Manager   Date: 9/20/94

ACZ Laboratories, Inc.

Organic Quality Control Data Summary

SURROGATE SPIKE RECOVERIES

Client:	RETEC Inc.	Report Date:	9/20/94
Project:		Date Received:	8/5/94
ACZ SDG No.:	L2730	Lab Nos.:	L2730-1 through 7

Matrix: Water Samples
WTPH-D by GC/FID, Deisel in Water

Lab Number	GC File	Analysis Date	OTP R%						
prep blank 8/25	40829-56	08/29/94	103						
prep blank 8/18	40829-57	08/29/94	91						
L2730-1	40829-58	08/29/94	101						
L2730-2	40829-59	08/29/94	98						
L2730-3	40829-60	08/30/94	91						
L2730-4	40829-61	08/30/94	97						
L2730-5	40829-62	08/30/94	86						
L2730-6	40829-64	08/30/94	87						
L2730-7	40829-65	08/30/94	88						

Note: OTP is ortho-Terphenyl

ACZ Laboratories, Inc.

Organic Quality Control Data Summary

METHOD BLANK DATA

Client:	RETEC Inc.	Report Date:	9/20/94
Project:		Date Received:	8/5/94
ACZ SDG No.:	L2730	Lab Nos.:	L2730-1 through 7

Matrix: Water Samples
WTPH-D by GC/FID, Deisel in Water

Concentration Units ug/L

Compound	blank 8/15 file 40829-56 08/29/94	C	blank 8/18 file 40829-57 08/29/94	C		C		
W-TPH-D	0.2		0.2					

Note:

ACZ Laboratories, Inc.

Organic Quality Control Data Summary

MATRIX SPIKE / MATRIX SPIKE DUPLICATE RECOVERIES

Client:	RETEC Inc.	Report Date:	9/20/94
Project:		Date Received:	8/5/94
ACZ SDG No.:	L2723	Lab Nos.:	L2723-1 to 15, 20, 22 to 24

Matrix: Water Samples
WTPH-D by GC/FID, Deisel in Water

Concentration Units 0

Compound	Sample No.	Sample Value ug/L	Spike Added ug/L	Matrix Spike ug/L	Matrix Spike Dup ug/L	Matrix Spike R%	Matrix Spike Dup R%	RPD%	
TPH	DI H20	0	2500	2300	2200	92	88	4.4	

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2730-01
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40829R-058
Sample ID:	DW-4	Date Received:	8/5/94
Matrix:	Water	Date Extracted:	8/15/94
Sample Date:	8/4/94	Date Analyzed:	8/29/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)	0.2	0.2	B

Carbon Range detected in sample: C12-C24

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Hydrocarbons detected in the method blank at 0.2 mg/L.

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc.
30400 Downhill Dr.
Steamboat Springs, CO 80487

(800) 334-5493
FAX: (303) 879-2216

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2730-02
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40829R-059
Sample ID:	DW-5	Date Received:	8/5/94
Matrix:	Water	Date Extracted:	8/15/94
Sample Date:	8/4/94	Date Analyzed:	8/29/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

	COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)		0.2	0.2	B

Carbon Range detected in sample: C12-C24

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Hydrocarbons detected in the method blank at 0.2 mg/L.

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2730-03
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40829R-060
Sample ID:	DW-1	Date Received:	8/5/94
Matrix:	Water	Date Extracted:	8/15/94
Sample Date:	8/4/94	Date Analyzed:	8/30/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)	0.3	0.2	B

Carbon Range detected in sample: Diesel, C12-C24

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Hydrocarbons detected in the method blank at 0.2 mg/L.

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc.
30400 Downhill Dr.
Steamboat Springs, CO 80487

(800) 334-5493
FAX: (303) 879-2216

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2730-04
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40829R-061
Sample ID:	40	Date Received:	8/5/94
Matrix:	Water	Date Extracted:	8/15/94
Sample Date:	8/4/94	Date Analyzed:	8/30/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)	0.2	0.2	B

Carbon Range detected in sample: C12-C24

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Hydrocarbons detected in the method blank at 0.2 mg/L.

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2730-05
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40829R-062
Sample ID:	40B	Date Received:	8/5/94
Matrix:	Water	Date Extracted:	8/18/94
Sample Date:	8/4/94	Date Analyzed:	8/30/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

	COMPOUND	CONCENTRATION	MDL Q
Hydrocarbon Range (C9 - C36)		0.2	0.2 B

Carbon Range detected in sample: C12-C24

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Hydrocarbons detected in the method blank at 0.2 mg/L.

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2730-06
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40829R-064
Sample ID:	102	Date Received:	8/5/94
Matrix:	Water	Date Extracted:	8/18/94
Sample Date:	8/4/94	Date Analyzed:	8/30/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)	0.2	0.2	B

Carbon Range detected in sample: C12-C24

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Hydrocarbons detected in the method blank at 0.2 mg/L.

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2730-07
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40829R-065
Sample ID:	DW-2	Date Received:	8/5/94
Matrix:	Water	Date Extracted:	8/18/94
Sample Date:	8/4/94	Date Analyzed:	8/30/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)	0.2	0.2	B

Carbon Range detected in sample: C12-C24

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Hydrocarbons detected in the method blank at 0.2 mg/L.

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc.
30400 Downhill Dr.
Steamboat Springs, CO 80487
(800) 334-5493
FAX: (303) 879-2216

ACZ Laboratories, Inc.

Organic Quality Control Data Summary

COVER PAGE

Client:	RETEC Inc.	Report Date:	9/20/94
Project:		Date Received:	8/5/94
ACZ SDG No.:	L2723	Lab Nos.:	L2723-1 to 15, 20, 22 to 24
Matrix:	Water Samples WTPH-D by GC/FID, Deisel in Water		

	Sample Identification	Sample Date	Lab Number
1	3	08/03/94	L2723-1
2	4	08/03/94	L2723-2
3	4B	08/03/94	L2723-3
4	13	08/03/94	L2723-4
5	34	08/03/94	L2723-5
6	28	08/02/94	L2723-6
7	1	08/02/94	L2723-7
8	101	08/03/94	L2723-8
9	35	08/03/94	L2723-9
10	38	08/03/94	L2723-10
11	5	08/02/94	L2723-11
12	36	08/02/94	L2723-12
13	37	08/02/94	L2723-13
14	23	08/02/94	L2723-14
15	23B	08/02/94	L2723-15
16	19	08/02/94	L2723-20
17	100	08/02/94	L2723-22
18	SW-5	08/02/94	L2723-23
19	SW-6	08/03/94	L2723-24

Comments:

Name: D. Eric Woodland

Signature: [signature]

Title: Organic Manager

Date: 9/20/94

ACZ Laboratories, Inc.

Organic Quality Control Data Summary

SURROGATE SPIKE RECOVERIES

Client: RETEC Inc.
Project:
ACZ SDG No.: L2723

Report Date: 9/20/94
Date Received: 8/5/94
Lab Nos.: L2723-1 to 15, 20, 22 to 24

Matrix: Water Samples
WTPH-D by GC/FID, Deisel in Water

Lab Number	GC File	Analysis Date	OTP R%
BLANK 8/10	40817-7	08/17/94	89
BLANK 8/15	40818-16	08/19/94	84
DI MS	40818-17	08/19/94	89
DI MSD	40818-18	08/19/94	85
L2723-1	40815-7	08/15/94	64
L2723-2	40815-8	08/15/94	58
L2723-3	40817-8	08/17/94	70
L2723-4 10 DL	40817-23	08/18/94	DO ✓
L2723-5	40817-10	08/17/94	89
L2723-6	40817-11	08/17/94	70
L2723-7	40817-12	08/18/94	74
L2723-8	40817-14	08/18/94	80
L2723-9	40817-15	08/18/94	76
L2723-10	40817-16	08/18/94	82
L2723-11	40817-17	08/18/94	80
L2723-12	40817-18	08/18/94	81
L2723-13	40817-19	08/18/94	86
L2723-14	40817-20	08/18/94	86
L2723-15	40817-21	08/18/94	93
L2723-20	40817-22	08/18/94	57
L2723-22	40818-20	08/19/94	89
L2723-23	40818-21	08/19/94	87
L2723-24	40818-22	08/19/94	92

Note: OTP is ortho-Terphenyl

ACZ Laboratories, Inc.

Organic Quality Control Data Summary

METHOD BLANK DATA

Client: RETEC Inc.
Project:
ACZ SDG No.: L2723

Report Date: 9/20/94
Date Received: 8/5/94
Lab Nos.: L2723-1 to 15, 20, 22 to 24

Matrix: Water Samples
WTPH-D by GC/FID, Deisel in Water

Concentration Units ug/L

Compound	BLANK 8/10 FILE 40817-7 08/17/94	C	BLANK 8/15 40818-1 08/19/94	C		C		
W-TPH-D	0.2	U	0.2	U				

Note:

ACZ Laboratories, Inc.

Organic Quality Control Data Summary

MATRIX SPIKE / MATRIX SPIKE DUPLICATE RECOVERIES

Client: RETEC Inc.
Project:
ACZ SDG No.: L2723

Report Date: 9/20/94
Date Received: 8/5/94
Lab Nos.: L2723-1 to 15, 20, 22 to 24

Matrix: Water Samples
WTPH-D by GC/FID, Deisel in Water

Concentration Units 0

Compound	Sample No.	Sample Value ug/L	Spike Added ug/L	Matrix Spike ug/L	Matrix Spike Dup ug/L	Matrix Spike R%	Matrix Spike Dup R%	RPD%	
TPH	DI H20	0	2500	2300	2200	92	88	4.4	

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-01
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40815F-007
Sample ID:	3	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/9/94
Sample Date:	8/3/94	Date Analyzed:	8/15/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)	1.	0.2	

Carbon Range detected in sample: Diesel Components, C12-C24

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-02
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40815F-008
Sample ID:	4	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/9/94
Sample Date:	8/3/94	Date Analyzed:	8/15/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)	0.6	0.2	

Carbon Range detected in sample: Diesel Components C12-C24

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc.
30400 Downhill Dr.
Steamboat Springs, CO 80487

(800) 334-5493
FAX: (303) 879-2216

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-03
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40817F-008
Sample ID:	4B	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/10/94
Sample Date:	8/3/94	Date Analyzed:	8/17/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

	COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)		1.	0.2	

Carbon Range detected in sample: Diesel Components, C12-C24

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED:

Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-04
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40817F-023
Sample ID:	13	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/10/94
Sample Date:	8/3/94	Date Analyzed:	8/18/94
Report Date:	2/23/95	Dilution Factor:	10
		% Solids:	
Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)	6.5	0.2	

Carbon Range detected in sample: Diesel, C12-C24

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-05
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40817F-010
Sample ID:	34	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/10/94
Sample Date:	8/3/94	Date Analyzed:	8/17/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)	0.3	0.2	

Carbon Range detected in sample: Diesel Components, C12-C24

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED:

Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-06
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40817F-011
Sample ID:	28	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/10/94
Sample Date:	8/2/94	Date Analyzed:	8/17/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

	COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)		2.5	0.2	

Carbon Range detected in sample: Diesel, C12-C24

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-07
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40817F-012
Sample ID:	1	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/10/94
Sample Date:	8/2/94	Date Analyzed:	8/18/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

	COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)			0.2	U

Carbon Range detected in sample:

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-08
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40817F-014
Sample ID:	101	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/10/94
Sample Date:	8/3/94	Date Analyzed:	8/18/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)		0.2	U

Carbon Range detected in sample:

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ron Martino
Organic Laboratory Supervisor

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FAX: (303) 879-2216

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-09
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40817F-015
Sample ID:	35	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/10/94
Sample Date:	8/3/94	Date Analyzed:	8/18/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)	0.4	0.2	

Carbon Range detected in sample: Diesel Components, C12-C24

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-10
Client Project No:	3-1161	GC File ID:	40817F-016
Sample ID:	38	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/10/94
Sample Date:	8/3/94	Date Analyzed:	8/18/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID: WTPH - D by GC/FID
Diesel in Water

Concentration Units: mg/L

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)	0.3	0.2	

Carbon Range detected in sample: Diesel Components, C12-C24

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-11
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40817F-017
Sample ID:	5	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/10/94
Sample Date:	8/2/94	Date Analyzed:	8/18/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)	0.1	0.2	J

Carbon Range detected in sample: Diesel Components, C12-C24

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-12
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40817F-018
Sample ID:	36	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/10/94
Sample Date:	8/2/94	Date Analyzed:	8/18/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

	COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)		0.6	0.2	

Carbon Range detected in sample: Diesel, C12-C24

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature]
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ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-13
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40817F-019
Sample ID:	37	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/10/94
Sample Date:	8/2/94	Date Analyzed:	8/18/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

	COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)		0.5	0.2	

Carbon Range detected in sample: Diesel, C12-C24

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: Ron Martino
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-14
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40817F-020
Sample ID:	23	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/10/94
Sample Date:	8/2/94	Date Analyzed:	8/18/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)	0.3	0.2	

Carbon Range detected in sample: Diesel Components, C12-C24

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-20
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40817F-022
Sample ID:	19	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/10/94
Sample Date:	8/2/94	Date Analyzed:	8/18/94
Report Date:	2/23/95	Dilution Factor:	1
		% Solids:	
Method ID:	WTPH - D by GC/FID	Concentration Units:	mg/L

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)	0.2	0.2	

Carbon Range detected in sample: Diesel Components, C12-C24

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature]
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ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-15
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40817F-021
Sample ID:	23B	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/10/94
Sample Date:	8/2/94	Date Analyzed:	8/18/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)	0.3	0.2	

Carbon Range detected in sample: Diesel Components, C12-C24

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-22
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40818F-020
Sample ID:	100	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/15/94
Sample Date:	8/2/94	Date Analyzed:	8/19/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)		0.2	U

Carbon Range detected in sample:

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature]
Organic Laboratory Supervisor

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ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-23
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40818F-021
Sample ID:	SW-5	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/15/94
Sample Date:	8/2/94	Date Analyzed:	8/19/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID: WTPH - D by GC/FID
Diesel in Water

Concentration Units: mg/L

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)	0.1	0.2	J

Carbon Range detected in sample: Light Diesel Components, C12-C24

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-24
Client Project No:	3-1161, BN-Skykomish	GC File ID:	40818F-022
Sample ID:	SW-6	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/15/94
Sample Date:	8/2/94	Date Analyzed:	8/19/94
Report Date:	2/23/95	Dilution Factor:	1

Method ID:	WTPH - D by GC/FID Diesel in Water	Concentration Units:	mg/L

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbon Range (C9 - C36)	0.1	0.2	J

Carbon Range detected in sample: Light Diesel Components, C12-C24

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc.
Organic Quality Control Data Summary

COVER PAGE

Client:	RETEC Inc.	Report Date:	9/20/94
Project:		Date Received:	8/5/94
ACZ SDG No.:	L2723	Lab Nos.:	L2723-19 to 22

Matrix: Water Samples
PCBs by EPA Method 8080 by GC/ECD

	Sample Identification	Sample Date	Lab Number
1	9	08/02/94	L2723-19
2	19	08/02/94	L2723-20
3	19B	08/02/94	L2723-21
4	100	08/02/94	L2723-22

Comments:

Name: D. Eric Woodland Signature: [signature]

Title: Organic Manager Date: 9/20/94

ACZ Laboratories, Inc.

Organic Quality Control Data Summary

SURROGATE SPIKE RECOVERIES

Client: RETEC Inc.
Project:
ACZ SDG No.: L2723

Report Date: 9/20/94
Date Received: 8/5/94
Lab Nos.: L2723-19 to 22

Matrix: Water Samples
PCBs by EPA Method 8080 by GC/ECD

Lab Number	GC File	Analysis Date	DCB R%	TCX R%					
BLANK	40810-2	08/10/94	116	76					
L2723-19	40810-3	08/10/94	61	66					
L2723-20	40810-4	08/10/94	67	60					
L2723-21	40810-5	08/11/94	74	81					
L2723-22	40810-6	08/11/94	52	91					

DCB is decachlorobiphenyl and TCX is tetrachloro-m-xylene

ACZ Laboratories, Inc.

Organic Quality Control Data Summary

METHOD BLANK DATA

Client:	RETEC Inc.	Report Date:	9/20/94
Project:		Date Received:	8/5/94
ACZ SDG No.:	L2723	Lab Nos.:	L2723-19 to 22

Matrix: Water Samples
PCBs by EPA Method 8080 by GC/ECD

Concentration Units ug/L

Compound	BLANK FILE 40810-2 08/10/94 C			C		C		
PCBs	NONE	DETECTED						

Note:

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-22
Client Project No:	3-1161, BN-Skykomish	Lab File ID:	40810-06
Sample ID:	100	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/8/94
Sample Date:	8/2/94	Date Analyzed:	8/11/94
Report Date:	8/11/94	Dilution Factor:	1
Method ID:	PCBs BY EPA 8080, GC/ECD	Concentration Units:	ug/L

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor-1016		0.50	U
11104-28-2	Aroclor-1221		0.50	U
11141-16-5	Aroclor-1232		0.50	U
53469-21-9	Aroclor-1242		0.50	U
12672-29-6	Aroclor-1248		0.50	U
11097-69-1	Aroclor-1254		1.00	U
11096-82-5	Aroclor-1260		1.00	U

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-19
Client Project No:	3-1161, BN-Skykomish	Lab File ID:	40810-03
Sample ID:	9	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/8/94
Sample Date:	8/2/94	Date Analyzed:	8/10/94
Report Date:	8/11/94	Dilution Factor:	1
Method ID:	PCBs BY EPA 8080, GC/ECD	Concentration Units:	ug/L

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor-1016		0.50	U
11104-28-2	Aroclor-1221		0.50	U
11141-16-5	Aroclor-1232		0.50	U
53469-21-9	Aroclor-1242		0.50	U
12672-29-6	Aroclor-1248		0.50	U
11097-69-1	Aroclor-1254		1.00	U
11096-82-5	Aroclor-1260		1.00	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-20
Client Project No:	3-1161, BN-Skykomish	Lab File ID:	40810-04
Sample ID:	19	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/8/94
Sample Date:	8/2/94	Date Analyzed:	8/10/94
Report Date:	8/11/94	Dilution Factor:	1
Method ID:	PCBs BY EPA 8080, GC/ECD	Concentration Units:	ug/L

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor-1016		0.50	U
11104-28-2	Aroclor-1221		0.50	U
11141-16-5	Aroclor-1232		0.50	U
53469-21-9	Aroclor-1242		0.50	U
12672-29-6	Aroclor-1248		0.50	U
11097-69-1	Aroclor-1254		1.00	U
11096-82-5	Aroclor-1260		1.00	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature]
Organic Laboratory Supervisor

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ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	L2723-21
Client Project No:	3-1161, BN-Skykomish	Lab File ID:	40810-05
Sample ID:	19B	Date Received:	8/4/94
Matrix:	Water	Date Extracted:	8/8/94
Sample Date:	8/2/94	Date Analyzed:	8/11/94
Report Date:	8/11/94	Dilution Factor:	1
Method ID:	PCBs BY EPA 8080, GC/ECD	Concentration Units:	ug/L

CAS NO.	COMPOUND	CONCENTRATION	MDL	Q
12674-11-2	Aroclor-1016		0.50	U
11104-28-2	Aroclor-1221		0.50	U
11141-16-5	Aroclor-1232		0.50	U
53469-21-9	Aroclor-1242		0.50	U
12672-29-6	Aroclor-1248		0.50	U
11097-69-1	Aroclor-1254		1.00	U
11096-82-5	Aroclor-1260		1.00	U

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS:

APPROVED: [signature]
Organic Laboratory Supervisor

RETEC

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Seattle, WA 98134
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FAX (206) 624-2839

DATA VALIDATION REPORT

TO: Shelly Birch
FROM: Kim Lofgren
DATE: December 6, 1994
RE: Review of Analytical Data

1.0 GENERAL

PROJECT:	BNRR Skykomish #3-1161-340
DATE SAMPLED:	11/08/1994
RECEIVING LAB:	Analytical Resources, Incorporated.
ANALYTICAL METHODS:	Polynuclear aromatic hydrocarbons: SW846-8310
NUMBER OF SAMPLES:	15
MATRIX:	water
DATE(S) EXTRACTED:	all samples were extracted within the holding time limits
DATE(S) ANALYZED:	all samples were analyzed within the holding time limits

- Laboratory results with qualifiers are given as Attachment 1.
- All the samples and all of the Quality Assurance/Quality Control (QA/QC) in this data set have been reviewed with respect to holding times, method blanks, surrogate recoveries, matrix spikes, sample results, and any other QC measures (field blanks, lab blank spikes, field duplicates, etc.).

2.0 VALIDITY AND COMMENTS

This section summarizes only those instances where acceptance criteria were not met or a discussion of the data were warranted.

2.1 GENERAL COMMENTS

The objectives of this review were to determine the quality of the analytical data by examining the level of precision, accuracy, and completeness. Precision is a measure of the mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is determined through analysis of duplicate samples. The accuracy of data is the degree of agreement of a measurement with an accepted reference or true value. The level of accuracy is determined by examination of laboratory matrix spike analyses. Completeness is a determined by assessing the number of samples where valid results are reported versus the number of samples which were submitted to the laboratory for analysis. The overall measure of completeness will be the ratio of valid analyses received compared to the expected amount of data to be obtained under correct or normal conditions.

QA/QC for this project included specific criteria by which precision, accuracy, and completeness were evaluated. Precision, is measured through the evaluation of field QA/QC including duplicate analysis and analysis of field blanks. Evaluation of duplicate samples for precision was done using the relative percent difference (RPD). RPD is defined as the difference between two duplicate samples divided by the mean and expressed as a percent. The criteria for acceptable RPD values are 0-30% for water samples.

Laboratory QC, which evaluates accuracy, involves using a method blank (reagent blank) for approximately 20 actual samples, a matrix spike/matrix spike duplicate (MS/MSD) for approximately one out of every 20 samples, and analysis of surrogate standards for organic analyses. Method blanks are analyzed to identify compounds which are introduced during the laboratory extraction or analysis phase (i.e. laboratory contaminants). MS/MSD percent recoveries (%Rs) and RPD reported are compared to published QC limits. Surrogates are compounds that are "like" the compounds requested for analysis, but not structurally the same. They are analyzed to demonstrate that structurally similar compounds can be recovered and quantified by the lab. The completeness goal is set at 90%. The laboratory data showing the raw analytical data, the sample data results and all QA/QC backup data is found in Attachment 1.

All appropriate data were found in the raw data, the forms provided, or the narrative part of the report from Analytical Resources, Incorporated (ARI), Seattle, Washington. The amount extracted, dilution factor and amount analyzed was included for all of the samples in this data set. Table 1-1 provides a summary of the groundwater data. Parameters identified in the QA/QC review as outside the control limits are shown in bold and shaded. All samples with were analyzed for polynuclear aromatic hydrocarbon (PAH) analysis. Selected compounds in samples MW-11 and MW-23 had raised detection limits due to matrix interference.

2.2 HOLDING TIMES

The times and dates for sampling were taken from RETEC's Chain of Custody (COC). The dates for extraction and analyses were taken from the ARI organic analysis data sheets.

For the purpose of this review, the holding times stated in SW-846 were used to qualify data. All samples met the holding time requirements for the preparation type requirements unless otherwise stated in the appropriate analysis section of the report.

2.3 POLYNUCLEAR AROMATIC HYDROCARBONS - ANALYSIS OF WATER

Fifteen water samples were reviewed for PAH validity in this data set.

2.3.1 Method Blank and Field Blank

Method Blank - One method blank was extracted and analyzed with the PAH samples. Target analytes were not detected in the method blank.

Field Blank - Two field blanks (MW-101 and MW-102) were submitted, extracted and analyzed with the PAH samples. Table 2-1 summaries the results of the field blanks. No target analytes were detected in the field blanks. The non-positive results for MW-101 have been qualified with a "UJ" qualifier (the material was analyzed for, but not detected, and the sample quantitation limit is an estimated quantity) due to poor surrogate recoveries.

2.3.2 Surrogate Recovery

Surrogate percent recoveries (%Rs) for d14-terphenyl and d10-diphenyl were reported with each sample on the Organics Analysis Data Sheet (Form-1). The surrogate %Rs for samples MW-11, MW-101, MW-370 were outside the acceptable control limits of 59-160% for d14-terphenyl and 43-144% for d10-diphenyl. For samples MW-11, MW-101, and MW-370, the positive results have been qualified with a "J" qualifier (the associated numerical value is an estimated quantity), and non-positive results with a "UJ" qualifier based on poor surrogate recoveries, which indicates poor spiking technique.

2.3.3 Matrix Spike/Matrix Spike Duplicate (MS/MSD) and Blank Spike (BS)

One sample MS/MSD summary report (MW-16) was submitted with this data set. The MS %Rs ranged from 51.8-54.0%, and the MSD %Rs ranged from 84.4-87.2%, which are within acceptable control limits. However, the RPD values ranged from 44.0-50.6%, which exceeded the maximum allowable control limit of 30% for water samples, indicating poor spiking technique. No qualifiers were warranted based on the MS/MSD RPD values.

One blank spike (BS) was extracted and analyzed with this data set. All BS %Rs were within acceptable control limits.

2.3.4 Field and Laboratory Duplicates

Two field duplicates were included in this data set; however, were not labelled as such by RETEC personnel. Sample MW-370 is a field duplicate of sample MW-37, and MW-90 is a field duplicate of MW-9. Table 2-1 summarizes the RPD values for the samples and their corresponding duplicates. Five RPD values were calculated for MW-9 and MW-90, which ranged from 6.1-159%; and three RPD values were calculated for MW-37 and MW-370, which ranged from 8.4-183%. Six out of eight RPD values exceeded the maximum control limit of 30% for waters, suggesting poor field sampling techniques of laboratory procedures. However, for sample MW-370, the positive results have been qualified with a "J" qualifier and non-positive results with a "UJ" qualifier due to poor surrogate recoveries, indicating poor laboratory procedures. No data are qualified on the basis of duplicate analysis results alone.

Laboratory duplicates were not included in this sample set.

2.3.5 Overall Assessment of Data

The quantity of water extracted, the amounts analyzed and the dilution factors were included in this data set for all of the samples. All compounds were reviewed based on holding time limits, detection limits, method blank, field blanks, surrogate %Rs, MS/MSD %Rs, RPD values, and field duplicates. Samples MW-11, MW-101, and MW-370 positive results were qualified with a "J" qualifier and non-positive results with a "UJ" qualifier due to poor surrogate %Rs. All other data were found to be accurate based on the information given.

Field accuracy and precision have been determined acceptable based on the field blank.

Laboratory accuracy and precision have been determined acceptable based on method blanks, MS/MSD %Rs, BS %Rs, and surrogate %Rs.

2.4 CONCLUSION

Completeness is determined by assessing the number of samples where valid results were reported versus the number of samples which were submitted to the laboratory for analysis. The overall completeness goal is to achieve 90% valid data. A completeness goal of 90% was met for the water samples.

For field QA/QC, a completeness goal of 90% was also obtain for the duplicate analysis and the field blank. At least one duplicate sample was submitted for every ten samples. Since, disposable bailers were used instead of non disposable bailers decontamination blanks were not warranted.

For laboratory QA/QC, a completeness goal 90% was achieved for the method blanks, the RPD values, the surrogate recoveries, and the MS/MSD recoveries.

Matrix Spikes/Matrix Spike Duplicates and method blanks were exacted and analyzed for every 20 samples for each analyses. All MS/MSD recoveries were within control limits. Surrogate recoveries were analyzed with every sample for PAHs. Samples MW-11, MW-101, and MW-370 had suurogate %Rs below acceptable control limits.

Qualifiers

"J" = The associated numerical value is an estimated quantity.

"UJ" = The material was analyzed for, but was not detected. The sample quanitation limit is an estimated quantity.

References

EPA,1988. Laboratory Data Validation Functional Guidelines For Evaluating Organic Analyses. Prepared by The U.S. EPA Data Review Work Group.

TABLE 1-1

BNRR SKYKOMISH
WATER DATA VALIDATION
FOURTH QUARTER - NOVEMBER, 1994
ANALYTICAL RESOURCES, INCORPORATED

SAMPLE ID	DATE SAMPLED	DATE EXTRACTED	PARAMETERS ANALYZED	COMMENTS
MW-11	11/08/94	11/11/94	PAH (8310)	(1) Surrogates %Rs = NR Re-analyzed due to high analyte concentration, 1:100 dilution Surrogate %Rs = D, postive results qualified w/ "J", non-positive results w/ ""UJ"
MW-12	11/08/94	11/11/94	PAH (8310)	(1)
MW-34	11/08/94	11/11/94	PAH (8310)	(1) BDL
MW-9	11/08/94	11/11/94	PAH (8310)	(1)
MW-90 Field Duplicate of MW-9	11/08/94	11/11/94	PAH (8310)	(1) Field Dup - RPD values ranged from 6.1 - 159%, 2 out of 5 RPD values excceeded upper control limits
MW-16	11/08/94	11/11/94	PAH (8310)	(1) BDL MS %Rs ranged from 51.8-54.0%, w/in QC limits MSD %R ranged from 84.5-87.2%, w/in QC limits RPD values ranged 44.0-50.6%, exceeded QC limits
MW-5	11/08/94	11/11/94	PAH (8310)	(1)
MW-23	11/08/94	11/11/94	PAH (8310)	(1)
MW-101 Field Blank	11/08/94	11/11/94	PAH (8310)	(1) BDL Surrogates below QC liimits, non-positive results qualified w/ "UJ"
MW-35	11/08/94	11/11/94	PAH (8310)	(1)
MW-102 Field Blank	11/08/94	11/11/94	PAH (8310)	(1) BDL
MW-37	11/08/94	11/11/94	PAH (8310)	(1)
MW-38	11/08/94	11/11/94	PAH (8310)	BDL
MW-370 Field Duplicate of MW-37	11/08/94	11/11/94	PAH (8310)	(1) Surrogates %Rs = NR Surrogate %Rs = D, postive results qualified w/ "J", non-positive results w/ ""UJ" Field Dup - RPD values ranged from 8.4 - 183%, 2 out of 3 RPD values excceeded upper control limits
SW-5	11/08/94	11/11/94	PAH (8310)	(1)

TABLE 1-1

BNRR SKYKOMISH
WATER DATA VALIDATION
FOURTH QUARTER - NOVEMBER, 1994
ANALYTICAL RESOURCES, INCORPORATED

SAMPLE ID	DATE SAMPLED	DATE EXTRACTED	PARAMETERS ANALYZED	COMMENTS
Method Blank I904MB		11/11/94	PAH (8310)	(1)
BS I904SB		11/11/94	PAH (8310)	(1) BS %Rs ranged from 65.0-80.0%, w/in QC limits

ABBREVIATIONS/DEFINITIONS

(1) - Standard QA/QC including methods, analysis, detection limits, holding times, surrogate recoveries, etc. are within QA/QC limits unless otherwise noted.
QA - Quality assurance
QC - Quality control
PAH - Polynuclear aromatic hydrocabons
SVOC - Semivolatile organic compounds
MS - Matrix spike
MSD - Matrix spike duplicate
BS - Blank spike
%R - Percent recovery
BDL - Below detection limit
RPD - Relative percent difference
J - Qualifier denoting an estimated value
UJ - Qualifier denoting the quanitation limit is an estimated quantity
D - Diluted out
NR - Not recovered

TABLE 2-1

FOURTH QUARTER
PAH QA/QC ANALYTICAL RESULTS – WATER
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Sample ID: Lab Sample ID: Sample Date:		MW-9 I904D 11/08/94	MW-90 (MW-9 Dup) I904E 11/08/94	RPD [1] MW-9 MW-90 11/08/94	MW-37 I904L 11/08/94	MW-370 (MW-37 Dup) I904N 11/08/94	RPD [1] MW-37 MW-370 11/08/94
PAH (EPA 8310)							
Naphthalene	µg/L	< 1.8	< 1.8	NC	< 1.8	**1.6 J**	NC
Acenaphthylene	µg/L	< 2.3	< 2.3	NC	< 2.3	< 2.3 UJ	NC
Acenaphthene	µg/L	< 1.8	< 1.8	NC	< 1.8	< 1.8 UJ	NC
Fluorene	µg/L	**0.24**	**0.17 J**	**34.1**	**1.7**	**0.32 J**	**137**
Phenanthrene	µg/L	< 0.64	< 0.64	NC	< 0.64	< 0.64 UJ	NC
Anthracene	µg/L	**0.68**	**0.64 J**	**6.1**	**0.99**	**0.91 J**	**8.4**
Fluoranthene	µg/L	**1.3**	**0.15 J**	**159**	**8.8**	**0.39 J**	**183**
Pyrene	µg/L	< 0.27	< 0.27	NC	< 0.27	< 0.27 UJ	NC
Benzo(a)anthracene	µg/L	**0.20**	**0.14**	**35.3**	**0.10**	< 0.02 UJ	NC
Chrysene	µg/L	**0.09 J**	< 0.15	NC	**0.10 J**	< 0.15 UJ	NC
Benzo(b)fluoranthene	µg/L	**0.011 J**	< 0.020	NC	< 0.020	< 0.020 UJ	NC
Benzo(k)fluoranthene	µg/L	< 0.020	< 0.020	NC	< 0.020	< 0.020 UJ	NC
Benzo(a)pyrene	µg/L	< 0.030	< 0.030	NC	< 0.030	< 0.030 UJ	NC
Dibenz(a,h)anthracene	µg/L	< 0.030	< 0.030	NC	< 0.030	< 0.030 UJ	NC
Benzo(g,h,i)perylene	µg/L	< 0.080	< 0.080	NC	< 0.080	< 0.080 UJ	NC
Indeno(1,2,3-cd)pyrene	µg/L	**0.170**	**0.031 J**	**138**	< 0.050	< 0.050 UJ	NC

PAH – Polynuclear aromatic hydrocarbons
J – Indicates an estimated value above detection but below the PQL
UJ – The material was analyzed for, but was not detected. The sample quantitation limit is an estimated quantity.
NA – Not analyzed
NC – Not calculated
1. Relative percent difference = absolute value of $((X_1 - X_2)/(X_1 + {}_2)*1/2)*100$ where X_1 is the concentration of the orginal sample, and X_2 is the concentration of the duplicate sample.

TABLE 2–1 (Continued)

FOURTH QUARTER
PAH QA/QC ANALYTICAL RESULTS – WATER
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Sample ID:		MW–101 Field Blank	MW–102 Field Blank	PQL	DL	Method Blank	DL
Lab Sample ID:		I904I	I904K			I904MB	
Sample Date:		11/08/94	11/08/94			NA	
PAH (EPA 8310)							
Naphthalene	µg/L	< 1.8 UJ	< 1.8	6.0	1.8	< 1.8	1.0
Acenaphthylene	µg/L	< 2.3 UJ	< 2.3	7.6	2.3	< 2.3	1.0
Acenaphthene	µg/L	< 1.8 UJ	< 1.8	6.0	1.8	< 1.8	1.0
Fluorene	µg/L	< 0.21 UJ	< 0.21	0.70	0.21	< 0.21	1.0
Phenanthrene	µg/L	< 0.64 UJ	< 0.64	2.0	0.64	< 0.64	1.0
Anthracene	µg/L	< 0.66 UJ	< 0.66	2.2	0.66	< 0.66	1.0
Fluoranthene	µg/L	< 0.21 UJ	< 0.21	0.70	0.21	< 0.21	1.0
Pyrene	µg/L	< 0.27 UJ	< 0.27	0.90	0.27	< 0.27	1.0
Benzo(a)anthracene	µg/L	< 0.020 UJ	< 0.020	0.060	0.020	< 0.020	1.0
Chrysene	µg/L	< 0.15 UJ	< 0.15	0.50	0.15	< 0.15	1.0
Benzo(b)fluoranthene	µg/L	< 0.020 UJ	< 0.020	0.060	0.020	< 0.020	1.0
Benzo(k)fluoranthene	µg/L	< 0.020 UJ	< 0.020	0.060	0.020	< 0.020	1.0
Benzo(a)pyrene	µg/L	< 0.030 UJ	< 0.030	0.090	0.030	< 0.030	1.0
Dibenz(a,h)anthracene	µg/L	< 0.030 UJ	< 0.030	0.10	0.030	< 0.030	1.0
Benzo(g,h,i)perylene	µg/L	< 0.080 UJ	< 0.080	0.25	0.080	< 0.080	1.0
Indeno(1,2,3–cd)pyrene	µg/L	< 0.05 UJ	< 0.05	0.24	0.05	< 0.05	1.0

PAH – Polynuclear aromatic hydrocarbons
J – Indicates an estimated value above detection but below the PQL
UJ – The material was analyzed for, but was not detected. The sample quantitation limit is an estimated quantity.
NA – Not analyzed
NC – Not calculated
1. Relative percent difference = absolute value of $((X_1 - X_2)/(X_1 + {}_2)$*1/ where X_1 is the concentration of the orginal sample, and X_2 is the concentration of the duplicate sample.

ATTACHMENT 1

Analytical Resources, Incorporated
Analytical Chemists and Consultants

25 November 1994

Shelly Birch
Remediation Technologies Inc.
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134

RE: Client Project: 3-1161-320 BN-Skykomish;
ARI Project: #I904

Dear Ms. Birch,

Please find enclosed the original chain-of-custody record (COC) and results for the above referenced project. Fifteen water samples were received on 11/9/94, in good condition. There were no discrepancies between the COC and sample containers, and the log-in procedure was without incident of note.

As we discussed on the telephone on 11/17, samples **101** and **370** have very low/no surrogate recoveries. This is due either to matrix effect, or to an error made during the extraction process, however there was no extra volume to perform reextractions, therefore no corrective action could be taken.

Sample **11** required analysis at a 1 to 100 dilution due to analyte concentrations that saturated the detector ("S" qualified) and were above the linear range of the instrument ("E" qualified). Note that there are compounds with raised detection limits on the reports for samples **11**, its dilution, and **23**, denoted with the "Y" qualifier. These compounds are undetected at the levels shown; the limits had to be raised due to matrix interferences.

There were no samples designated for QC analyses, however additional volume was provided for sample **16**, which was, therefore, extracted as a matrix spike and matrix spike duplicate (MS/MSD). A Laboratory Control Sample was also extracted and analyzed with these samples, and the recoveries reported, to provide additional QC documentation for the project.

A copy of this package will be kept on file with ARI should you require any further information or copies of additional documentation. If you have any questions please feel free to call any time.

Sincerely,
ANALYTICAL RESOURCES, INC.

Kate Stegemoeller
Project Manager
206-340-2866, ext. 117

Enclosures
cc: file #I904

Nº 5399

CHAIN OF CUSTODY RECORD

I904

PROJ. NO.: 3-1161-320

PROJECT NAME: BN - Skykomish

SAMPLERS: D. Kinney

RECEIVING LABORATORY: ARI

SEND RESULTS TO: Shelly Birch

Cooler temp ① 4.0°C ② 4.0°C

LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS	PAH (method 8310)							REMARKS
	11/8/94	0855	11	1	X							2 coolers
	↓	0920	12	1	X							
	↓	1140	34	1	X							
	↓	1030	9	1	X							
	↓	1035	90	1	X							
	↓	1105	16	2	X							
	↓	1620	5	1	X							
	↓	1440	23	1	X							
	↓	1420	101	1	X							
	↓	1225	35	1	X							
	↓	1140	102	1	X							
	↓	1310	37	1	X							
	↓	1355	38	1	X							
	↓	1320	370	1	X							
	↓	1600	SW-5	1	X							

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
[signature]	11/8/94 2000	Shelly S. Birch			

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time
Shelly S. Birch	11/9/94 0820	Shelby Miller	11/9/94 12:10

Shipper Information: Courier

RETEC
REMEDIATION TECHNOLOGIES INC

REMEDIATION TECHNOLOGIES
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PINK COPY - Sampler   YELLOW COPY - Laboratory   WHITE COPY - ReTeC

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Facsimile

Date of transmittal: 12/05/94 Time: 10:09

Addressee: **Kim Lofgren** Fax No: (206) 624-2839

Company: Retec Phone No: (206) 624-9349

From: Kate Stegemoeller Fax No: (206) 621-7523

Number of pages: 2 Phone No: (206) 621-6490
(including this cover page)

If you do not receive the number of pages indicated, please contact sender at ARI immediately.

Message

Kim,

Here is the table of MDL, RL, and QL values for PAHs by Method 8310. I'm sorry for my confused state on Friday. Up until now the reported detection limits we've used have been from the SW-846 method specifications. Now that we have completed the MDL study, we have set these limits as more appropriate for our capabilities. As you can see, some are lower and some are higher than those previously reported. These should only be applied to analyses done from this point forward. If you have questions about this or need more, information, don't hesitate to call me, or perhaps Michelle Turner, our QA Manager.

333 Ninth Avenue North • Seattle WA 98109-5187 • **206-621-6490** • **206-621-7523** fax

METHOD REPORTING AND QUANTITATION LIMITS
Polynuclear Aromatic Hydrocarbons by HPLC

Analyte	Water MDL	Water RL	Water QL	Soil MDL	Soil RL	Soil QL	Tissue NA	Tissue RL	Tissue QL
Naphthalene	2.5	2.5	5.0	15	120	240	NA	NA	NA
Acenaphthylene	5.3	5.3	11	60	150	300	NA	NA	NA
Acenaphthene	0.73	1.8	5.0	30	120	240	NA	NA	NA
Fluorene	0.46	0.46	0.92	1.5	13	26	NA	NA	NA
Phenanthrene	0.06	0.20	0.64	3.0	13	26	NA	NA	NA
Anthracene	0.07	0.20	0.66	1.3	13	26	NA	NA	NA
Fluoranthene	0.49	0.49	0.99	3.5	13	26	NA	NA	NA
Pyrene	0.05	0.10	0.27	2.1	7.0	14	NA	NA	NA
Benzo(a)Anthracene	0.05	0.05	0.10	1.3	1.3	2.6	NA	NA	NA
Chrysene	0.05	0.08	0.16	1.7	6.0	12	NA	NA	NA
Benzo(b)Fluoranthene				0.74	1.2	3.6	NA	NA	NA
Benzo(k)Fluoranthene	0.06	0.06	0.11	0.47	1.1	3.3	NA	NA	NA
Benzo(a)Pyrene	0.07	0.07	0.15	0.34	1.7	3.4	NA	NA	NA
Dibenz(a,h)Anthracene	0.45	0.45	0.90	0.46	2.0	4.0	NA	NA	NA
Benzo(ghi)Perylene	0.11	0.11	0.22	0.78	5.0	10	NA	NA	NA
Indeno(1,2,3-cd)Pyrene	0.07	0.07	0.15	1.1	2.9	5.8	NA	NA	NA
Units:		µg/L			µg/kg			µg/kg	

Method Detection Limit (MDL) studies were performed in accordance with 40 CFR Part 136, Appendix B, using six degrees of freedom.

MDLs are statistically derived values, and are a measure of short term precision. True detection at the statistical MDL may not be achievable for all analytes and methods.

Reporting Limit (RL) : The RL is the lowest value at which qualitative detection of a given analyte is reported. The RL is based on the statistical MDL, method efficiency, and analyte response. The RL will, at minimum, equal the statistical MDL. The RL will exceed the statistical MDL for the more variable analytes or methods.

Quantitation Limit (QL): The QL is the level at which an analyte is considered quantifiable. The QL defines the lower limit of the useful range of measurements. The QL is generally two to five times the RL, depending upon the analyte and method. The QL will, at minimum, equal the RL.

NA indicates data not available.

ANALYTICAL RESOURCES INCORPORATED

Analytical Chemists & Consultants

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(206) 621-7523 (FAX)

ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: Method Blank

Lab Sample ID: I904MB
LIMS ID: 94-18930
Matrix: Water

QC Report No: I904-Remediation Technologies, Inc.
Project: BN-SKYKOMISH
3-1161-320
Date Sampled: NA
Date Received: NA

Data Release Authorized:
Reported: 11/23/94

Date extracted: 11/11/94
Date analyzed: 11/17/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L	
91-20-3	Naphthalene	1.8	U
83-32-9	Acenaphthylene	2.3	U
208-96-8	Acenaphthene	1.8	U
86-73-7	Fluorene	0.21	U
85-01-8	Phenanthrene	0.64	U
120-12-7	Anthracene	0.66	U
206-44-0	Fluoranthene	0.21	U
129-00-0	Pyrene	0.27	U
56-55-3	Benzo(a)anthracene	0.020	U
218-01-9	Chrysene	0.15	U
205-99-2	Benzo(b)fluoranthene	0.020	U
207-08-9	Benzo(k)fluoranthene	0.020	U
50-32-8	Benzo(a)pyrene	0.030	U
53-70-3	Dibenzo(a,h)anthracene	0.030	U
191-24-2	Benzo(g,h,i)perylene	0.080	U
193-39-5	Indeno(1,2,3-cd)pyrene	0.050	U

Surrogate Recoveries

Diphenyl	61.0%
Terphenyl	75.2%

Data Qualifiers

U Indicates compound was analyzed for, but not detected at the given detection limit.
J Indicates an estimated value when that result is less than the calculated detection limit.
E Indicates a value above the linear range of the detector. Dilution Required
S Indicates no value reported due to saturation of the detector.
D Indicates the surrogate was diluted out.
B Found in associated method blank.
Y Indicates a raised detection limit due to matrix interference.
NA Indicates compound was not analyzed.
NR Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 11

Lab Sample ID: I904A
LIMS ID: 94-18930
Matrix: Water

QC Report No: I904-Remediation Technologies, Inc.
Project: BN-SKYKOMISH
3-1161-320
Date Sampled: 11/08/94
Date Received: 11/09/94

Data Release Authorized: [signature]
Reported: 11/23/94

Date extracted: 11/11/94
Date analyzed: 11/18/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L	
91-20-3	**Naphthalene**	**26**	
83-32-9	**Acenaphthylene**	**9.3**	
208-96-8	**Acenaphthene**	**28**	
86-73-7	**Fluorene**	**24**	**E**
85-01-8	**Phenanthrene**	**Comment**	**S**
120-12-7	**Anthracene**	**Comment**	**S**
206-44-0	**Fluoranthene**	**Comment**	**S**
129-00-0	**Pyrene**	**12**	**E**
56-55-3	**Benzo(a)anthracene**	**3.7**	
218-01-9	**Chrysene**	**1.6**	
205-99-2	Benzo(b)fluoranthene	0.47	Y
207-08-9	Benzo(k)fluoranthene	0.74	Y
50-32-8	Benzo(a)pyrene	0.18	Y
53-70-3	Dibenzo(a,h)anthracene	0.13	Y
191-24-2	Benzo(g,h,i)perylene	0.70	Y
193-39-5	Indeno(1,2,3-cd)pyrene	0.050	U

Surrogate Recoveries

Diphenyl	NR
Terphenyl	NR

Data Qualifiers

- U Indicates compound was analyzed for, but not detected at the given detection limit.
- J Indicates an estimated value when that result is less than the calculated detection limit.
- E Indicates a value above the linear range of the detector. Dilution Required
- S Indicates no value reported due to saturation of the detector.
- D Indicates the surrogate was diluted out.
- B Found in associated method blank.
- Y Indicates a raised detection limit due to matrix interference.
- NA Indicates compound was not analyzed.
- NR Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 11
DILUTION

Lab Sample ID: I904A-DL
LIMS ID: 94-18930
Matrix: Water

QC Report No: I904-Remediation Technologies, Inc.
Project: BN-SKYKOMISH
3-1161-320
Date Sampled: 11/08/94
Date Received: 11/09/94

Data Release Authorized:
Reported: 11/23/94

Date extracted: 11/11/94
Date analyzed: 11/18/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:100

CAS Number	Analyte	ug/L
91-20-3	Naphthalene	180 U
83-32-9	Acenaphthylene	230 U
208-96-8	Acenaphthene	180 U
86-73-7	**Fluorene**	**24**
85-01-8	**Phenanthrene**	**97**
120-12-7	Anthracene	66 U
206-44-0	**Fluoranthene**	**1,500**
129-00-0	Pyrene	400 Y
56-55-3	Benzo(a)anthracene	16 Y
218-01-9	Chrysene	16 Y
205-99-2	Benzo(b)fluoranthene	2.0 U
207-08-9	Benzo(k)fluoranthene	2.0 U
50-32-8	Benzo(a)pyrene	3.0 U
53-70-3	Dibenzo(a,h)anthracene	3.0 U
191-24-2	Benzo(g,h,i)perylene	8.0 U
193-39-5	Indeno(1,2,3-cd)pyrene	5.0 U

Surrogate Recoveries

Diphenyl	D
Terphenyl	D

Data Qualifiers

- U Indicates compound was analyzed for, but not detected at the given detection limit.
- J Indicates an estimated value when that result is less than the calculated detection limit.
- E Indicates a value above the linear range of the detector. Dilution Required
- S Indicates no value reported due to saturation of the detector.
- D Indicates the surrogate was diluted out.
- B Found in associated method blank.
- Y Indicates a raised detection limit due to matrix interference.
- NA Indicates compound was not analyzed.
- NR Indicates no recovery due to interferences.

FORM-1

ANALYTICAL
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INCORPORATED

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 12

Lab Sample ID: I904B
LIMS ID: 94-18931
Matrix: Water

QC Report No: I904-Remediation Technologies, Inc.
Project: BN-SKYKOMISH
3-1161-320
Date Sampled: 11/08/94
Date Received: 11/08/94

Data Release Authorized:
Reported: 11/23/94

Date extracted: 11/11/94
Date analyzed: 11/18/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L	
91-20-3	Naphthalene	1.8	U
83-32-9	Acenaphthylene	2.3	U
208-96-8	Acenaphthene	1.8	U
86-73-7	Fluorene	0.21	U
85-01-8	Phenanthrene	0.64	U
120-12-7	Anthracene	0.66	U
206-44-0	Fluoranthene	0.21	U
129-00-0	Pyrene	0.27	U
56-55-3	**Benzo(a)anthracene**	**0.063**	
218-01-9	Chrysene	0.15	U
205-99-2	**Benzo(b)fluoranthene**	**0.014**	**J**
207-08-9	Benzo(k)fluoranthene	0.020	U
50-32-8	Benzo(a)pyrene	0.030	U
53-70-3	**Dibenzo(a,h)anthracene**	**0.045**	
191-24-2	Benzo(g,h,i)perylene	0.080	U
193-39-5	Indeno(1,2,3-cd)pyrene	0.050	U

Surrogate Recoveries

Diphenyl	68.6%
Terphenyl	66.8%

Data Qualifiers

U Indicates compound was analyzed for, but not detected at the given detection limit.
J Indicates an estimated value when that result is less than the calculated detection limit.
E Indicates a value above the linear range of the detector. Dilution Required
S Indicates no value reported due to saturation of the detector.
D Indicates the surrogate was diluted out.
B Found in associated method blank.
Y Indicates a raised detection limit due to matrix interference.
NA Indicates compound was not analyzed.
NR Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 34

Lab Sample ID: I904C
LIMS ID: 94-18932
Matrix: Water

QC Report No: I904-Remediation Technologies, Inc.
Project: BN-SKYKOMISH
3-1161-320
Date Sampled: 11/08/94
Date Received: 11/09/94

Data Release Authorized: [signature]
Reported: 11/23/94

Date extracted: 11/11/94
Date analyzed: 11/17/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L
91-20-3	Naphthalene	1.8 U
83-32-9	Acenaphthylene	2.3 U
208-96-8	Acenaphthene	1.8 U
86-73-7	Fluorene	0.21 U
85-01-8	Phenanthrene	0.64 U
120-12-7	Anthracene	0.66 U
206-44-0	Fluoranthene	0.21 U
129-00-0	Pyrene	0.27 U
56-55-3	Benzo(a)anthracene	0.020 U
218-01-9	Chrysene	0.15 U
205-99-2	Benzo(b)fluoranthene	0.020 U
207-08-9	Benzo(k)fluoranthene	0.020 U
50-32-8	Benzo(a)pyrene	0.030 U
53-70-3	Dibenzo(a,h)anthracene	0.030 U
191-24-2	Benzo(g,h,i)perylene	0.080 U
193-39-5	Indeno(1,2,3-cd)pyrene	0.050 U

Surrogate Recoveries

Diphenyl	78.2%
Terphenyl	71.5%

Data Qualifiers

U	Indicates compound was analyzed for, but not detected at the given detection limit.
J	Indicates an estimated value when that result is less than the calculated detection limit.
E	Indicates a value above the linear range of the detector. Dilution Required
S	Indicates no value reported due to saturation of the detector.
D	Indicates the surrogate was diluted out.
B	Found in associated method blank.
Y	Indicates a raised detection limit due to matrix interference.
NA	Indicates compound was not analyzed.
NR	Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 9

Lab Sample ID: I904D
LIMS ID: 94-18933
Matrix: Water

QC Report No: I904-Remediation Technologies, Inc.
Project: BN-SKYKOMISH
3-1161-320
Date Sampled: 11/08/94
Date Received: 11/09/94

Data Release Authorized: [signature]
Reported: 11/23/94

Date extracted: 11/11/94
Date analyzed: 11/18/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L	
91-20-3	Naphthalene	1.8	U
83-32-9	Acenaphthylene	2.3	U
208-96-8	Acenaphthene	1.8	U
86-73-7	**Fluorene**	**0.24**	
85-01-8	Phenanthrene	0.64	U
120-12-7	**Anthracene**	**0.68**	
206-44-0	**Fluoranthene**	**1.3**	
129-00-0	Pyrene	0.27	U
56-55-3	**Benzo(a)anthracene**	**0.20**	
218-01-9	**Chrysene**	**0.090**	**J**
205-99-2	**Benzo(b)fluoranthene**	**0.011**	**J**
207-08-9	Benzo(k)fluoranthene	0.020	U
50-32-8	Benzo(a)pyrene	0.030	U
53-70-3	Dibenzo(a,h)anthracene	0.030	U
191-24-2	Benzo(g,h,i)perylene	0.080	U
193-39-5	**Indeno(1,2,3-cd)pyrene**	**0.17**	

Surrogate Recoveries

Diphenyl	95.0%
Terphenyl	79.5%

Data Qualifiers

U	Indicates compound was analyzed for, but not detected at the given detection limit.
J	Indicates an estimated value when that result is less than the calculated detection limit.
E	Indicates a value above the linear range of the detector. Dilution Required
S	Indicates no value reported due to saturation of the detector.
D	Indicates the surrogate was diluted out.
B	Found in associated method blank.
Y	Indicates a raised detection limit due to matrix interference.
NA	Indicates compound was not analyzed.
NR	Indicates no recovery due to interferences.

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Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 90

Lab Sample ID: I904E
LIMS ID: 94-18934
Matrix: Water

QC Report No: I904-Remediation Technologies, Inc.
Project: BN-SKYKOMISH
3-1161-320
Date Sampled: 11/08/94
Date Received: 11/09/94

Data Release Authorized: [signature]
Reported: 11/23/94

Date extracted: 11/11/94
Date analyzed: 11/18/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L
91-20-3	Naphthalene	1.8 U
83-32-9	Acenaphthylene	2.3 U
208-96-8	Acenaphthene	1.8 U
86-73-7	**Fluorene**	**0.17 J**
85-01-8	Phenanthrene	0.64 U
120-12-7	**Anthracene**	**0.64 J**
206-44-0	**Fluoranthene**	**0.15 J**
129-00-0	Pyrene	0.27 U
56-55-3	**Benzo(a)anthracene**	**0.14**
218-01-9	Chrysene	0.15 U
205-99-2	Benzo(b)fluoranthene	0.020 U
207-08-9	Benzo(k)fluoranthene	0.020 U
50-32-8	Benzo(a)pyrene	0.030 U
53-70-3	Dibenzo(a,h)anthracene	0.030 U
191-24-2	Benzo(g,h,i)perylene	0.080 U
193-39-5	**Indeno(1,2,3-cd)pyrene**	**0.031 J**

Surrogate Recoveries

Diphenyl	78.6%
Terphenyl	77.8%

Data Qualifiers

- U Indicates compound was analyzed for, but not detected at the given detection limit.
- J Indicates an estimated value when that result is less than the calculated detection limit.
- E Indicates a value above the linear range of the detector. Dilution Required
- S Indicates no value reported due to saturation of the detector.
- D Indicates the surrogate was diluted out.
- B Found in associated method blank.
- Y Indicates a raised detection limit due to matrix interference.
- NA Indicates compound was not analyzed.
- NR Indicates no recovery due to interferences.

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Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 16

Lab Sample ID: I904F
LIMS ID: 94-18935
Matrix: Water

QC Report No: I904-Remediation Technologies, Inc.
Project: BN-SKYKOMISH
3-1161-320
Date Sampled: 11/08/94
Date Received: 11/09/94

Data Release Authorized:
Reported: 11/23/94

Date extracted: 11/11/94
Date analyzed: 11/17/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L
91-20-3	Naphthalene	1.8 U
83-32-9	Acenaphthylene	2.3 U
208-96-8	Acenaphthene	1.8 U
86-73-7	Fluorene	0.21 U
85-01-8	Phenanthrene	0.64 U
120-12-7	Anthracene	0.66 U
206-44-0	Fluoranthene	0.21 U
129-00-0	Pyrene	0.27 U
56-55-3	Benzo(a)anthracene	0.020 U
218-01-9	Chrysene	0.15 U
205-99-2	Benzo(b)fluoranthene	0.020 U
207-08-9	Benzo(k)fluoranthene	0.020 U
50-32-8	Benzo(a)pyrene	0.030 U
53-70-3	Dibenzo(a,h)anthracene	0.030 U
191-24-2	Benzo(g,h,i)perylene	0.080 U
193-39-5	Indeno(1,2,3-cd)pyrene	0.050 U

Surrogate Recoveries

Diphenyl	76.2%
Terphenyl	73.0%

Data Qualifiers

U	Indicates compound was analyzed for, but not detected at the given detection limit.
J	Indicates an estimated value when that result is less than the calculated detection limit.
E	Indicates a value above the linear range of the detector. Dilution Required
S	Indicates no value reported due to saturation of the detector.
D	Indicates the surrogate was diluted out.
B	Found in associated method blank.
Y	Indicates a raised detection limit due to matrix interference.
NA	Indicates compound was not analyzed.
NR	Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 16
MATRIX SPIKE

Lab Sample ID: I904F-MS
LIMS ID: 94-18935
Matrix: Water

QC Report No: I904-Remediation Technologies, Inc.
Project: BN-SKYKOMISH
3-1161-320
Date Sampled: 11/08/94
Date Received: 11/09/94

Data Release Authorized:
Reported: 11/23/94

Date extracted: 11/11/94
Date analyzed: 11/17/94
Sample Amount: 500 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L
91-20-3	Naphthalene	3.6 U
83-32-9	Acenaphthylene	4.6 U
208-96-8	Acenaphthene	---
86-73-7	Fluorene	0.42 U
85-01-8	Phenanthrene	1.3 U
120-12-7	Anthracene	1.3 U
206-44-0	Fluoranthene	---
129-00-0	Pyrene	0.54 U
56-55-3	Benzo(a)anthracene	---
218-01-9	Chrysene	0.30 U
205-99-2	Benzo(b)fluoranthene	0.036 U
207-08-9	Benzo(k)fluoranthene	0.034 U
50-32-8	Benzo(a)pyrene	0.046 U
53-70-3	Dibenzo(a,h)anthracene	0.060 U
191-24-2	Benzo(g,h,i)perylene	0.15 U
193-39-5	Indeno(1,2,3-cd)pyrene	0.086 U

Surrogate Recoveries

Diphenyl	76.3%
Terphenyl	81.4%

Data Qualifiers

- U Indicates compound was analyzed for, but not detected at the given detection limit.
- J Indicates an estimated value when that result is less than the calculated detection limit.
- E Indicates a value above the linear range of the detector. Dilution Required
- S Indicates no value reported due to saturation of the detector.
- D Indicates the surrogate was diluted out.
- B Found in associated method blank.
- Y Indicates a raised detection limit due to matrix interference.
- NA Indicates compound was not analyzed.
- NR Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 16
MS DUPLICATE

Lab Sample ID: I904F-MSD
LIMS ID: 94-18935
Matrix: Water

QC Report No: I904-Remediation Technologies, Inc.
Project: BN-SKYKOMISH
3-1161-320
Date Sampled: 11/08/94
Date Received: 11/09/94

Data Release Authorized:
Reported: 11/23/94

Date extracted: 11/11/94
Date analyzed: 11/17/94
Sample Amount: 500 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: No
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L
91-20-3	Naphthalene	3.6 U
83-32-9	Acenaphthylene	4.6 U
208-96-8	Acenaphthene	---
86-73-7	Fluorene	0.42 U
85-01-8	Phenanthrene	1.3 U
120-12-7	Anthracene	1.3 U
206-44-0	Fluoranthene	---
129-00-0	Pyrene	0.54 U
56-55-3	Benzo(a)anthracene	---
218-01-9	Chrysene	0.30 U
205-99-2	Benzo(b)fluoranthene	0.036 U
207-08-9	Benzo(k)fluoranthene	0.034 U
50-32-8	Benzo(a)pyrene	0.046 U
53-70-3	Dibenzo(a,h)anthracene	0.060 U
191-24-2	Benzo(g,h,i)perylene	0.15 U
193-39-5	Indeno(1,2,3-cd)pyrene	0.086 U

Surrogate Recoveries

Diphenyl	76.7%
Terphenyl	79.0%

Data Qualifiers

U Indicates compound was analyzed for, but not detected at the given detection limit.
J Indicates an estimated value when that result is less than the calculated detection limit.
E Indicates a value above the linear range of the detector. Dilution Required
S Indicates no value reported due to saturation of the detector.
D Indicates the surrogate was diluted out.
B Found in associated method blank.
Y Indicates a raised detection limit due to matrix interference.
NA Indicates compound was not analyzed.
NR Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 5

Lab Sample ID: I904G
LIMS ID: 94-18936
Matrix: Water

QC Report No: I904-Remediation Technologies, Inc.
Project: BN-SKYKOMISH
3-1161-320
Date Sampled: 11/08/94
Date Received: 11/09/94

Data Release Authorized:
Reported: 11/23/94

Date extracted: 11/11/94
Date analyzed: 11/17/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L	
91-20-3	Naphthalene	1.8	U
83-32-9	Acenaphthylene	2.3	U
208-96-8	Acenaphthene	1.8	U
86-73-7	Fluorene	0.21	U
85-01-8	Phenanthrene	0.64	U
120-12-7	Anthracene	0.66	U
206-44-0	Fluoranthene	0.21	U
129-00-0	Pyrene	0.27	U
56-55-3	**Benzo(a)anthracene**	**0.063**	
218-01-9	Chrysene	0.15	U
205-99-2	Benzo(b)fluoranthene	0.020	U
207-08-9	Benzo(k)fluoranthene	0.020	U
50-32-8	Benzo(a)pyrene	0.030	U
53-70-3	Dibenzo(a,h)anthracene	0.030	U
191-24-2	Benzo(g,h,i)perylene	0.080	U
193-39-5	Indeno(1,2,3-cd)pyrene	0.050	U

Surrogate Recoveries

Diphenyl	90.1%
Terphenyl	66.3%

Data Qualifiers

- U Indicates compound was analyzed for, but not detected at the given detection limit.
- J Indicates an estimated value when that result is less than the calculated detection limit.
- E Indicates a value above the linear range of the detector. Dilution Required
- S Indicates no value reported due to saturation of the detector.
- D Indicates the surrogate was diluted out.
- B Found in associated method blank.
- Y Indicates a raised detection limit due to matrix interference.
- NA Indicates compound was not analyzed.
- NR Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 23

Lab Sample ID: I904H
LIMS ID: 94-18937
Matrix: Water

QC Report No: I904-Remediation Technologies, Inc.
Project: BN-SKYKOMISH
3-1161-320
Date Sampled: 11/08/94
Date Received: 11/09/94

Data Release Authorized: [signature]
Reported: 11/23/94

Date extracted: 11/11/94
Date analyzed: 11/18/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L	
91-20-3	Naphthalene	1.8	U
83-32-9	Acenaphthylene	2.3	U
208-96-8	Acenaphthene	1.8	U
86-73-7	Fluorene	0.21	U
85-01-8	Phenanthrene	0.64	U
120-12-7	Anthracene	0.66	U
206-44-0	Fluoranthene	0.21	U
129-00-0	Pyrene	0.27	U
56-55-3	**Benzo(a)anthracene**	**0.042**	
218-01-9	Chrysene	0.15	U
205-99-2	**Benzo(b)fluoranthene**	**0.073**	
207-08-9	**Benzo(k)fluoranthene**	**0.024**	
50-32-8	Benzo(a)pyrene	0.030	U
53-70-3	Dibenzo(a,h)anthracene	0.20	Y
191-24-2	Benzo(g,h,i)perylene	0.080	U
193-39-5	Indeno(1,2,3-cd)pyrene	0.080	Y

Surrogate Recoveries

Diphenyl	70.1%
Terphenyl	71.6%

Data Qualifiers

U	Indicates compound was analyzed for, but not detected at the given detection limit.
J	Indicates an estimated value when that result is less than the calculated detection limit.
E	Indicates a value above the linear range of the detector. Dilution Required
S	Indicates no value reported due to saturation of the detector.
D	Indicates the surrogate was diluted out.
B	Found in associated method blank.
Y	Indicates a raised detection limit due to matrix interference.
NA	Indicates compound was not analyzed.
NR	Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 101

Lab Sample ID: I904I
LIMS ID: 94-18938
Matrix: Water

QC Report No: I904-Remediation Technologies, Inc.
Project: BN-SKYKOMISH
3-1161-320
Date Sampled: 11/08/94
Date Received: 11/09/94

Data Release Authorized:
Reported: 11/23/94

Date extracted: 11/11/94
Date analyzed: 11/17/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L
91-20-3	Naphthalene	1.8 U
83-32-9	Acenaphthylene	2.3 U
208-96-8	Acenaphthene	1.8 U
86-73-7	Fluorene	0.21 U
85-01-8	Phenanthrene	0.64 U
120-12-7	Anthracene	0.66 U
206-44-0	Fluoranthene	0.21 U
129-00-0	Pyrene	0.27 U
56-55-3	Benzo(a)anthracene	0.020 U
218-01-9	Chrysene	0.15 U
205-99-2	Benzo(b)fluoranthene	0.020 U
207-08-9	Benzo(k)fluoranthene	0.020 U
50-32-8	Benzo(a)pyrene	0.030 U
53-70-3	Dibenzo(a,h)anthracene	0.030 U
191-24-2	Benzo(g,h,i)perylene	0.080 U
193-39-5	Indeno(1,2,3-cd)pyrene	0.050 U

Surrogate Recoveries

Diphenyl	6.8%
Terphenyl	9.4%

Data Qualifiers

U	Indicates compound was analyzed for, but not detected at the given detection limit.
J	Indicates an estimated value when that result is less than the calculated detection limit.
E	Indicates a value above the linear range of the detector. Dilution Required
S	Indicates no value reported due to saturation of the detector.
D	Indicates the surrogate was diluted out.
B	Found in associated method blank.
Y	Indicates a raised detection limit due to matrix interference.
NA	Indicates compound was not analyzed.
NR	Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 35

Lab Sample ID: I904J
LIMS ID: 94-18939
Matrix: Water

QC Report No: I904-Remediation Technologies, Inc.
Project: BN-SKYKOMISH
3-1161-320
Date Sampled: 11/08/94
Date Received: 11/09/94

Data Release Authorized:
Reported: 11/23/94

Date extracted: 11/11/94
Date analyzed: 11/17/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L	
91-20-3	Naphthalene	1.8	U
83-32-9	Acenaphthylene	2.3	U
208-96-8	Acenaphthene	1.8	U
86-73-7	**Fluorene**	**0.17**	**J**
85-01-8	Phenanthrene	0.64	U
120-12-7	Anthracene	0.66	U
206-44-0	Fluoranthene	0.21	U
129-00-0	Pyrene	0.27	U
56-55-3	**Benzo(a)anthracene**	**0.038**	
218-01-9	Chrysene	0.15	U
205-99-2	Benzo(b)fluoranthene	0.020	U
207-08-9	Benzo(k)fluoranthene	0.020	U
50-32-8	Benzo(a)pyrene	0.030	U
53-70-3	Dibenzo(a,h)anthracene	0.030	U
191-24-2	Benzo(g,h,i)perylene	0.080	U
193-39-5	Indeno(1,2,3-cd)pyrene	0.050	U

Surrogate Recoveries

Diphenyl	76.7%
Terphenyl	73.9%

Data Qualifiers

U	Indicates compound was analyzed for, but not detected at the given detection limit.
J	Indicates an estimated value when that result is less than the calculated detection limit.
E	Indicates a value above the linear range of the detector. Dilution Required
S	Indicates no value reported due to saturation of the detector.
D	Indicates the surrogate was diluted out.
B	Found in associated method blank.
Y	Indicates a raised detection limit due to matrix interference.
NA	Indicates compound was not analyzed.
NR	Indicates no recovery due to interferences.

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Consultants

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 102

Lab Sample ID: I904K
LIMS ID: 94-18940
Matrix: Water

QC Report No: I904-Remediation Technologies, Inc.
Project: BN-SKYKOMISH
3-1161-320
Date Sampled: 11/08/94
Date Received: 11/09/94

Data Release Authorized:
Reported: 11/23/94

Date extracted: 11/11/94
Date analyzed: 11/17/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L
91-20-3	Naphthalene	1.8 U
83-32-9	Acenaphthylene	2.3 U
208-96-8	Acenaphthene	1.8 U
86-73-7	Fluorene	0.21 U
85-01-8	Phenanthrene	0.64 U
120-12-7	Anthracene	0.66 U
206-44-0	Fluoranthene	0.21 U
129-00-0	Pyrene	0.27 U
56-55-3	Benzo(a)anthracene	0.020 U
218-01-9	Chrysene	0.15 U
205-99-2	Benzo(b)fluoranthene	0.020 U
207-08-9	Benzo(k)fluoranthene	0.020 U
50-32-8	Benzo(a)pyrene	0.030 U
53-70-3	Dibenzo(a,h)anthracene	0.030 U
191-24-2	Benzo(g,h,i)perylene	0.080 U
193-39-5	Indeno(1,2,3-cd)pyrene	0.050 U

Surrogate Recoveries

Diphenyl	82.3%
Terphenyl	80.2%

Data Qualifiers

- U Indicates compound was analyzed for, but not detected at the given detection limit.
- J Indicates an estimated value when that result is less than the calculated detection limit.
- E Indicates a value above the linear range of the detector. Dilution Required
- S Indicates no value reported due to saturation of the detector.
- D Indicates the surrogate was diluted out.
- B Found in associated method blank.
- Y Indicates a raised detection limit due to matrix interference.
- NA Indicates compound was not analyzed.
- NR Indicates no recovery due to interferences.

FORM-1

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 37

Lab Sample ID: I904L
LIMS ID: 94-18941
Matrix: Water

QC Report No: I904-Remediation Technologies, Inc.
Project: BN-SKYKOMISH
3-1161-320
Date Sampled: 11/08/94
Date Received: 11/09/94

Data Release Authorized:
Reported: 11/23/94

Date extracted: 11/11/94
Date analyzed: 11/17/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L	
91-20-3	Naphthalene	1.8	U
83-32-9	Acenaphthylene	2.3	U
208-96-8	Acenaphthene	1.8	U
86-73-7	**Fluorene**	**1.7**	
85-01-8	Phenanthrene	0.64	U
120-12-7	**Anthracene**	**0.99**	
206-44-0	**Fluoranthene**	**8.8**	
129-00-0	Pyrene	0.27	U
56-55-3	**Benzo(a)anthracene**	**0.10**	
218-01-9	**Chrysene**	**0.10**	**J**
205-99-2	Benzo(b)fluoranthene	0.020	U
207-08-9	Benzo(k)fluoranthene	0.020	U
50-32-8	Benzo(a)pyrene	0.030	U
53-70-3	Dibenzo(a,h)anthracene	0.030	U
191-24-2	Benzo(g,h,i)perylene	0.080	U
193-39-5	Indeno(1,2,3-cd)pyrene	0.050	U

Surrogate Recoveries

Diphenyl	134%
Terphenyl	75.9%

Data Qualifiers

U Indicates compound was analyzed for, but not detected at the given detection limit.
J Indicates an estimated value when that result is less than the calculated detection limit.
E Indicates a value above the linear range of the detector. Dilution Required
S Indicates no value reported due to saturation of the detector.
D Indicates the surrogate was diluted out.
B Found in associated method blank.
Y Indicates a raised detection limit due to matrix interference.
NA Indicates compound was not analyzed.
NR Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 38

Lab Sample ID: I904M
LIMS ID: 94-18942
Matrix: Water

QC Report No: I904-Remediation Technologies, Inc.
Project: BN-SKYKOMISH
3-1161-320
Date Sampled: 11/08/94
Date Received: 11/09/94

Data Release Authorized:
Reported: 11/23/94

Date extracted: 11/11/94
Date analyzed: 11/18/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L
91-20-3	Naphthalene	1.8 U
83-32-9	Acenaphthylene	2.3 U
208-96-8	Acenaphthene	1.8 U
86-73-7	Fluorene	0.21 U
85-01-8	Phenanthrene	0.64 U
120-12-7	Anthracene	0.66 U
206-44-0	Fluoranthene	0.21 U
129-00-0	Pyrene	0.27 U
56-55-3	Benzo(a)anthracene	0.020 U
218-01-9	Chrysene	0.15 U
205-99-2	Benzo(b)fluoranthene	0.020 U
207-08-9	Benzo(k)fluoranthene	0.020 U
50-32-8	Benzo(a)pyrene	0.030 U
53-70-3	Dibenzo(a,h)anthracene	0.030 U
191-24-2	Benzo(g,h,i)perylene	0.080 U
193-39-5	Indeno(1,2,3-cd)pyrene	0.050 U

Surrogate Recoveries

Diphenyl	71.2%
Terphenyl	70.3%

Data Qualifiers

U Indicates compound was analyzed for, but not detected at the given detection limit.
J Indicates an estimated value when that result is less than the calculated detection limit.
E Indicates a value above the linear range of the detector. Dilution Required
S Indicates no value reported due to saturation of the detector.
D Indicates the surrogate was diluted out.
B Found in associated method blank.
Y Indicates a raised detection limit due to matrix interference.
NA Indicates compound was not analyzed.
NR Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: 370

Lab Sample ID: I904N
LIMS ID: 94-18943
Matrix: Water

QC Report No: I904-Remediation Technologies, Inc.
Project: BN-SKYKOMISH
3-1161-320
Date Sampled: 11/08/94
Date Received: 11/09/94

Data Release Authorized: [signature]
Reported: 11/23/94

Date extracted: 11/11/94
Date analyzed: 11/18/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L	
91-20-3	**Naphthalene**	**1.6**	**J**
83-32-9	Acenaphthylene	2.3	U
208-96-8	Acenaphthene	1.8	U
86-73-7	**Fluorene**	**0.32**	
85-01-8	Phenanthrene	0.64	U
120-12-7	**Anthracene**	**0.91**	
206-44-0	**Fluoranthene**	**0.39**	
129-00-0	Pyrene	0.27	U
56-55-3	Benzo(a)anthracene	0.020	U
218-01-9	Chrysene	0.15	U
205-99-2	Benzo(b)fluoranthene	0.020	U
207-08-9	Benzo(k)fluoranthene	0.020	U
50-32-8	Benzo(a)pyrene	0.030	U
53-70-3	Dibenzo(a,h)anthracene	0.030	U
191-24-2	Benzo(g,h,i)perylene	0.080	U
193-39-5	Indeno(1,2,3-cd)pyrene	0.050	U

Surrogate Recoveries

Diphenyl	NR
Terphenyl	NR

Data Qualifiers

U	Indicates compound was analyzed for, but not detected at the given detection limit.
J	Indicates an estimated value when that result is less than the calculated detection limit.
E	Indicates a value above the linear range of the detector. Dilution Required
S	Indicates no value reported due to saturation of the detector.
D	Indicates the surrogate was diluted out.
B	Found in associated method blank.
Y	Indicates a raised detection limit due to matrix interference.
NA	Indicates compound was not analyzed.
NR	Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Polynuclear Aromatic Hydrocarbons by HPLC

Sample No: SW-5

Lab Sample ID: I904O
LIMS ID: 94-18944
Matrix: Water

QC Report No: I904-Remediation Technologies, Inc.
Project: BN-SKYKOMISH
3-1161-320
Date Sampled: 11/08/94
Date Received: 11/09/94

Data Release Authorized:
Reported: 11/23/94

Date extracted: 11/11/94
Date analyzed: 11/18/94
Sample Amount: 1000 mL
Final Ext Vol: 1.0 mL

Alumina Cleanup: Yes
GPC Cleanup: No
Conc/Dilution Factor: 1:1

CAS Number	Analyte	ug/L	
91-20-3	Naphthalene	1.8	U
83-32-9	Acenaphthylene	2.3	U
208-96-8	Acenaphthene	1.8	U
86-73-7	Fluorene	0.21	U
85-01-8	Phenanthrene	0.64	U
120-12-7	Anthracene	0.66	U
206-44-0	**Fluoranthene**	**0.20**	**J**
129-00-0	Pyrene	0.27	U
56-55-3	**Benzo(a)anthracene**	**0.021**	
218-01-9	Chrysene	0.15	U
205-99-2	Benzo(b)fluoranthene	0.020	U
207-08-9	Benzo(k)fluoranthene	0.020	U
50-32-8	Benzo(a)pyrene	0.030	U
53-70-3	Dibenzo(a,h)anthracene	0.030	U
191-24-2	Benzo(g,h,i)perylene	0.080	U
193-39-5	Indeno(1,2,3-cd)pyrene	0.050	U

Surrogate Recoveries

Diphenyl	76.0%
Terphenyl	82.9%

Data Qualifiers

U Indicates compound was analyzed for, but not detected at the given detection limit.
J Indicates an estimated value when that result is less than the calculated detection limit.
E Indicates a value above the linear range of the detector. Dilution Required
S Indicates no value reported due to saturation of the detector.
D Indicates the surrogate was diluted out.
B Found in associated method blank.
Y Indicates a raised detection limit due to matrix interference.
NA Indicates compound was not analyzed.
NR Indicates no recovery due to interferences.

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ORGANICS ANALYSIS DATA SHEET
Principle Hazardous Constituents by Method 8310

LIMS ID: 94-18935 Sample No: 16
Lab Sample ID: I904F QC Report No: I904-Remediation Technologies, Inc.
Matrix: Water Project: BN-SKYKOMISH
3-1161-320
Date Release Authorized: Date Received: 11/09/94

MATRIX SPIKE/SPIKE DUPLICATE RECOVERY

CONSTITUENT	SAMPLE VALUE	SPIKE VALUE	SPIKE AMT	% RECOVERY	RPD
MATRIX SPIKE					
Acenaphthene	< 1.80	2.16	4.00	54.0%	
Fluoranthene	< 0.21	2.08	4.00	52.0%	
Benzo(a)anthracene	< 0.02	2.07	4.00	51.8%	
MATRIX SPIKE DUPLICATE					
Acenaphthene	< 1.80	3.38	4.00	84.5%	44.0%
Fluoranthene	< 0.21	3.49	4.00	87.2%	50.6%
Benzo(a)anthracene	< 0.02	3.39	4.00	84.8%	48.4%

Values reported in ug/L

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ORGANICS ANALYSIS DATA SHEET
Principle Hazardous Constituents by Method 8310

Lab Sample ID: I904SB
LIMS ID: 94-18930
Matrix: Water

QC Report No: I904-Remediation Technologies, Inc.
Project: BN-SKYKOMISH
3-1161-320

Data Release Authorized:
Reported: 11/23/94

BLANK SPIKE RECOVERY CONSTITUENT	SPIKE VALUE	SPIKE ADDED	% RECOVERY
Acenaphthene	1.3	2.00	65.0%
Fluoranthene	1.6	2.00	80.0%
Benzo(a)anthracene	1.6	2.00	80.0%

Spike Blank Surrogate Recovery

Diphenyl	66.9%
Terphenyl	81.1%

Values reported in ug/L

RETEC

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DATA VALIDATION REPORT

TO: Shelly Birch
FROM: Kim Lofgren
DATE: February 2, 1995
RE: Review of Analytical Data

1.0 GENERAL

PROJECT:	BNRR Skykomish #3-1611-340
DATE SAMPLED:	11/08-09/1994
RECEIVING LAB	ACZ Laboratories, Inc.
ANALYTICAL METHODS:	Washington Total Petroleum Hydrocarbons-Diesel: SW846-8015 (Extended) Dissolved Metals: SW846-6010, 7061, or 7421 Total Suspended Solids: EPA 160.2
NUMBER OF SAMPLES:	30
MATRIX:	water
DATE(S) EXTRACTED:	all samples were extracted within the holding time limits
DATE(S) ANALYZED:	all samples were analyzed within the holding time limits

- Laboratory results with qualifiers are given as Attachment 1.
- All the samples and all of the quality assurance/quality control (QA/QC) in this data set have been reviewed with respect to holding times, method blanks, surrogate recoveries, matrix spikes, sample results, and any other QC measures (field blanks, lab blank spikes, field

duplicates, etc.).

2.0 VALIDITY AND COMMENTS

This section summarizes only those instances where acceptance criteria were not met or a discussion of the data were warranted.

2.1 GENERAL COMMENTS

The objectives of this review were to determine the quality of the analytical data collected in November 1994, by examining the level of precision, accuracy, and completeness as stated in the Quality Assurance Project Plan (QAPP). Precision is a measure of the mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is determined through analysis of field duplicate samples and field blanks. The accuracy of data is the degree of agreement of a measurement with an accepted reference or true value. The level of accuracy is determined by examination of laboratory matrix spike analyses, laboratory control spike analysis, method blanks, and surrogate recoveries for organic analyses. Completeness is determined by assessing the number of samples where valid results are reported versus the number of samples which were submitted to the laboratory for analysis. The overall measure of completeness will be the ratio of valid analyses received compared to the expected amount of data to be obtained under correct or normal conditions.

The QAPP required that field QC, which measured precision, include duplicate analysis of 10% of the collected samples with a one per matrix. Evaluation of duplicate samples for precision was done using the relative percent difference (RPD). RPD is defined as the difference between two duplicate samples divided by the mean and expressed as a percent. The criteria for acceptable RPD values are 0-30% for water samples. Field blanks were required to be collected at one per ten samples.

The QAPP required that Laboratory QC, which measured accuracy, include using a method blank (reagent blank) for approximately 20 actual samples, a spike/spike duplicate for approximately one out of every 20 samples, and analysis of surrogate standards for organic analyses. Method blanks were analyzed to identify compounds which could be introduced during the laboratory extraction or analysis phase (i.e. laboratory contaminants). Matrix spike/spike duplicate (MS/MSD) or laboratory control spike/spike duplicate (LCS/LCSD) percent recoveries (%Rs) and spike RPD values reported are compared to published QC limits. Surrogates are compounds that are structurally similar to the compounds requested for analysis, but are not generally found in nature (i.e., deuterated compounds). They are analyzed to demonstrate that structurally similar compounds can be recovered and quantified by the lab.

The QAPP for completeness goal was the overal measure of the ratio of samples planned versus the number of samples with valid analyses. The data quality objective for BNRR Skykomish Fueling Facility laboratory data was to achieve 90-100% completeness of the data collected.

All appropriate data were found in the forms provided from ACZ Laboratories. The amount extracted, dilution factor and amount analyzed was included for all of the samples in this data set. Table 1-1 provides a summary of the groundwater data. Parameters identified in the QA/QC review as outside the control limits are shown in bold and shaded. Not all water samples were analyzed for each parameter, refer to Table 1-1 for exact analyses of each sample.

2.2 HOLDING TIMES

The times and dates for sampling were taken from RETEC's Chain of Custody (COC). The dates for extraction and analyses were taken from the ACZ organic analysis data sheets. For the purpose of this review, the holding times stated in SW-846 were used to qualify data. All samples met the holding time requirements for the preparation type.

2.3 WASHINGTON TOTAL PETROLEUM HYDROCARBON - ANALYSIS OF WATER

Twenty-five water samples were reviewed for Washington total petroleum hydrocarbon for diesel (WTPH-D Extended) validity in this data set.

2.3.1 Method Blanks and Field Blanks

Method Blanks - One method blank was extracted and analyzed with the fuel hydrocarbon samples. Diesel was not detected in the method blank.

Field Blanks - Three field blanks (MW-101, MW-103, and MW-104) were submitted with this data set. Table 2-1 summarizes the results of the field blanks. Diesel was not detected in the field blanks.

2.3.2 Surrogate Recovery

Surrogate %Rs for o-terphenyl were reported on the Quality Control Data Summary forms. The %R for ortho-terphenyl was not recovered in samples MW-11 and MW-103. The positive result for sample MW-11 has been qualified with a J qualifier (the associated numerical value is an estimated quantity); and the non-positive result for MW-103 with a UJ qualified (the material was analyzed for, but was not detected, and the associated numerical value is the sample quantition limit), based on the poor surrogate recovery. All other surrogate %Rs were within the control limits of 50-150% for o-terphenyl.

2.3.3 Blanks Spike/Blank Spike Duplicate (BS/BSD)

A MS/MSD summary report was not submitted with this data set.

One Blank Spike/Blank Spike Duplicate (BS/BSD) was reported with this data set. The BS %R was 107% and the BSD %R was 112% for fuel hydrocarbon, which were within control limits of 68-144%. The RPD value was 4%, which was also within the control limits of 0-30%.

2.3.4 Continuing Calibraton Verification Spikes (CCV)

Two CCV spikes were submitted within with this data set. The CCV %Rs were within acceptable control limits.

2.3.5 Field Duplicates

Three field duplicates were included in this data set; however, were not labelled as such by RETEC personnel. Sample MW-190 is a field duplicate of sample MW-19, sample MW-370 is a field duplicate of sample MW-37, and sample MW-400 is a field duplicate of sample MW-40. Table 2-1 summarizes the RPD values for these samples and their corresponding duplicates. Only one RPD value could be calculated for the diesel analysis. The RPD value was 19%, which is within acceptable control limits of 0-30%. Field sampling techniques are considered to be acceptable based on the field duplicate analyses.

2.3.6 Overall Assessment of Data

The quantity of the water extracted, amounts analyzed, and dilution factors were included in this data set for all of the samples. All compounds were reviewed based on the holding time limits, detection limits, method blank, field blanks, surrogate %Rs, BS %R, BSD %R, BS/BSD RPD value, and field duplicates. The positive result for diesel in sample MW-11 has been qualified with a J, and the non-positive result in sample MW-103 has been qualified with a UJ. All other data were found to be accurate based on the information given.

Field precision has been determined acceptable based on the field blanks and field duplicate RPD value. A completeness of 100% was achieved for field QC samples.

Laboratory accuracy and precision has be determined acceptable based on the method blank, BS %R, BSD %R, and BS/BSD RPD value. A completnes goal of 90% was not achieved for the fuel hydrocarbon data. Only one Method Blank and one BS/BSD was prepared, extracted, and analyzed for the twenty-five water samples.

2.4 METALS - ANALYSIS OF WATER

Fifteen water samples were reviewed for dissolved metals (i.e., arsenic, copper and lead) validity in this data set.

2.4.1 Method Blank and Field Blanks

Method Blank - One method blank was extracted and analyzed for dissolved arsenic chromium, and lead.

Field Blanks - Three field blanks (MW-101, MW-103 and MW-104) were submitted with the dissolved metals. Table 2-1 summarizes the results of the field blanks. Target analytes were not detected in the field blanks.

2.4.2 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Two MS/MSD were extracted and analyzed for dissolved arsenic, chromium and lead. All MS %Rs, MSD %Rs, and RPD values were within acceptable control limits for the dissolved metal analyses.

2.4.3 Field and Laboratory Duplicates

Two field duplicates were included with the dissolved metals in this data set; however, were not labelled as such by RETEC personnel. Sample MW-370 is a field duplicate of sample MW-37, and sample MW-400 is a field duplicate of sample MW-40. Table 2-1 summarizes the RPD values for these samples and their corresponding duplicates. Three RPD values were calculated for the field duplicate metal analysis. One RPD value for arenic in samples MW-37/MW-370 was 67%, which exceeded the upper control limit of 30%. The concentration of arsenic in samples MW-37 and MW-370 were 0.002 ug/L and 0.001 ug/L, repectively, which are very low; and therfore, accounts for the high RPD value. No qualifiers were warranted based on the high RPD value, and field sampling techniques are considered acceptable.

2.4.4 Overall Assessment of Data

The quantity of water extracted, amounts analyzed and dilution factors were included in this data set for all of the samples. All compounds were reviewed based on holding time limits, detection limits, method blanks, field blank, surrogate %Rs, MS %Rs, MSD %Rs, and field duplicates. All data were found to be accurate based on the information given.

Field precision has been determined acceptable based on the field blanks and field duplicates RPD values. A completeness of 100% was achieved for field QC samples.

Laboratory accuracy has been determined acceptable based on the method blanks, the MS %Rs, MSD %Rs, and RPD values. A completeness of 100% was achieved for laboratory QC samples.

2.5 TOTAL SUSPENDED SOILIDS - ANALYSIS OF WATER

Fourteen water samples were reviewed for total suspended solids (TSS) validity in this data set.

2.5.1 Method Blank and Field Blanks

Method Blank - One method blank was extracted and analyzed for TSS.

Field Blanks - Two field blanks (MW-101 and MW-103) were submitted with the dissolved metals. Table 2-1 summarizes the results of the field blanks. TSS was not detected in the field blanks.

2.5.2 Laboratory Control Spikes (LCS)

One LCS was extracted and analyzed for TSS. The LCS %R was within acceptable control limits for TSS.

2.5.3 Field and Laboratory Duplicates

One field duplicate was included with the TSS samples in this data set; however, was not labelled as such by RETEC personnel. Sample MW-370 is a field duplicate of sample MW-37. Table 2-1 summarizes the RPD value for this sample and the corresponding duplicate. The RPD value could not calculated for the field duplicate TSS analysis because a positive result was found in only one sample. Field sampling techniques are considered acceptable based on the duplicate sample results.

One laboratory duplicate was extracted and analyzed with the TSS analyis. The RPD value was 67%, which exceeds the acceptable control limits of 0-20% for laboratory duplicate samples.

2.5.4 Overall Assessment of Data

The quantity of water extracted, amounts analyzed and dilution factors were included in this data set for all of the samples. All compounds were reviewed based on holding time limits, detection limits, method blank, field blank, MS %R, LCS %R, and field duplicate. All data were found to be accurate based on the information given.

Field precision has been determined acceptable based on the field blanks and field duplicates RPD values. A completeness of 100% was achieved for field QC samples.

Laboratory accuracy has been determined acceptable based on the method blank, the MS %R, and the LCS %R. A completeness of 90% was achieved for laboratory QC samples.

Explanation of qualifiers:

"J" = The associated numerical value is an estimated quantity.

"UJ" = The material was analyzed for, but was not detected. The sample quantitation limit is an estimated quantity.

References

EPA,1988. laboratory Data Validation Functional Guidelines For Evaluating Organics Analyses. Prepared by The USEPA Data Review Work Group.

TABLE 1-1

BNRR SKYKOMISH
WATER DATA VALIDATION
FOURTH QUARTER - NOVEMBER, 1994
ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	DATE EXTRACTED	PARAMETERS ANALYZED	COMMENTS
MW-11	11/08/94	11/22/94	WTPH-D (8015 ext.)	(1) Surrogate o-Terphenyl %R = NR, result qualifeid with a "J"
MW-9	11/08/94	11/22/94	WTPH-D (8015 ext.)	(1) o-Terphenyl %R w/in QC limits
		11/16/94	TSS (EPA 160.2)	
			Diss. Metals	
		11/14/94	As (EPA 7060)	
		12/03/94	Cr (EPA 6010)	BDL
		11/22/94	Pb (EPA 7421)	BDL MS - %R = 93%, w/in QC limits MSD - %R = 93%, w/in QC limits RPD value = 0%
MW-16	11/08/94	11/16/94	TSS (EPA 160.2)	(1)
			Diss. Metals	
		11/14/94	As (EPA 7060)	BDL
		12/03/94	Cr (EPA 6010)	
		11/22/94	Pb (EPA 7421)	BDL MS - %R = 103%, w/in QC limits MSD - %R = 104%, w/in QC limits RPD value = 1.0%
MW-34	11/08/94	11/22/94	WTPH-D (8015 ext.)	(1) BDL, o-Terphenyl %R w/in QC limits
MW-35	11/08/94	11/22/94	WTPH-D (8015 ext.)	(1) o-Terphenyl %R w/in QC limits
		11/16/94	TSS (EPA 160.2)	
			Diss. Metals	
		11/14/94	As (EPA 7060)	BDL
		12/03/94	Cr (EPA 6010)	BDL
		11/22/94	Pb (EPA 7421)	BDL
MW-38	11/08/94	11/22/94	Pb (EPA 7421)	(1) o-Terphenyl %R w/in QC limits
		11/16/94	TSS (EPA 160.2)	
			Diss. Metals	
		11/14/94	As (EPA 7060)	BDL
		12/03/94	Cr (EPA 6010)	BDL
		11/22/94	Pb (EPA 7421)	BDL
MW-101 Field Blank	11/08/94	11/22/94	WTPH-D (8015 ext.)	(1) BDL, o-Terphenyl %R w/in QC limits
		11/16/94	TSS (EPA 160.2)	BDL
			Diss. Metals	
		11/14/94	As (EPA 7060)	BDL MS - %R = 104%, w/in QC limits MSD - %R = 104%, w/in QC limits RPD value = 0.5%
		12/03/94	Cr (EPA 6010)	BDL
		11/22/94	Pb (EPA 7421)	BDL

TABLE 1-1

BNRR SKYKOMISH
WATER DATA VALIDATION
FOURTH QUARTER - NOVEMBER, 1994
ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	DATE EXTRACTED	PARAMETERS ANALYZED	COMMENTS
MW-23	11/08/94	11/22/94	WTPH-D (8015 ext.)	(1) BDL, o-Terphenyl %R w/in QC limits
		11/16/94	TSS (EPA 160.2)	
			Diss. Metals	
		11/14/94	As (EPA 7060)	BDL
		12/03/94	Cr (EPA 6010)	BDL
		11/22/94	Pb (EPA 7421)	BDL
SW-5	11/08/94	11/22/94	WTPH-D (8015 ext.)	(1) BDL, o-Terphenyl %R w/in QC limits
MW-37	11/08/94	11/22/94	WTPH-D (8015 ext.)	(1) o-Terphenyl %R w/in QC limits
		11/16/94	TSS (EPA 160.2)	Lab Dup - RPD value = 67%, outside QC limits
			Diss. Metals	
		11/14/94	As (EPA 7060)	
		12/03/94	Cr (EPA 6010)	BDL MS - %R = 101%, w/in QC limits MSD - %R = 99.8%, w/in QC limits RPD value = 1.6%
		11/22/94	Pb (EPA 7421)	BDL
MW-370 Field Duplicate of MW-37	11/08/94	11/22/94	WTPH-D (8015 ext.)	(1) o-Terphenyl %R w/in QC limits Field Dup - RPD value = 19%, w/in QC limits
		11/16/94	TSS (EPA 160.2)	BDL
			Diss. Metals	
		11/14/94	As (EPA 7060)	Field Dup - RPD value = 67%, exceeded QC limits
		12/03/94	Cr (EPA 6010)	BDL Field Dup - RPD value = NC
		11/22/94	Pb (EPA 7421)	BDL Field Dup - RPD value = NC
MW-26	11/09/94	11/22/94	WTPH-D (8015 ext.)	(1) o-Terphenyl %R w/in QC limits
MW-1	11/09/94	11/22/94	WTPH-D (8015 ext.)	(1) BDL, o-Terphenyl %R w/in QC limits
MW-3	11/09/94	11/22/94	WTPH-D (8015 ext.)	(1) BDL, o-Terphenyl %R w/in QC limits
MW-4	11/09/94	11/22/94	WTPH-D (8015 ext.)	(1) BDL, o-Terphenyl %R w/in QC limits
MW-13	11/09/94	11/22/94	WTPH-D (8015 ext.)	(1) BDL, o-Terphenyl %R w/in QC limits
MW-2	11/09/94	11/16/94	TSS (EPA 160.2)	(1)
			Diss. Metals	
		11/14/94	As (EPA 7060)	
		12/03/94	Cr (EPA 6010)	BDL
		11/22/94	Pb (EPA 7421)	BDL

TABLE 1–1

BNRR SKYKOMISH
WATER DATA VALIDATION
FOURTH QUARTER – NOVEMBER, 1994
ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	DATE EXTRACTED	PARAMETERS ANALYZED	COMMENTS
DW–3	11/09/94	11/16/94	TSS (EPA 160.2)	(1)
			Diss. Metals	
		11/14/94	As (EPA 7060)	BDL MS – %R = 109%, w/in QC limits MSD – %R = 109%, w/in QC limits RPD value = 0.5%
		12/03/94	Cr (EPA 6010)	BDL
		11/22/94	Pb (EPA 7421)	BDL
MW–31	11/09/94	11/16/94	TSS (EPA 160.2)	(1)
			Diss. Metals	
		11/14/94	As (EPA 7060)	BDL
		12/03/94	Cr (EPA 6010)	BDL
		11/22/94	Pb (EPA 7421)	BDL
DW–2	11/09/94	11/16/94	TSS (EPA 160.2)	(1)
			Diss. Metals	
		11/14/94	As (EPA 7060)	BDL
		12/03/94	Cr (EPA 6010)	BDL
		11/22/94	Pb (EPA 7421)	BDL
SW–6	11/09/94	11/22/94	WTPH–D (8015 ext.)	(1) BDL, o–Terphenyl %R w/in QC limits
MW–104 **Field Blank**	11/09/94	11/22/94	WTPH–D (8015 ext.)	(1) BDL, o–Terphenyl %R w/in QC limits
MW–5	11/08/94	11/22/94	WTPH–D (8015 ext.)	(1) o–Terphenyl %R w/in QC limits
		11/16/94	TSS (EPA 160.2)	
			Diss. Metals	
		11/14/94	As (EPA 7060)	
		12/03/94	Cr (EPA 6010)	BDL
		11/22/94	Pb (EPA 7421)	BDL
MW–14	11/09/94	11/22/94	WTPH–D (8015 ext.)	(1) BDL, o–Terphenyl %R w/in QC limits
MW–19	11/09/94	11/22/94	WTPH–D (8015 ext.)	(1) BDL, o–Terphenyl %R w/in QC limits
MW–190 **Field Duplicate of MW–19**	11/09/94	11/22/94	WTPH–D (8015 ext.)	(1) BDL, o–Terphenyl %R w/in QC limits Field Dup – RPD value = NC
SW–7	11/09/94	11/22/94	WTPH–D (8015 ext.)	(1) o–Terphenyl %R w/in QC limits

TABLE 1-1

BNRR SKYKOMISH
WATER DATA VALIDATION
FOURTH QUARTER - NOVEMBER, 1994
ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	DATE EXTRACTED	PARAMETERS ANALYZED	COMMENTS
MW-103	11/09/94	11/22/94	WTPH-D (8015 ext.)	**(1) BDL, o-Terphenyl %R = NR, result qualified with "UJ"**
Field Blank				
		11/16/94	TSS (EPA 160.2)	BDL
			Diss. Metals	
		11/14/94	As (EPA 7060)	BDL
		12/03/94	Cr (EPA 6010)	BDL
		11/22/94	Pb (EPA 7421)	BDL
MW-40	11/09/94	11/22/94	WTPH-D (8015 ext.)	(1) BDL, o-Terphenyl %R w/in QC limits
		11/16/94	TSS (EPA 160.2)	
			Diss. Metals	
		11/14/94	As (EPA 7060)	
		12/03/94	Cr (EPA 6010)	BDL
		11/22/94	Pb (EPA 7421)	
MW-400	11/09/94	11/22/94	WTPH-D (8015 ext.)	(1) BDL, o-Terphenyl %R w/in QC limits
Field Duplicate of MW-40				Field Dup - RPD value = NC
			Diss. Metals	
		11/14/94	As (EPA 7060)	Field Dup - RPD value = 0%, w/im QC limits
		12/03/94	Cr (EPA 6010)	BDL
				Field Dup - RPD value = NC
				MS - %R = 100%, w/in QC limits
				MSD - %R = 100%, w/in QC limits
		11/22/94	Pb (EPA 7421)	Field Dup - RPD value = 0%, w/im QC limits
Prep Blank		11/29/94	WTPH-D (8015)	BDL, o-Terphenyl %R w/in QC limits
BLK 9/29				**Date Prep Blank was prepared and extracted?**
				25 samples only one Prep Blank
CCV1		11/29/94	WTPH-D (8015)	Surrogate w/in QC limits
CCV2		11/29/94	WTPH-D (8015)	Surrogate w/in QC limits
BS/BSD		NO DATE	WTPH-D (8015)	BS %R = 107% w/in QC limits
L3825				BSD %R = 112% w/in QC limits
				RPD value = 4% w/in QC limits
				Date Prep Blank was prepared and extracted?

TABLE 1-1

BNRR SKYKOMISH
WATER DATA VALIDATION
FOURTH QUARTER - NOVEMBER, 1994
ACZ LABORATORIES

SAMPLE ID	DATE SAMPLED	DATE EXTRACTED	PARAMETERS ANALYZED	COMMENTS
Laboratory Control Checks		11/14/94	Diss. Arsenic (7061)	%R within QC limits
		12/03/94	Diss. Chromium (6010)	%R within QC limits
		11/22/94	Diss. Lead (7421)	%R within QC limits
		11/15/94	TSS (160.2)	%R within QC limits
PREP BLANKS		11/14/94	Diss. Arsenic (7061)	BDL
		12/03/94	Diss. Chromium (6010)	BDL
		11/22/94	Diss. Lead (7421)	BDL
		11/15/94	TSS (160.2)	BDL

ABBEVIATIONS/DEFINITIONS

(1) - Standard QA/QC including methods, analysis, detection limits, holding times, surrogate recoveries, etc., are within QA/QC limits unless otherwise noted.
EPA - Enviromental Protection Agency
QA - Quality assurance
QC - Quality control
LQC - Laboratory quality control
BDL - Below detection limit
MS - Matrix spike
MSD - Matrix spike duplicate
BS - Blank spike
BSD - Blank spike duplicate
RPD - Relative percent difference
NC - Not calculated
%R - Percent recovery
UJ - The material was analyzed for, but was not detected. The sample quantitation limit is an estimated quantity.
J - The associated numerical value is an estimated quantity.
WTPH-D - Washington total petroluem hydrocarbon-diesel
Diss. - Dissolved
TSS - Total suspended solids
Comments shown in bold are questions pertaining to the laboratory data.
Comments bolded and shaded are outside QA/QC limits.

TABLE 2-1

FOURTH QUARTER
TOTAL PETROLEUM HYDRCARBONS, DISSOLVED METALS, AND TOTAL SUSPENDED SOLIDS
QA/QC ANALYTICAL RESULTS - WATER
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Sample ID:		MW-19	MW-190 (MW-19 Dup)	RPD [1] MW-19 MW-190	MW-37	MW-370 (MW-37 Dup)	RPD [1] MW-37 MW-370
Sample Date:		11/09/94	11/09/94	11/08/94	11/08/94	11/08/94	11/08/94
WTPH-D	mg/L	< 0.2 U	< 0.2 U	NC	0.52	0.43	19
Dissolved Metals							
Arsenic	mg/L	NA	NA	NA	0.002	0.001	67
Chromium	mg/L	NA	NA	NA	< 0.01	< 0.01	NC
Lead	mg/L	NA	NA	NA	< 0.001	< 0.001	NC
Total Suspended Solids	mg/L	NA	NA	NA	8	< 5	NC

WTPH-D - Washington total petroleum hydrocarbons; analyzed using EPA 8015 modified method.
Dissolved Metals analyzed using EPA 6000 and 7000 series.
Total Suspended Solids measured using EPA M160.2 Gravimetric
QA - Quality assurance
QC - Quality control
NA - Not applicable
NC - Not calculated
UJ - The material was analyzed for, but was not detected. The sample quantitation limit is an estimated quantity.
1. Relative percent difference = absolute value of $((X_1 - X_2)/(X_1 + {}_2)*1/2)*100$
where X_1 is the concentration of the orginal sample, and X_2 is the concentration of the duplicate sample.

TABLE 2-1 (Continued)

FOURTH QUARTER
TOTAL PETROLEUM HYDRCARBONS, DISSOLVED METALS, AND TOTAL SUSPENDED SOLIDS
QA/QC ANALYTICAL RESULTS – WATER
BNRR MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

Sample ID:		MW-40	MW-400 (MW-40 Dup)	RPD [1] MW-40 MW-400	MW-101 Field Blank	MW-103 Field Blank	MW-104 Field Blank	Method Blank
Sample Date:		11/08/94	11/08/94	11/08/94	11/08/94	11/08/94	11/08/94	NA
WTPH-D	mg/L	< 0.2 U	< 0.2 U	NC	< 0.2	< 0.2 UJ	< 0.2	< 0.2
Dissolved Metals								
Arsenic	mg/L	0.002	0.002	0	< 0.001	< 0.001	NA	< 0.001
Chromium	mg/L	< 0.01	< 0.01	NC	< 0.01	< 0.01	NA	< 0.01
Lead	mg/L	0.003	0.003	0	< 0.001	< 0.001	NA	< 0.001
Total Suspended Solids	mg/L	1100	NA	NC	< 5	< 5	NA	< 2

WTPH-D – Washington total petroleum hydrocarbons; analyzed using EPA 8015 modified method.
Dissolved Metals analyzed using EPA 6000 and 7000 series.
Total Suspended Solids measured using EPA M160.2 Gravimetric
QA – Quality assurance
QC – Quality control
NA – Not applicable
NC – Not calculated
UJ – The material was analyzed for, but was not detected. The sample quantitation limit is an estimated quantity.
1. Relative percent difference = absolute value of $((X_1 - X_2)/(X_1 + {}_2)*1/2)*100$
where X_1 is the concentration of the orginal sample, and X_2 is the concentration of the duplicate sample.

ATTACHMENT 1

ACZ Laboratories, Inc.

Organic Quality Control Data Summary

COVER PAGE

Client:	RETEC, Inc.	Report Date:	11/30/95
Project:	3-1161-320	Date Received:	11/11/94
ACZ SDG No.:	L3825	Lab Nos.:	L3825-01 to 30

Matrix: Water
TPH Scan by Modified 8015 - GC/FID

	Sample Identification	Sample Date	Lab Number
1	9	11/08/94	L3825-01
2	35	11/08/94	L3825-02
3	38	11/08/94	L3825-03
4	101	11/08/94	L3825-04
5	23	11/08/94	L3825-05
6	37	11/08/94	L3825-06
7	370	11/08/94	L3825-07
8	5	11/08/94	L3825-08
9	103	11/09/94	L3825-09
10	40	11/09/94	L3825-10
11	11	11/08/94	L3825-11
12	34.0	11/08/94	L3825-12
13	SW-5	11/08/94	L3825-13
14	26	11/09/94	L3825-14
15	1	11/09/94	L3825-15
16	3	11/09/94	L3825-16
17	4	11/09/94	L3825-17
18	13	11/09/94	L3825-18
19	SW-6	11/09/94	L3825-19
20	104	11/09/94	L3825-20
21	14	11/09/94	L3825-21
22	19	11/09/94	L3825-22
23	190	11/09/94	L3825-23
24	SW-7	11/09/94	L3825-24
25	400	11/08/94	L3825-30

Comments:

Name: Ron Martino
Signature: Ron Martino

Title: Organic Supervisor
Date: 1/18/95

L3825 1/4

№ 5644

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME
3-1161-320	BN-Skykomish

SAMPLERS: D. Kinney

RECEIVING LABORATORY: ACZ

SEND RESULTS TO: Shelly Birch

LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS	Metals - Arsenic, Lead(1), Chromium	WTPH-D extended	TSS				REMARKS
	11/8/94	0855	11	1		X					(1) Lead by Graphite Furnace Atomic Absorption method
	↓	1030	9	3	X	X	X				
	↓	1105	16	2	X		X				
	↓	1140	34	2		X					Extra for QC
	↓	1225	35	3	X	X	X				
	↓	1355	38	3	X	X	X				
	↓	1420	101	3	X	X	X				
	↓	1440	23	3	X	X	X				
	↓	1600	SW-5	1		X					

~~Condition of Samples Upon Receipt~~
By ACZ Laboratories, Inc:
Temperature of Contents: 2 °C
~~Sample Containers:~~ Intact
~~Custody Seals:~~ Intact

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
[signature]	11/10/94 1130	Fed Ex			
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time		
		[signature]	11.11.94 930		

Shipper Information
Fed Ex Airbill # 2764085063

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REMEDIATION TECHNOLOGIES INC

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1011 S.W. Klickitat Way
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№ 5645

CHAIN OF CUSTODY RECORD

PROJ. NO.: 3-1161-320

PROJECT NAME: BN - Skykomish

SAMPLERS: D. Kinney

RECEIVING LABORATORY: ACZ

SEND RESULTS TO: Shelly Birch

LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS	Metals - Arsenic, Lead(1), Chromium	WTPH-D extended	TSS					REMARKS
	11/8/94	1310	.37	3	X	X	X					(1) Lead by Graphite Furnace, Atomic Absorption method
	11	1320	.370	3	X	X	X					

Condition of Samples Upon Receipt By ACZ Laboratories, Inc:
Temperature of Contents: 2 °C
Sample Containers: intact
Custody Seals: intact

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
D. W. Kinney	11/10/94 1130	Fed Ex			

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time
		B. [illegible]	11-11-94 0930

Shipper Information: Fed Ex Airbill # 2764085052

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3/4

CHAIN OF CUSTODY RECORD

PROJ. NO.: 3-1161-320
PROJECT NAME: BN-Skykomish
SAMPLERS: D. Kinney
RECEIVING LABORATORY: ACZ
SEND RESULTS TO: Shelly Birch

LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS	Metals - Arsenic, Lead(1), Chromium	WTPH-D extended	TSS					REMARKS
	11/9/94	0900	26	2		X						extra for QC
		0925	1	1		X						
		0950	3	1		X						(1) Lead by GFAA
		1030	4	1		X						
		1050	13	1		X						
		1210	2	4	X		X					extra for QC
		1250	DW-3	2	X		X					
		1310	31	2	X		X					
		1430	DW-2	2	X		X					
		1535	SW-6	1		X						
	↓	0935	104	1		X						

Condition of Samples Upon Receipt By ACZ Laboratories, Inc:
Temperature of Contents: 2 °C
Sample Containers: Intact
Custody Seals: Intact

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
[signature]	11/10/94 1130	Fed Ex			

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time
		[signature]	11-11-94 0930

Shipper Information: Fed Ex Airbill # 2764085026

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№ 5647

CHAIN OF CUSTODY RECORD

PROJ. NO.: 3-1161-320

PROJECT NAME: BN-Skykomish

SAMPLERS: D. Kinney

RECEIVING LABORATORY: ACZ

SEND RESULTS TO: Shelly Birch

LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS	WTPH-D extended	TSS	Metals - As, Pb(1), Cr					REMARKS
	11/8/94	1620	.5	3	X	X	X					(1) Lead by GFAA
	11/9/94	1105	.14	1	X							
		1135	.19	1	X							
		1140	.190	1	X							
		1145	'SW-7	1	X							
		1325	.103	3	X	X	X					
		1345	.40	3	X	X	X					
	↓	1355	.400	3	X		X					

~~Condition of Samples Upon Receipt~~
By ACZ Laboratories, Inc:
Temperature of Contents: 2 °C
Sample Containers: Intact
Custody Seals: Intact

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
[signature]	11/10/94 1130	Fed EX			

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time
		[signature]	11-11-94 0930

Shipper Information: Fed Ex Airbill # 2764085015

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ACZ Laboratories, Inc.

Organic Quality Control Data Summary

SURROGATE SPIKE RECOVERIES

Client:	RETEC, Inc.	Report Date:	11/30/95
Project:	3-1161-320	Date Received:	11/11/94
ACZ SDG No.:	L3825	Lab Nos.:	L3825-01 to 30

Matrix: Water
TPH Scan by Modified 8015 - GC/FID

Lab Number	GC File	Analysis Date	OTP R%	Remarks
Prep Balnk	012F0101	11/29/94	77.2	
L3825-01	013F0101	11/29/94	81.8	
L3825-02	014F0101	11/29/94	91.0	
L3825-03	015F0101	11/29/94	86.4	
L3825-04	016F0101	11/29/94	91.0	
L3825-05	017F0101	11/29/94	81.8	
L3825-06	018F0101	11/29/94	79.1	
L3825-07	019F0101	11/29/94	72.7	
L3825-08	020F0101	11/29/94	89.1	
L3825-09	021F0101	11/29/94	*	Surrogate was not revovered. Not enough sample to re-extract
L3825-10	022F0101	11/29/94	72.7	
L3825-11	036F0101	11/29/94	*	Surrogate was interfered with due to high results.
L3825-12	025F0101	11/29/94	72.7	
L3825-13	036F0101	11/29/94	63.6	
L3825-14	027F0101	11/29/94	72.7	
L3825-15	028F0101	11/29/94	74.6	
L3825-16	029F0101	11/29/94	76.4	
L3825-17	030F0101	11/29/94	72.7	
L3825-18	031F0101	11/29/94	66.4	
L3825-19	063R0101	11/29/94	84.0	
L3825-20	064R0101	11/29/94	78.0	
L3825-21	065R0101	11/29/94	75.0	
L3825-22	066R0101	11/29/94	90.0	
L3825-23	067R0101	11/29/94	71.0	
L3825-24	068R0101	11/29/94	80.0	
L3825-30	069R0101	11/29/94	75.0	

Note: OTP = ortho-Terphenyl

ACZ Laboratories, Inc.

Organic Quality Control Data Summary

METHOD BLANK / CCV DATA

Client:	RETEC, Inc.	Report Date:	11/30/95
Project:	3-1161-320	Date Received:	11/11/94
ACZ SDG No.:	L3825	Lab Nos.:	L3825-01 to 30

Matrix: Water

TPH Scan by Modified 8015 - GC/FID

Concentration Units mg/L

Lab Number	GC File	Analysis Date	True Value	C	TPH	C	R%	Remarks
Prep Blank 11/23	012F0101	11/29/94		U		U		
CCV1		11/29/94	2500.0		2522.0		100.9	
CCV2		11/29/94	2500.0		2439.0		97.6	

Note:

ACZ Laboratories, Inc.

Organic Quality Control Data Summary

MATRIX SPIKE / MATRIX SPIKE DUPLICATE RECOVERIES

Client:	RETEC, Inc.	Report Date:	11/30/95
Project:	3-1161-320	Date Received:	11/11/94
ACZ SDG No.:	L3825	Lab Nos.:	L3825-01 to 30

Matrix: Water

TPH Scan by Modified 8015 - GC/FID

Concentration Units mg/L

Sample ID	Lab No.	Sample Value mg/L	Spike Added mg/L	Matrix Spike mg/L	Matrix Spike Dup mg/L	Matrix Spike R%	Matrix Spike Dup R%	RPD%	
DI Water 11/23	LCS	0	2.5	2.68	2.79	107	112	4.0	

Note:

ACZ Laboratories
QUALITY CONTROL DATA SUMMARY

Client:	ReTec Inc. - Seattle	**Report Date:**	01/03/95
Project:	3-1161-320	**Samples:**	L3825-01 through -25
Attention:	Kim Lofgren		

Laboratory Control Samples - Percent Recovery

Analyte	SW 846 Method	Analysis Date	Certified Value	Observed Value	% Recovery
Arsenic, diss	7060	11/14/94	0.030	0.030	100
Chromium, diss	6010	12/3/94	1.00	1.02	102
Lead,diss	7421	11/22/94	0.030	0.031	103
TSS	160.2	11/15/94	279	262	94

CRM - Certified Reference Materials are prepared using distilled water and are an indication of the overall accuracy (bias) associated with the analytical methods.

Matrix Spikes - Percent Recovery

Analyte	EPA Method	Analysis Date	Sample Number	True Value	Observed Value	% Recovery
Arsenic, diss	7060	11/14/94	L3825-04	0.020	0.021	104
			L3825-27	0.020	0.022	109
Chromium, diss	6010	12/3/94	L3825-06	0.500	0.507	101
			L3825-30	0.500	0.502	100
Lead,diss	7421	11/22/94	L3825-01	0.020	0.019	93
			L3825-25	0.020	0.021	103

Matrix Spike Recoveries are used to determine the accuracy (bias) associated with the sample matrix. They are calculated as follows:

$$\frac{\text{Observed Spike Concentration - Sample Concentration}}{\text{Spike concentration}}$$

ACZ Laboratories
QUALITY CONTROL DATA SUMMARY

Client:	ReTec Inc. - Seattle	**Report Date:**	01/03/95
Project:	3-1161-320	**Samples:**	L3825-01 through -25
Attention:	Kim Lofgren		

Matrix Spike/ Sample Duplicates - Relative Percent Difference (RPD)

Analyte	EPA Method	Analysis Date	Sample Number	Observed Value 1	Observed Value 2	RPD
Arsenic, diss	7060	11/14/94	L3825-04	0.021	0.021	0.5
			L3825-27	0.022	0.022	0.5
Chromium, diss	6010	12/3/94	L3825-06	0.507	0.499	1.6
			L3825-30	0.502	0.501	0.2
Lead,diss	7421	11/22/94	L3825-01	0.019	0.019	0.0
			L3825-25	0.020	0.021	1.0
TSS	160.2	11/15/94	L3825-06	8	4	67.0

The Relative Percent Difference is used to assess the precision associated with the analytical methods and the sample matrix.

They are calculated as follows:

$$\frac{\text{Absolute Value (Observed value 1 - Observed V}}{\text{Average of (Observed Value 1 + Observed value 2)}} \quad X\ 100\ \%$$

PREP BLANKS

Analyte	EPA Method	Analysis Date	
Arsenic, diss	7060	11/14/94	<0.001
Chromium, diss	6010	12/3/94	< 0.01
Lead,diss	7421	11/22/94	< 0.001
TSS	160.2	11/15/94	< 5

Prep Blanks are distilled/deionized water taken through any preparative steps in the methods. They are used to determine the possiblity of laboratory contamination.

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC, Inc.	ACZ Project No.:	L3825
Client Project:	3-1161-320	Date Extracted:	11/22/94
Date Received:	11/11/94	Date Analyzed:	11/29/94
Report Date:	11/30/94	Matrix:	Water

Method ID: TPH Scan by Modified 8015 GC/FID

Lab Sample ID	Sample ID	Sample Date	GC File ID	DF	Petroleum Hydrocarbons (mg/L)	MDL	Q	Identification
L3825-01	9	11/8/94	013F0101	1	0.58	0.2		Diesel
L3825-02	35	11/8/94	014F0101	1	0.32	0.2		Diesel
L3825-03	38	11/8/94	015F0101	1	0.09	0.2	J	Diesel
L3825-04	101	11/8/94	016F0101	1		0.2	U	
L3825-05	23	11/8/94	017F0101	1		0.2	U	
L3825-06	37	11/8/94	018F0101	1	0.52	0.2		Diesel
L3825-07	370	11/8/94	019F0101	1	0.43	0.2		Diesel
L3825-08	5	11/8/94	020F0101	1	0.69	0.2		Diesel
L3825-09	103	11/8/94	021F0101	1		0.2	U	
L3825-10	40	11/8/94	023F0101	1		0.2	U	

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Carbon range between C9 - C36.

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC, Inc.	ACZ Project No.:	L3825
Client Project:	3-1161-320	Date Extracted:	11/22/94
Date Received:	11/11/94	Date Analyzed:	11/29/94
Report Date:	11/30/94	Matrix:	Water

Method ID: TPH Scan by Modified 8015 GC/FID

Lab Sample ID	Sample ID	Sample Date	GC File ID	DF	Petroleum Hydrocarbons (mg/L)	MDL	Q	Identification
L3825-11	11	11/8/94	036F0101	1	37.	0.2		Diesel
L3825-12	34	11/8/94	025F0101	1		0.2	U	
L3825-13	SW-5	11/8/94	026F0101	1		0.2	U	
L3825-14	26	11/9/94	027F0101	1	2.6	0.2		Diesel
L3825-15	1	11/9/94	028F0101	1		0.2	U	
L3825-16	3	11/9/94	029F0101	1		0.2	U	
L3825-17	4	11/9/94	030F0101	1		0.2	U	
L3825-18	13	11/9/94	031F0101	1	0.83	0.2		Diesel
L3825-19	SW-6	11/9/94	063R0101	1		0.2	U	
L3825-20	104	11/9/94	064R0101	1		0.2	U	

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Carbon range between C9 - C36.

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc.
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Steamboat Springs, CO 80487

(800) 334-5493
FAX: (303) 879-2216

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC, Inc.	ACZ Project No.:	L3825
Client Project:	3-1161-320	Date Extracted:	11/22/94
Date Received:	11/11/94	Date Analyzed:	11/29/94
Report Date:	11/30/94	Matrix:	Water

Method ID: TPH Scan by Modified 8015 GC/FID

Lab Sample ID	Sample ID	Sample Date	GC File ID	DF	Petroleum Hydrocarbons (mg/L)	MDL	Q	Identification
L3825-21	14	11/9/94	065R0101	1		0.2	U	
L3825-22	19	11/9/94	066R0101	1		0.2	U	
L3825-23	190	11/9/94	067R0101	1		0.2	U	
L3825-24	SW-7	11/9/94	068R0101	1		0.2	U	
L3825-30	400	11/8/94	069R0101	1		0.2	U	

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Carbon range between C9 - C36.

APPROVED:
Organic Laboratory Supervisor

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ACZ

Analytical Results

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Lab Sample ID: *L3825-01*
Client Sample ID: *9*
Client Project ID: *3-1161-320 SKYKOMISH*
ACZ Report ID: *RG1639*

Retec, Inc.
1011 S.W. Klickitat Way Suite 207
Seattle, WA 98134
Attn: Dean

Date Sampled: *11/8/94*
Date Received: *11/11/94*
Date Reported: *12/6/94*

Sample Matrix: *Ground Water*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Arsenic, dissolved	M7060 GFAA	0.006		mg/L	0.001	0.005	11/14/94	dc
Chromium, dissolved	M6010 ICP		U	mg/L	0.01	0.05	12/3/94	fp
Lead, dissolved	M7421 GFAA		U	mg/L	0.001	0.005	11/22/94	dc

Wet Chemistry

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Residue, Non-Filterable (TSS) @103-5C	M160.2 - Gravimetric	320		mg/L	5	20	11/16/94	das

Inorganic Qualifiers (based on EPA CLP 3/90)
U = Analyte was analyzed for but not detected
B = Analyte concentration detected at a value between MDL and PQL
PQL = Practical Quantitation Limit

S. Habermehl
Reviewer: Scott Habermehl

F. Polniak
Inorganic Supr: Frank Polniak

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Analytical Results

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Retec, Inc.
1011 S.W. Klickitat Way Suite 207
Seattle, WA 98134
Attn: Dean

Lab Sample ID: *L3825-02*
Client Sample ID: *35*
Client Project ID: *3-1161-320 SKYKOMISH*
ACZ Report ID: *RG1546*

Date Sampled: *11/8/94*
Date Received: *11/11/94*
Date Reported: *12/6/94*

Sample Matrix: *Ground Water*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Arsenic, dissolved	M7060 GFAA		U	mg/L	0.001	0.005	11/14/94	dc
Chromium, dissolved	M6010 ICP		U	mg/L	0.01	0.05	12/3/94	fp
Lead, dissolved	M7421 GFAA		U	mg/L	0.001	0.005	11/22/94	dc

Wet Chemistry

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Residue, Non-Filterable (TSS) @103-5C	M160.2 - Gravimetric	550		mg/L	5	20	11/16/94	das

Inorganic Qualifiers (based on EPA CLP 3/90)
U = Analyte was analyzed for but not detected
B = Analyte concentration detected at a value between MDL and PQL
PQL = Practical Quantitation Limit

S. Habermehl
Reviewer: Scott Habermehl

F. Polniak
Inorganic Supr: Frank Polniak

ACZ **Analytical Results**

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Retec, Inc.
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Seattle, WA 98134
Attn: Dean

Lab Sample ID: *L3825-03*
Client Sample ID: *38*
Client Project ID: *3-1161-320 SKYKOMISH*
ACZ Report ID: *RG1547*

Date Sampled: *11/8/94*
Date Received: *11/11/94*
Date Reported: *12/6/94*

Sample Matrix: *Ground Water*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Arsenic, dissolved	M7060 GFAA		U	mg/L	0.001	0.005	11/14/94	dc
Chromium, dissolved	M6010 ICP		U	mg/L	0.01	0.05	12/3/94	fp
Lead, dissolved	M7421 GFAA		U	mg/L	0.001	0.005	11/22/94	dc

Wet Chemistry

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Residue, Non-Filterable (TSS) @103-5C	M160.2 - Gravimetric	210		mg/L	5	20	11/16/94	das

Inorganic Qualifiers (based on EPA CLP 3/90)
U = Analyte was analyzed for but not detected
B = Analyte concentration detected at a value between MDL and PQL
PQL = Practical Quantitation Limit

S. Habermehl
Reviewer: Scott Habermehl

F. Polniak
Inorganic Supr: Frank Polniak

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Retec, Inc.
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Attn: Dean

Lab Sample ID: *L3825-04*
Client Sample ID: *101*
Client Project ID: *3-1161-320 SKYKOMISH*
ACZ Report ID: *RG1548*

Date Sampled: *11/8/94*
Date Received: *11/11/94*
Date Reported: *12/6/94*

Sample Matrix: *Ground Water*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Arsenic, dissolved	M7060 GFAA		U	mg/L	0.001	0.005	11/14/94	dc
Chromium, dissolved	M6010 ICP		U	mg/L	0.01	0.05	12/3/94	fp
Lead, dissolved	M7421 GFAA		U	mg/L	0.001	0.005	11/22/94	dc

Wet Chemistry

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Residue, Non-Filterable (TSS) @103-5C	M160.2 - Gravimetric		U	mg/L	5	20	11/16/94	das

Inorganic Qualifiers (based on EPA CLP 3/90)
U = Analyte was analyzed for but not detected
B = Analyte concentration detected at a value between MDL and PQL
PQL = Practical Quantitation Limit

S. Habermehl
Reviewer: Scott Habermehl

F. Polniak
Inorganic Supr: Frank Polniak

Form: REPIN001.11.94.01

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Attn: Dean

Lab Sample ID: *L3825-05*
Client Sample ID: *23*
Client Project ID: *3-1161-320 SKYKOMISH*
ACZ Report ID: *RG1549*

Date Sampled: *11/8/94*
Date Received: *11/11/94*
Date Reported: *12/6/94*

Sample Matrix: *Ground Water*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Arsenic, dissolved	M7060 GFAA		U	mg/L	0.001	0.005	11/14/94	dc
Chromium, dissolved	M6010 ICP		U	mg/L	0.01	0.05	12/3/94	fp
Lead, dissolved	M7421 GFAA		U	mg/L	0.001	0.005	11/22/94	dc

Wet Chemistry

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Residue, Non-Filterable (TSS) @103-5C	M160.2 - Gravimetric	1600		mg/L	5	20	11/16/94	das

Inorganic Qualifiers (based on EPA CLP 3/90)
U = Analyte was analyzed for but not detected
B = Analyte concentration detected at a value between MDL and PQL
PQL = Practical Quantitation Limit

S. Habermehl
Reviewer: Scott Habermehl

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Inorganic Supr: Frank Polniak

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Attn: Dean

Lab Sample ID: *L3825-06*
Client Sample ID: *37*
Client Project ID: *3-1161-320 SKYKOMISH*
ACZ Report ID: *RG1550*

Date Sampled: *11/8/94*
Date Received: *11/11/94*
Date Reported: *12/6/94*

Sample Matrix: *Ground Water*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Arsenic, dissolved	M7060 GFAA	0.002	B	mg/L	0.001	0.005	11/14/94	dc
Chromium, dissolved	M6010 ICP		U	mg/L	0.01	0.05	12/3/94	fp
Lead, dissolved	M7421 GFAA		U	mg/L	0.001	0.005	11/22/94	dc

Wet Chemistry

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Residue, Non-Filterable (TSS) @103-5C	M160.2 - Gravimetric	8	B	mg/L	5	20	11/16/94	das

Inorganic Qualifiers (based on EPA CLP 3/90)
U = Analyte was analyzed for but not detected
B = Analyte concentration detected at a value between MDL and PQL
PQL = Practical Quantitation Limit

S. Habermehl
Reviewer: Scott Habermehl

F. Polniak
Inorganic Supr: Frank Polniak

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Attn: Dean

Lab Sample ID: *L3825-07*
Client Sample ID: *370*
Client Project ID: *3-1161-320 SKYKOMISH*
ACZ Report ID: *RG1551*

Date Sampled: *11/8/94*
Date Received: *11/11/94*
Date Reported: *12/6/94*

Sample Matrix: *Ground Water*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Arsenic, dissolved	M7060 GFAA	0.001	B	mg/L	0.001	0.005	11/14/94	dc
Chromium, dissolved	M6010 ICP		U	mg/L	0.01	0.05	12/3/94	fp
Lead, dissolved	M7421 GFAA		U	mg/L	0.001	0.005	11/22/94	dc

Wet Chemistry

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Residue, Non-Filterable (TSS) @103-5C	M160.2 - Gravimetric		U	mg/L	5	20	11/16/94	das

Inorganic Qualifiers (based on EPA CLP 3/90)
U = Analyte was analyzed for but not detected
B = Analyte concentration detected at a value between MDL and PQL
PQL = Practical Quantitation Limit

S. Habermehl
Reviewer: Scott Habermehl

F. Polniak
Inorganic Supr: Frank Polniak

ACZ

Analytical Results

ACZ Laboratories, Inc.
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Steamboat Springs, CO 80487
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Lab Sample ID: *L3825-08*
Client Sample ID: *5*
Client Project ID: *3-1161-320 SKYKOMISH*
ACZ Report ID: *RG1552*

Retec, Inc.
1011 S.W. Klickitat Way Suite 207
Seattle, WA 98134
Attn: Dean

Date Sampled: *11/8/94*
Date Received: *11/11/94*
Date Reported: *12/6/94*

Sample Matrix: *Ground Water*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Arsenic, dissolved	M7060 GFAA	0.009		mg/L	0.001	0.005	11/14/94	dc
Chromium, dissolved	M6010 ICP		U	mg/L	0.01	0.05	12/3/94	fp
Lead, dissolved	M7421 GFAA		U	mg/L	0.001	0.005	11/22/94	dc

Wet Chemistry

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Residue, Non-Filterable (TSS) @103-5C	M160.2 - Gravimetric	220		mg/L	5	20	11/16/94	das

Inorganic Qualifiers (based on EPA CLP 3/90)
U = Analyte was analyzed for but not detected
B = Analyte concentration detected at a value between MDL and PQL
PQL = Practical Quantitation Limit

S. Habermehl
Reviewer: Scott Habermehl

F. Polniak
Inorganic Supr: Frank Polniak

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Analytical Results

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Attn: Dean

Lab Sample ID: ***L3825-09***
Client Sample ID: *103*
Client Project ID: *3-1161-320 SKYKOMISH*
ACZ Report ID: *RG1553*

Date Sampled: *11/9/94*
Date Received: *11/11/94*
Date Reported: *12/6/94*

Sample Matrix: *Ground Water*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Arsenic, dissolved	M7060 GFAA		U	mg/L	0.001	0.005	11/14/94	dc
Chromium, dissolved	M6010 ICP		U	mg/L	0.01	0.05	12/3/94	fp
Lead, dissolved	M7421 GFAA		U	mg/L	0.001	0.005	11/22/94	dc

Wet Chemistry

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Residue, Non-Filterable (TSS) @103-5C	M160.2 - Gravimetric		U	mg/L	5	20	11/16/94	das

Inorganic Qualifiers (based on EPA CLP 3/90)
U = Analyte was analyzed for but not detected
B = Analyte concentration detected at a value between MDL and PQL
PQL = Practical Quantitation Limit

S. Habermehl
Reviewer: Scott Habermehl

Fr. Polniak
Inorganic Supr: Frank Polniak

ACZ **Analytical Results**

ACZ Laboratories, Inc.
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Lab Sample ID: *L3825-10*
Client Sample ID: *40*
Client Project ID: *3-1161-320 SKYKOMISH*
ACZ Report ID: *RG1555*

Retec, Inc.
1011 S.W. Klickitat Way Suite 207
Seattle, WA 98134
Attn: Dean

Date Sampled: *11/9/94*
Date Received: *11/11/94*
Date Reported: *12/6/94*

Sample Matrix: *Ground Water*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Arsenic, dissolved	M7060 GFAA	0.002	B	mg/L	0.001	0.005	11/14/94	dc
Chromium, dissolved	M6010 ICP		U	mg/L	0.01	0.05	12/3/94	fp
Lead, dissolved	M7421 GFAA	0.003	B	mg/L	0.001	0.005	11/22/94	dc

Wet Chemistry

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Residue, Non-Filterable (TSS) @103-5C	M160.2 - Gravimetric	1100		mg/L	5	20	11/16/94	das

Inorganic Qualifiers (based on EPA CLP 3/90)

U = Analyte was analyzed for but not detected
B = Analyte concentration detected at a value between MDL and PQL
PQL = Practical Quantitation Limit

S. Habermehl
Reviewer: Scott Habermehl

F. Polniak
Inorganic Supr: Frank Polniak

Form: REPIN001.11.94.01

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Analytical Results

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Retec, Inc.
1011 S.W. Klickitat Way Suite 207
Seattle, WA 98134
Attn: Dean

Lab Sample ID: *L3825-25*
Client Sample ID: *16*
Client Project ID: *3-1161-320 SKYKOMISH*
ACZ Report ID: *RG1570*

Date Sampled: *11/8/94*
Date Received: *11/11/94*
Date Reported: *12/6/94*

Sample Matrix: *Ground Water*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Arsenic, dissolved	M7060 GFAA		U	mg/L	0.001	0.005	11/14/94	dc
Chromium, dissolved	M6010 ICP	0.01	B	mg/L	0.01	0.05	12/3/94	fp
Lead, dissolved	M7421 GFAA		U	mg/L	0.001	0.005	11/22/94	dc

Wet Chemistry

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Residue, Non-Filterable (TSS) @103-5C	M160.2 - Gravimetric	1100		mg/L	5	20	11/16/94	das

Inorganic Qualifiers (based on EPA CLP 3/90)
U = Analyte was analyzed for but not detected
B = Analyte concentration detected at a value between MDL and PQL
PQL = Practical Quantitation Limit

S. Habermehl
Reviewer: Scott Habermehl

F. Polniak
Inorganic Supr: Frank Polniak

ACZ

Analytical Results

ACZ Laboratories, Inc.
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Lab Sample ID: *L3825-26*
Client Sample ID: *2*
Client Project ID: *3-1161-320 SKYKOMISH*
ACZ Report ID: *RG1571*

Retec, Inc.
1011 S.W. Klickitat Way Suite 207
Seattle, WA 98134
Attn: Dean

Date Sampled: *11/9/94*
Date Received: *11/11/94*
Date Reported: *12/6/94*

Sample Matrix: *Ground Water*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Arsenic, dissolved	M7060 GFAA	0.003	B	mg/L	0.001	0.005	11/14/94	dc
Chromium, dissolved	M6010 ICP		U	mg/L	0.01	0.05	12/3/94	fp
Lead, dissolved	M7421 GFAA		U	mg/L	0.001	0.005	11/22/94	dc

Wet Chemistry

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Residue, Non-Filterable (TSS) @103-5C	M160.2 - Gravimetric	360		mg/L	5	20	11/16/94	das

Inorganic Qualifiers (based on EPA CLP 3/90)

U = Analyte was analyzed for but not detected
B = Analyte concentration detected at a value between MDL and PQL
PQL = Practical Quantitation Limit

S. Habermehl
Reviewer: Scott Habermehl

F. Polniak
Inorganic Supr. Frank Polniak

ACZ

Analytical Results

ACZ Laboratories, Inc.
30400 Downhill Drive
Steamboat Springs, CO 80487
(800) 334-5493

Retec, Inc.
1011 S.W. Klickitat Way Suite 207
Seattle, WA 98134
Attn: Dean

Lab Sample ID: *L3825-27*
Client Sample ID: *DW-3*
Client Project ID: *3-1161-320 SKYKOMISH*
ACZ Report ID: *RG1572*

Date Sampled: *11/9/94*
Date Received: *11/11/94*
Date Reported: *12/6/94*

Sample Matrix: *Ground Water*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Arsenic, dissolved	M7060 GFAA		U	mg/L	0.001	0.005	11/14/94	dc
Chromium, dissolved	M6010 ICP		U	mg/L	0.01	0.05	12/3/94	fp
Lead, dissolved	M7421 GFAA		U	mg/L	0.001	0.005	11/22/94	dc

Wet Chemistry

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Residue, Non-Filterable (TSS) @103-5C	M160.2 - Gravimetric	130		mg/L	5	20	11/16/94	das

Inorganic Qualifiers (based on EPA CLP 3/90)
U = Analyte was analyzed for but not detected
B = Analyte concentration detected at a value between MDL and PQL
PQL = Practical Quantitation Limit

S. Habermehl
Reviewer: Scott Habermehl

F. Polniak
Inorganic Supr: Frank Polniak

Form: REPIN001.11.94.01

ACZ

Analytical Results

ACZ Laboratories, Inc.
30400 Downhill Drive
Steamboat Springs, CO 80487
(800) 334-5493

Retec, Inc.
1011 S.W. Klickitat Way Suite 207
Seattle, WA 98134
Attn: Dean

Lab Sample ID: *L3825-28*
Client Sample ID: *31*
Client Project ID: *3-1161-320 SKYKOMISH*
ACZ Report ID: *RG1573*

Date Sampled: *11/9/94*
Date Received: *11/11/94*
Date Reported: *12/6/94*

Sample Matrix: *Ground Water*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Arsenic, dissolved	M7060 GFAA		U	mg/L	0.001	0.005	11/14/94	dc
Chromium, dissolved	M6010 ICP		U	mg/L	0.01	0.05	12/3/94	fp
Lead, dissolved	M7421 GFAA		U	mg/L	0.001	0.005	11/22/94	dc

Wet Chemistry

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Residue, Non-Filterable (TSS) @103-5C	M160.2 - Gravimetric	2000		mg/L	5	20	11/16/94	das

Inorganic Qualifiers (based on EPA CLP 3/90)
U = Analyte was analyzed for but not detected
B = Analyte concentration detected at a value between MDL and PQL
PQL = Practical Quantitation Limit

S. Habermehl
Reviewer: Scott Habermehl

F. Polniak
Inorganic Supr: Frank Polniak

ACZ **Analytical Results**

ACZ Laboratories, Inc.
30400 Downhill Drive
Steamboat Springs, CO 80487
(800) 334-5493

Retec, Inc.
1011 S.W. Klickitat Way Suite 207
Seattle, WA 98134
Attn: Dean

Lab Sample ID: *L3825-29*
Client Sample ID: *DW-2*
Client Project ID: *3-1161-320 SKYKOMISH*
ACZ Report ID: *RG1574*

Date Sampled: *11/9/94*
Date Received: *11/11/94*
Date Reported: *12/6/94*

Sample Matrix: *Ground Water*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Arsenic, dissolved	M7060 GFAA		U	mg/L	0.001	0.005	11/14/94	dc
Chromium, dissolved	M6010 ICP		U	mg/L	0.01	0.05	12/3/94	fp
Lead, dissolved	M7421 GFAA		U	mg/L	0.001	0.005	11/22/94	dc

Wet Chemistry

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Residue, Non-Filterable (TSS) @103-5C	M160.2 - Gravimetric	1400		mg/L	5	20	11/16/94	das

Inorganic Qualifiers (based on EPA CLP 3/90)
U = Analyte was analyzed for but not detected
B = Analyte concentration detected at a value between MDL and PQL
PQL = Practical Quantitation Limit

S. Habermehl
Reviewer: Scott Habermehl

F. Polniak
Inorganic Supr: Frank Polniak

ACZ

Analytical Results

ACZ Laboratories, Inc.
30400 Downhill Drive
Steamboat Springs, CO 80487
(800) 334-5493

Lab Sample ID: *L3825-30*
Client Sample ID: *4OO*
Client Project ID: *3-1161-320 SKYKOMISH*
ACZ Report ID: *RG1640*

Retec, Inc.
1011 S.W. Klickitat Way Suite 207
Seattle, WA 98134
Attn: Dean

Date Sampled: *11/8/94*
Date Received: *11/11/94*
Date Reported: *12/6/94*

Sample Matrix: *Ground Water*

Metals Analysis

Parameter	EPA Method	Result	Qual	Units	MDL	PQL	Date	Analyst
Arsenic, dissolved	M7060 GFAA	0.002	B	mg/L	0.001	0.005	11/14/94	dc
Chromium, dissolved	M6010 ICP		U	mg/L	0.01	0.05	12/3/94	fp
Lead, dissolved	M7421 GFAA	0.003	B	mg/L	0.001	0.005	11/22/94	dc

Inorganic Qualifiers (based on EPA CLP 3/90)

U = Analyte was analyzed for but not detected
B = Analyte concentration detected at a value between MDL and PQL
PQL = Practical Quantitation Limit

S. Habermehl
Reviewer: Scott Habermehl

F. Polniak
Inorganic Supr: Frank Polniak

APPENDIX I

PRODUCT CHARACTERIZATION DATA

ACZ Laboratories, Inc.

February 2, 1995

Ms. Elona Tumoi
Remediation Technologies Inc.
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134

Dear Ms. Tumoi:

Enclosed please revised TPH reports and chromatograms for four oil samples that were received by ACZ Laboratories on 11/19/93. The original reports did not include the carbon ranges for gasoline or heavy oil. I had the chromatograms reviewed by ACZ's Organic Laboratory Supervisor. It was determined that all of the hydrocarbons present are in the diesel range. The new reports reflect this but have the additional carbon ranges reported.

If you have any questions or require more information please give me call at (800)334-5493.

Sincerely,

Scott Habermehl

Scott Habermehl
Project Manager

30400 Downhill Drive
Steamboat Springs, CO 80487-9400
Phone (800) 334-5493
FAX No. (303) 879-2216

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	690-3628
Client Project No:	3-1161-320	GC File ID:	1217R054
Sample ID:	RIVER	Date Received:	11/19/93
Matrix:	Soil	Date Extracted:	12/17/93
Sample Date:	11/9/93	Date Analyzed:	12/17/93
Report Date:	1/30/95	Dilution Factor:	500
		% Solids:	100
Method ID:	WTPH - HCID by GC/FID Hydrocarbon Identification Method	Concentration Units:	mg/kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons - Gasoline Range (> C6 - C12)		10,000	U
Hydrocarbons - Diesel Range (C12 - C28)	490,000	25,000	
Hydrocarbons - Heavy Oil Range (> C28)		50,000	U

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Sample is an oil/water mixture. Oil phase was analyzed.

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc.
30400 Downhill Dr.
Steamboat Springs, CO 80487
(800) 334-5493
FAX: (303) 879-2216

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	690-3629
Client Project No:	3-1161-320	GC File ID:	1217R055
Sample ID:	MW27	Date Received:	11/19/93
Matrix:	Oil	Date Extracted:	12/17/93
Sample Date:	11/9/93	Date Analyzed:	12/17/93
Report Date:	1/30/95	Dilution Factor:	500
		% Solids:	100
Method ID:	WTPH - HCID by GC/FID Hydrocarbon Identification Method	Concentration Units:	mg/kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons - Gasoline Range (> C6 - C12)		10,000	U
Hydrocarbons - Diesel Range (C12 - C28)	480,000	25,000	
Hydrocarbons - Heavy Oil Range (> C28)		50,000	U

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Sample is a black, free-flowing oil.

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	690-3630
Client Project No:	3-1161-320	GC File ID:	1217R056
Sample ID:	MW~~21~~ 22	Date Received:	11/19/93
Matrix:	Oil	Date Extracted:	12/17/93
Sample Date:	11/9/93	Date Analyzed:	12/17/93
Report Date:	1/30/95	Dilution Factor:	500
		% Solids:	100
Method ID:	WTPH - HCID by GC/FID Hydrocarbon Identification Method	Concentration Units:	mg/kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons - Gasoline Range (> C6 - C12)		10,000	U
Hydrocarbons - Diesel Range (C12 - C28)	430,000	25,000	
Hydrocarbons - Heavy Oil Range (> C28)		50,000	U

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Sample is a black, free-flowing oil.

APPROVED: [signature]
Organic Laboratory Supervisor

ACZ Laboratories, Inc.
30400 Downhill Dr.
Steamboat Springs, CO 80487
(800) 334-5493
FAX: (303) 879-2216

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

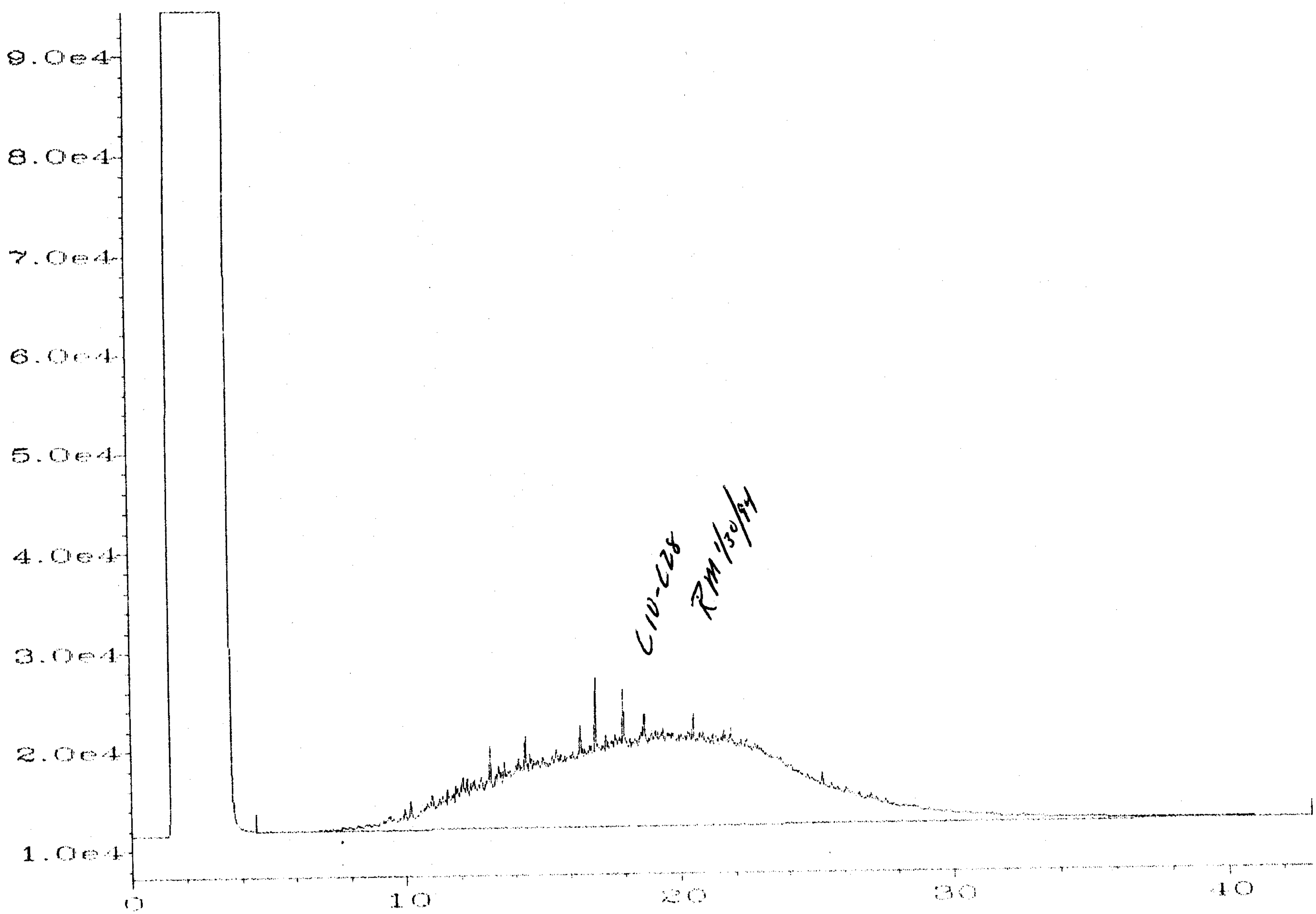
Client:	RETEC	Lab Sample ID:	690-3631
Client Project No:	3-1161-320	GC File ID:	1217R057
Sample ID:	MW39	Date Received:	11/19/93
Matrix:	Oil	Date Extracted:	12/17/93
Sample Date:	11/9/93	Date Analyzed:	12/17/93
Report Date:	1/30/95	Dilution Factor:	500
		% Solids:	100
Method ID:	WTPH - HCID by GC/FID Hydrocarbon Identification Method	Concentration Units:	mg/kg (dry wt. basis)

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons - Gasoline Range (> C6 - C12)		10,000	U
Hydrocarbons - Diesel Range (C12 - C28)	210,000	25,000	
Hydrocarbons - Heavy Oil Range (> C28)		50,000	U

Q FORMAT:
"U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Sample is a black, free-flowing oil.

APPROVED: Ron Martino
Organic Laboratory Supervisor



Sig. 2 in C:\HPCHEM\1\DATA\tph31217\054R0101.D

river bank

External Standard Report

Data File Name : C:\HPCHEM\1\DATA\tph31217\054R0101.D
Operator : RVV
Instrument : GC DUAL F
Sample Name : XO/690-3628
Run Time Bar Code:
Acquired on : 17 Dec 93 11:36 AM
Report Created on: 17 Dec 93 12:28 PM
Last Recalib on : 13 DEC 93 10:29 PM
Multiplier : ~~0.1~~ 490

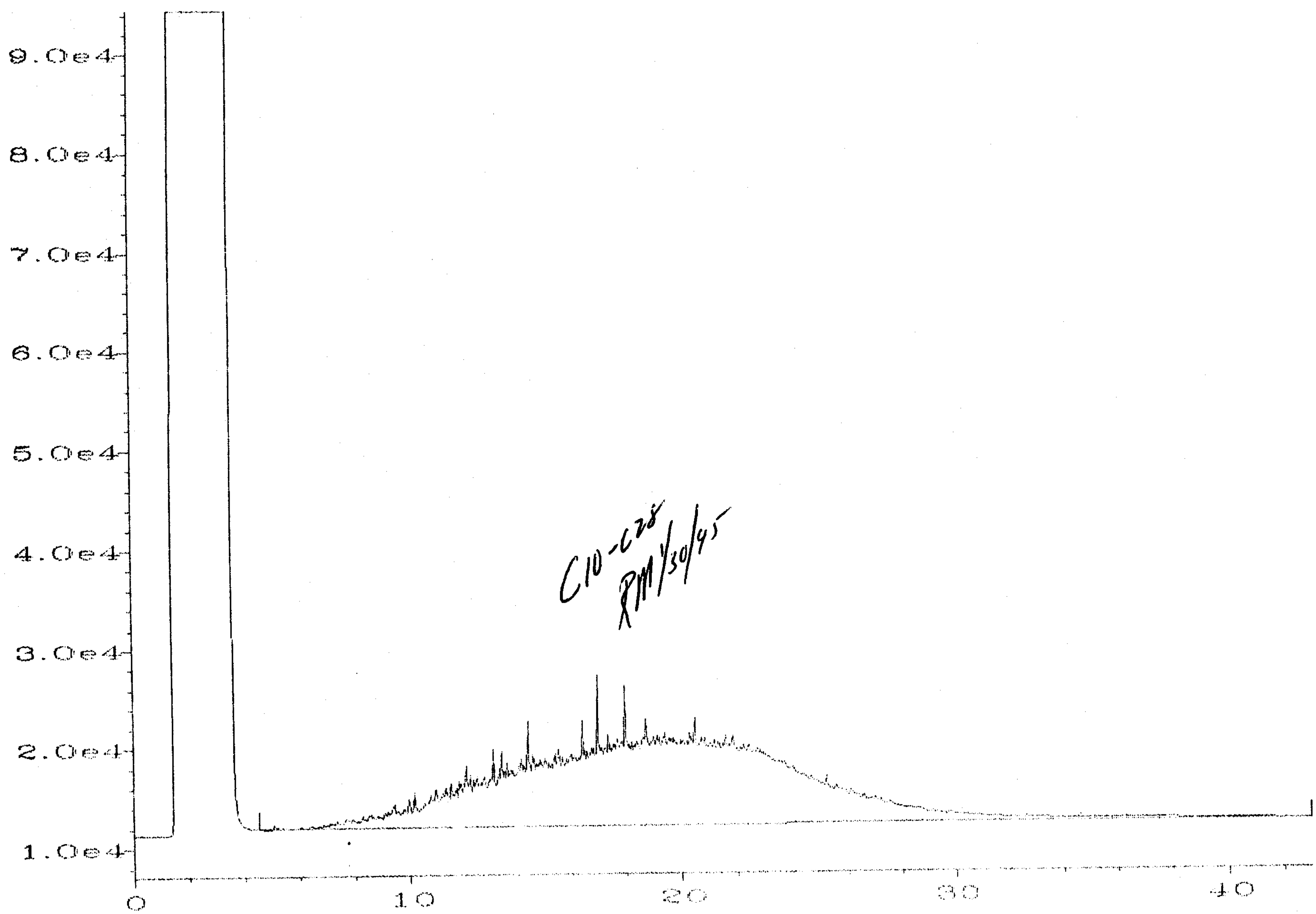
Page Number : 1
Vial Number : 54
Injection Number : 1
Sequence Line : 1
Instrument Method: TPHFINJ.MTH
Analysis Method : TPHRINJ.MTH
Sample Amount : 0
ISTD Amount :

Sig. 2 in C:\HPCHEM\1\DATA\tph31217\054R0101.D

Ret Time	Area	Type	Width	Ref#	mg/kG	Name
23.745	6903662	BB +	0.000	1	100.267	

x 4900

= 490,000



Sig. 2 in C:\HPCHEM\1\DATA\tph31217\055R0101.D

MW-27

==
External Standard Report
==

Data File Name : C:\HPCHEM\1\DATA\tph31217\055R0101.D
Operator : RVV
Instrument : GC DUAL F
Sample Name : XO/690-3629
Run Time Bar Code:
Acquired on : 17 Dec 93 12:28 PM
Report Created on: 17 Dec 93 01:20 PM
Last Recalib on : 13 DEC 93 10:29 PM
Multiplier : 0.1 495

Page Number : 1
Vial Number : 55
Injection Number : 1
Sequence Line : 1
Instrument Method: TPHFINJ.MTH
Analysis Method : TPHRINJ.MTH
Sample Amount : 0
ISTD Amount :

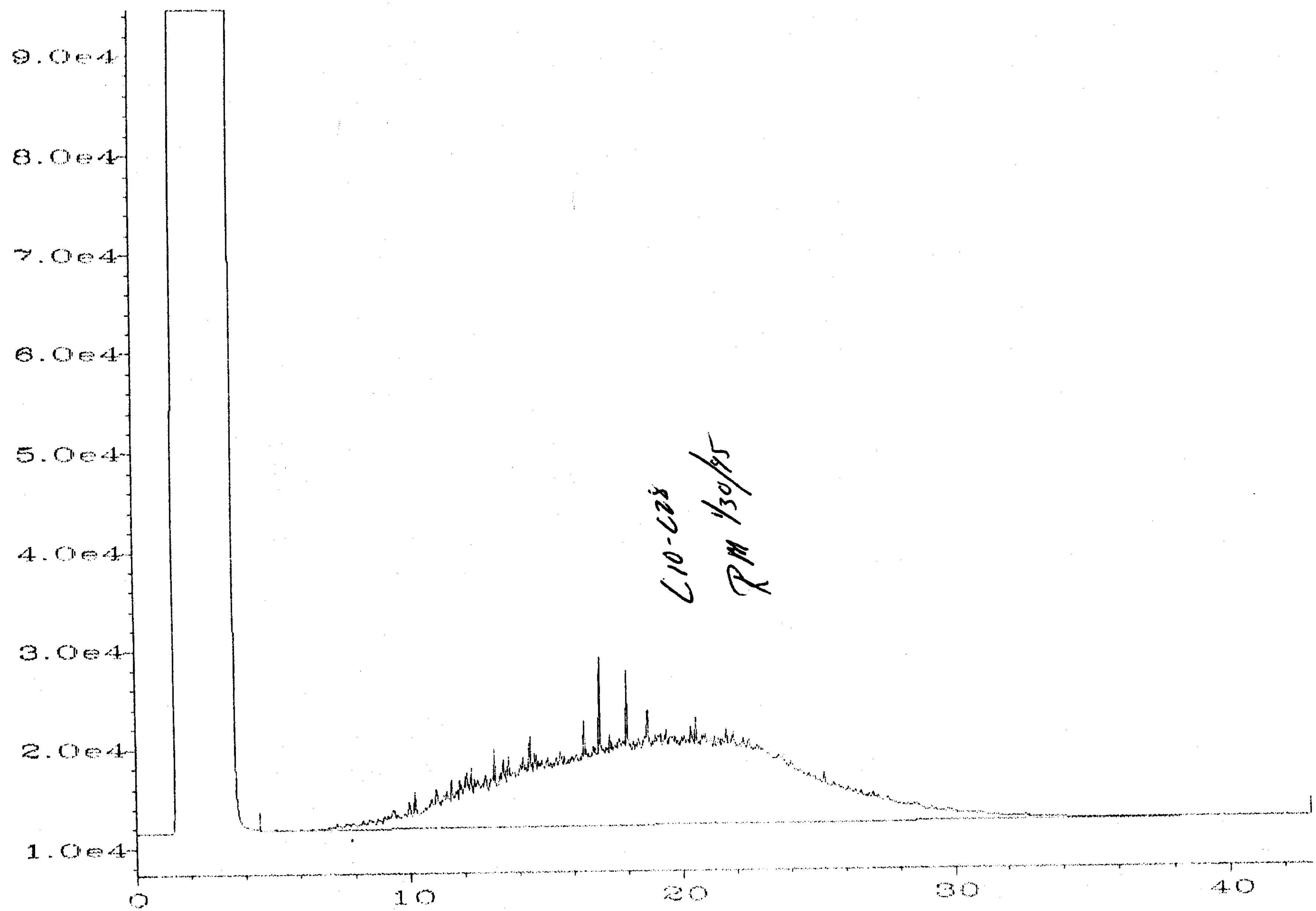
Sig. 2 in C:\HPCHEM\1\DATA\tph31217\055R0101.D

Ret Time	Area	Type	Width	Ref#	mg/kG	Name
23.745	6694193	BB +	0.000	1	97.343	

==

x 4950

= 480,000



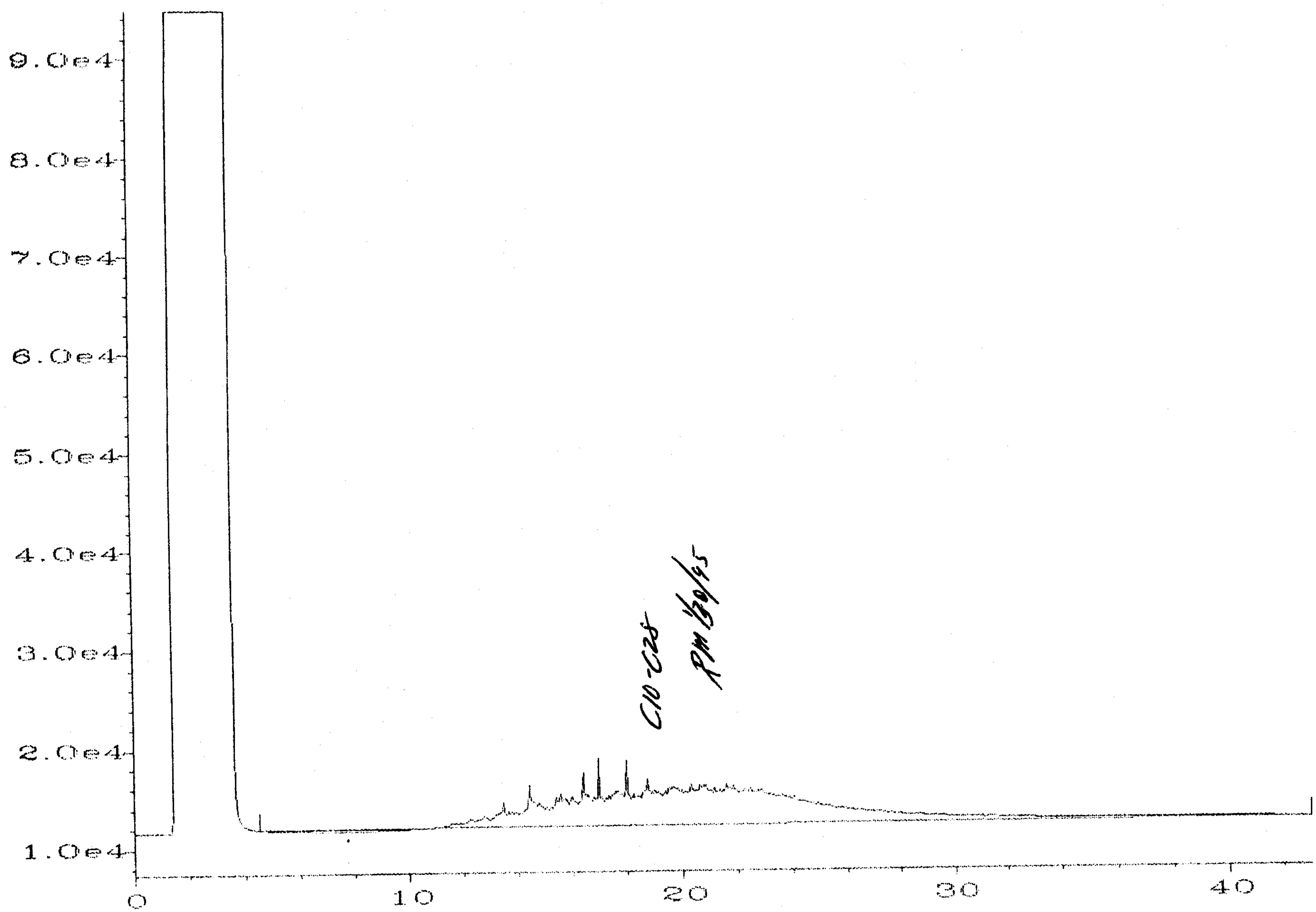
Sig. 2 in C:\HPCHEM\1\DATA\ph31217\056R0101.D

MW-22

External Standard Report

```
Data File Name    : C:\HPCHEM\1\DATA\tph31217\056R0101.D
Operator          : RVV                       Page Number        : 1
Instrument        : GC DUAL F                 Vial Number        : 56
Sample Name       : XO/690-3630               Injection Number   : 1
Run Time Bar Code:                            Sequence Line      : 1
Acquired on       : 17 Dec 93  01:20 PM       Instrument Method: TPHFINJ.MTH
Report Created on: 17 Dec 93  02:12 PM        Analysis Method    : TPHRINJ.MTH
Last Recalib on   : 13 DEC 93 10:29 PM        Sample Amount      : 0
Multiplier        : 0.1  446                  ISTD Amount        :

Sig. 2 in C:\HPCHEM\1\DATA\tph31217\056R0101.D
Ret Time    Area       Type Width Ref#  mg/kG              Name
|-------|------------|----|-----|-----|-------|----------------------------|
  23.745    6654771  BB + 0.000   1      96.793
                                         x446
                                       = 430,000
```



Sig. 2 in C:\HPCHEM\1\DATA\tph31217\057R0101.D

MW-39

External Standard Report

Data File Name	: C:\HPCHEM\1\DATA\tph31217\057R0101.D		
Operator	: RVV	Page Number	: 1
Instrument	: GC DUAL F	Vial Number	: 57
Sample Name	: XO/690-3631	Injection Number	: 1
Run Time Bar Code	:	Sequence Line	: 1
Acquired on	: 17 Dec 93 02:12 PM	Instrument Method	: TPHFINJ.MTH
Report Created on	: 17 Dec 93 03:03 PM	Analysis Method	: TPHRINJ.MTH
Last Recalib on	: 13 DEC 93 10:29 PM	Sample Amount	: 0
Multiplier	: ~~0.1~~ 546	ISTD Amount	:

Sig. 2 in C:\HPCHEM\1\DATA\tph31217\057R0101.D

Ret Time	Area	Type	Width	Ref#	mg/kG	Name
23.745	2468392	BB +	0.000	1	38.354 ×5460	

= 210,000

ACZ Laboratories, Inc.

30400 Downhill Drive
Steamboat Springs, CO 80487-9400
(303) 879-6590 (800) 334-5493
FAX No. (303) 879-2216

January 25, 1994

Mr. Ward Beebe
Remediation Technologies Inc.
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134

Dear Mr. Beebe:

Enclosed please find TPH reports for four oil samples that were received by ACZ Laboratories on 11/19/93. During a review of our records, it was found that this project was never reported.

The samples consisted of a black, free flowing oil and was identified as an unknown with a carbon range of C9 through C32. The TPH data is reported in mg/kg as diesel. Even though the samples are oil, the concentrations do not add up to 100 %. The reason is that the standards used to calibrate the GC/FID have a different response factor than the oil in the samples.

There is no charge for these analyses because of ACZ's delay in completing the project in a timely manner. I apologize for the over-sight. We have recently taken steps to eliminate future problems of this nature. We are developing a new computerized laboratory information management system (LIMS) that will computerize sample log-in and tracking, data transfer from instruments, and final report generation. The new LIMS is scheduled to begin parallel testing in the next two weeks.

I should have all the Quality Control Summaries finished by the end of next week and will forward them to Kim Lofgren.

If you have any questions or require more information

Sincerely,

Scott Habermehl

Scott Habermehl
Project Manager

086 690 (93-50/3628-3631)

6500

CHAIN OF CUSTODY RECORD

PROJ. NO.: 3-1162-320

PROJECT NAME: BNRR Maintenance + Refueling Facility Skykomish, WA

SAMPLERS: A. de Spirlet / S.S. Birch

RECEIVING LABORATORY: ACZ

SEND RESULTS TO: Shelly S. Birch

LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS	WTPH-HCID						REMARKS
	11-9-93	1400	River	1	✓						
	11-9-93	1345	MW27	1	✓						
	11-9-93	1300	MW-~~2X~~ 22 SSB	1	✓						
	11-9-93	1220	MW-39	1	✓						

Condition of Samples Upon Receipt
By ACZ Laboratories, Inc: 4
Temperature of Contents: 1 °C
Sample Containers: OK
Custody Seals: intact

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Shelly S Birch	11-18-93 / 1630				

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time
		B. [illegible]	11-19-93 / 1100

Shipper Information: Sent via Fed X ACZ 30400 Downhill Dr. Steamboat Springs Co. 80487 11-19-93

REMEDIATION TECHNOLOGIES INC

REMEDIATION TECHNOLOGIES
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PINK COPY - Sampler YELLOW COPY - Laboratory WHITE COPY - ReTeC

ACZ Laboratories, Inc.

QUALITY CONTROL DATA SUMMARY

Client:	Retec	Report Date:	2/3/94
Attn:	Ms. Kim Lofgren		
Project:	3-1161, Skykomish		

ACZ Sample ID:	Client Sample ID:	Performed Analysis	Sampled	Received
93-SO/690-3628	River	D	11/09/93	11/19/93
93-SO/690-3629	MW-27	D	11/09/93	11/19/93
93-SO/690-3630	MW-21	D	11/09/93	11/19/93
93-SO/690-3631	MW-39	D	11/09/93	11/19/93

Analyses performed on the above samples includes; (D) = WTPH-D by Washington Method - GC/FID

This summary package includes the following sections for each of the above mentioned analyses:

Surrogate Recoveries
Matrix Spike/Matrix Spike Duplicates

Abbreviations:

MS/MSD	=	Matrix Spike/Matrix Spike Duplicate
% R	=	Percent Recovery
RPD	=	Relative Percent Difference
NS	=	Not Spiked
N/A	=	Not Applicable

Jeffrey E. Filkins
QA/QC Officer

ACZ Laboratories, Inc.

QUALITY CONTROL DATA SUMMARY
WTPH-D by Washington Method - GC/FID
Matrix: Water

Client:	Retec	Report Date:	2/3/94
Attn:	Ms. Kim Lofgren		
Project:	3-1161, Skykomish		

Surrogate Recoveries
Units: %

Extraction Date	Sample Lab #	Spike Conc. ug/Kg	Nitro-benzene (NB)	Spike Conc. ug/Kg	o-Terphenyl (o-TP)	Analysis Date
12/17/93	690-3628	125	NS *	125	NS *	12/17/93
12/17/93	690-3629	125	NS *	125	NS *	12/17/93
12/17/93	690-3630	125	NS *	125	NS *	12/17/93
12/17/93	690-3631	125	NS *	125	NS *	12/17/93

* = Not Spiked due to the extraction being a waste dilution.

Prep. Blank Surrogate Recoveries

12/17/93 No prep. blank was prepared with these samples.

Duplicate Recoveries

Extraction Date	Sample Lab #	Sample Conc. mg/Kg	Sample Conc. (Dup) mg/Kg	RPD %	Analysis Date
12/17/93	No duplicates were prepared with these samples.				

Matrix Spike and Matrix Spike Duplicate Recoveries

Analysis Date	Sample Lab #	Spike Conc. mg/Kg	Component	Matrix Spike % R	Matrix Spike Duplicate % R	RPD %
N/A		NS **	API Diesel Std.	N/A	N/A	N/A

** = Not Spiked due to the extraction being a waste dilution.

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	690-3628
Client Project No:	3-1161-320	GC File ID:	1217R054
Sample ID:	RIVER	Date Received:	11/19/93
Matrix:	Oil	Date Extracted:	12/17/93
Sample Date:	11/9/93	Date Analyzed:	12/17/93
Report Date:	1/21/94	Dilution Factor:	500
		% Solids:	100
Method ID:	WTPH - HCID by GC/FID Hydrocarbon Identification Method	Concentration Units:	mg/kg

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons as Diesel	490,000	50,000	U

Product Identification detected in sample: C9 - C32 Unknown

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Sample is an oil/water mixture. Oil phase was analyzed.

APPROVED: Ralph V. Poulsen for CW

Organic Laboratory Supervisor

ACZ Laboratories, Inc.
30400 Downhill Dr.
Steamboat Springs, CO 80487

(800) 334-5493
FAX: (303) 879-2216

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	690-3629
Client Project No:	3-1161-320	GC File ID:	1217R055
Sample ID:	MW27	Date Received:	11/19/93
Matrix:	Oil	Date Extracted:	12/17/93
Sample Date:	11/9/93	Date Analyzed:	12/17/93
Report Date:	1/21/94	Dilution Factor:	500
		% Solids:	100
Method ID:	WTPH - HCID by GC/FID Hydrocarbon Identification Method	Concentration Units:	mg/kg

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons as Diesel	480,000	50,000	U

Product Identification detected in sample: C9- C32 Unknown

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Sample is a black, free-flowing oil.

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	690-3630
Client Project No:	3-1161-320	GC File ID:	1217R056
Sample ID:	MW~~21~~ 22 WS	Date Received:	11/19/93
Matrix:	Oil	Date Extracted:	12/17/93
Sample Date:	11/9/93	Date Analyzed:	12/17/93
Report Date:	1/21/94	Dilution Factor:	500
		% Solids:	100
Method ID:	WTPH - HCID by GC/FID Hydrocarbon Identification Method	Concentration Units:	mg/kg

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons as Diesel	430,000	50,000	U

Product Identification detected in sample: C9 - C32 Unknown

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Sample is a black, free-flowing oil.

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc.
30400 Downhill Dr.
Steamboat Springs, CO 80487

(800) 334-5493
FAX: (303) 879-2216

ACZ Laboratories, Inc

ORGANICS ANALYSIS REPORT

Client:	RETEC	Lab Sample ID:	690-3631
Client Project No:	3-1161-320	GC File ID:	1217R057
Sample ID:	MW39	Date Received:	11/19/93
Matrix:	Oil	Date Extracted:	12/17/93
Sample Date:	11/9/93	Date Analyzed:	12/17/93
Report Date:	1/21/94	Dilution Factor:	500
		% Solids:	100
Method ID:	WTPH - HCID by GC/FID Hydrocarbon Identification Method	Concentration Units:	mg/kg

COMPOUND	CONCENTRATION	MDL	Q
Hydrocarbons as Diesel	210,000	50,000	U

Product Identification detected in sample: C9 - C32 Unknown

Q FORMAT: "U" indicates compound was not detected
"J" indicates compound detected < MDL (Method Detection Limit)
"B" indicates compound was found in daily calibration blank

COMMENTS: Sample is a black, free-flowing oil.

APPROVED: Ralph V. Poulsen for CW
Organic Laboratory Supervisor

ACZ Laboratories, Inc.
30400 Downhill Dr.
Steamboat Springs, CO 80487
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FAX: (303) 879-2216

HAUSER

HAUSER CHEMICAL RESEARCH, INC.

CLIENT: Retec
1011 SW Klickitat Way
Suite 107
Seattle, WA 98134

Attention: Shelly Birch

PROJECT: L31849
DATE: 12/03/93

HAUSER LABORATORIES, INC.
A SUBSIDIARY

MATERIALS:

Four (4) bilayered oil samples received for analysis on 11/19/93 and labeled:

1. 11/9/93, River
2. 11/9/93, MW 27
3. 11/9/93, MW 21
4. 11/9/93, MW 39

DESCRIPTION OF WORK:

Determination of viscosity, surface tension, interfacial tension, and specific gravity per work order number WA1 31161-320.

RESULTS:

Test & Method	1. River	2. MW 27	3. MW ~~21~~ 22	4. MW 39
Surface Tension, Dynes/cm	39	35	33	38
Interfacial Tension, Dynes/cm @ room temperature ASTM D1331-89	27	81	49	25
Specific Gravity, 45°F ASTM D70-82	0.9818	0.9676	0.9740	1.0054
Viscosity, cP @ 45-46°F ASTM D2196-91	2,730	1,035	5,783	95,350

REPORT PREPARED BY:

John Hafen, Associate Chemist

ANALYSIS PERFORMED BY:

Brooke Smith, Technician I
Perry Christopher, Technician II

5555 Airport Blvd. • Boulder, Colorado 80301 • Ph: (303) 443-4662 • FAX: (303) 441-5803

6842

CHAIN OF CUSTODY RECORD

PROJ. NO.: 3-1161-320

PROJECT NAME: BNRR Maintenance & Fueling Facility SKYKOMISH, WA

SAMPLERS: A. de Spiriet / SS Birch

RECEIVING LABORATORY: HAUSER

SEND RESULTS TO: Shelly Birch

LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS	Viscosity at 45°F	Surface Tension	Interfacial Tension	Specific Gravity at 45°F				REMARKS
	11-9-93	1400	RIVER	1	✓	✓	✓	✓				
	"	1345	MW27	1	✓	✓	✓	✓				
	"	1300	MW21	1	✓	✓	✓	✓				
	"	1220	MW-39	1	✓	✓	✓	✓				

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Shelly S Birch	11-18-93 / 1630		Jon Tamstone Rogby	1/17 / 11 AM	

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time
		[signature]	11/19/93 11:50

Shipper Information: Sent via Fed X to Hauser - 5555 Airport Blvd Boulder CO 80301

RETEC REMEDIATION TECHNOLOGIES INC

REMEDIATION TECHNOLOGIES
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PINK COPY - Sampler YELLOW COPY - Laboratory WHITE COPY - ReTeC

HAUSER

HAUSER CHEMICAL RESEARCH, INC.

HAUSER LABORATORIES, INC.
A SUBSIDIARY

CLIENT: Retec
1011 SW Klickitat Way
Suite 107
Seattle, WA 98134

Attention: Shelly Birch

PROJECT: L40641
DATE: 4/21/94
Page 1 of 1

MATERIALS:

One (1) oil sample received for analysis on 4/19/94 and labeled:

1. MW 39

DESCRIPTION OF WORK:

Determination of specific gravity per client's request.

RESULTS:

Test & Method	1. MW 39
Specific Gravity, 45°F ASTM D70-82	0.9922

REPORT PREPARED BY:

John Hafen
Associate Chemist

ANALYSIS PERFORMED BY:

Cate Fowler
Technician I

5555 Airport Blvd. • Boulder, Colorado 80301 • Ph: (303) 443-4662 • FAX: (303) 441-5803

7133

CHAIN OF CUSTODY RECORD

PROJ. NO.: 3-1161-320

PROJECT NAME: BN SKYKOMISH

SAMPLERS: SB

RECEIVING LABORATORY: HAUSER LABS

SEND RESULTS TO: SHELLY BIRCH

LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS	SPEC GRAVITY							REMARKS
	4/18/94	2	MW 39	1	X							

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
[signature]	4/18/94 2				

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time

Shipper Information: FEDEX

RETEC
REMEDIATION TECHNOLOGIES INC

REMEDIATION TECHNOLOGIES
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

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APPENDIX J

AIR EMISSION ESTIMATION METHODS

APPENDIX J
SOIL TO AIR MODEL

Under typical conditions at a site, the surface soil can release compounds of interest into the air via volatilization and fugitive dust emission. These emissions, which are areal in nature, will mix with the air immediately above the soil surface to give concentrations of the compounds of interest in the air. This section presents a methodology for estimating emissions from volatilization and fugitive dust and mixing these emissions through the application of a box dispersion model to yield air concentrations.

This methodology is ideally suited to estimating long-term (i.e., chronic) air concentrations immediately above the areal soil source due to long-term emissions from surface soils. The methodology can also be used to estimate air concentration at the perimeter of the areal source due to emissions from surface soils.

1.1 Box Dispersion Model

The nearfield box dispersion model of Pasquill (1975)[1] was used to estimate concentrations of compounds of interest in the air from surface emissions. The model assumes a box exists above the areal source and mixes the areal emissions within this box to generate an air concentration. The average air concentration is given by:

$$\langle Ca \rangle = \frac{(\langle Ev \rangle + \langle Ed \rangle) \cdot Ac}{(Hb \cdot Wb \cdot um)} \qquad (1)$$

where:

$\langle Ca \rangle$	=	long-term average air concentration (mg/m^3)
$\langle Ev \rangle$	=	long-term average emission rate due to volatilization (mg/m^2-s)
$\langle Ed \rangle$	=	long-term average emission rate due to fugitive dust emission (mg/m^2-s)
Ac	=	area of areal source (m^2)
Hb	=	height of box (m)
Wb	=	width of box (m)
um	=	average windspeed through the box (m/s)

---

[1] The equations in this model are those presented in GRI (1988), Volume III, Appendix B.

The height of the box depends on the length of the box in the downwind direction.

$$Hb\ (Lb) = 0.137 + 0.0307 \cdot Lb + 0.302 \cdot Lb^{0.5} \qquad \textbf{(2)}$$

where:

Lb = length of box in downwind direction (m)

This relationship was derived from data presented in GRI (1988).

The average windspeed through the box can be determined from typically measured windspeeds and the box height (GRI, 1988):

$$um = 0.22 \cdot In(2.5 \cdot Hb) \cdot u10 \qquad \textbf{(3)}$$

In this expression, the variable um is:

u10 = windspeed measured at a 10 meter height (m/s)

1.2 Volatile Emissions

The average rate of volatile emission from soils depends on the properties of the chemical, the depth of contamination and the time over which the emission rate is averaged. For a soil of depth L and averaging time Tdur, the long-term average emission is given by:

$$Ev_{av} = \frac{fac1 * pb * L * Fv}{Tdur} * Csz \qquad \textbf{(4)}$$

where:

Ev_{av}	=	long term average emission rate (mg/m^2-s)
pb	=	bulk density of soil (g/cm^3 or Kg/L)
L	=	soil depth (m)
Tdur	=	duration of exposure (days)
Fv	=	fraction of chemical volatilized in time Tdur (unitless)
fac1	=	unit conversion factor, 0.0116 L-day/m^3-s
Csz	=	initial concentration of the chemical in the soil (mg/Kg)

The principal unknown variable in Equation 4 is Fv, the fraction of chemical volatized in time Tdur. The analysis is based on a model developed by Clark Allen of Research Triangle Institute (the RTI model as presented in EPA, 1989a). This model assumes that emissions from the surface of the soil/waste mixture are limited by the diffusion of vapors through the pore spaces in the soil/waste mixture and further assumes the an equilibrium concentration of organic vapors exists at all times within the soil pore spaces. The model is based on Fick's law of diffusion applied to a flat slab, and includes a term to estimate biological decay, assuming a decay rate that is first order with respect to waste loading in the soil. Here, the same starting point is taken as in the Clark Allen model, but the air emission equations are developed in a more rigorous and substantially simpler way.

The starting equations for the model are assumed to be equations 5-4 and 5-5 of EPA 1989a, which describe a chemical's emission rate from a soil. One equation given emissions for "short" times, while the other gives emissions for "long" times and are written as:

$$E_{short} = M_0 \left(\frac{fac2 \, * \, Keq \, * \, D}{\pi \; Tdur \; L^2} \right)^{1/2} e^{-Tdur * kdeg} \tag{5}$$

and

$$E_{long} = M_0 \left(\frac{2 \, * \, fac2 \, * \, Keq \, * \, De}{L^2} \right) e^{-\frac{fac2 * Keq * D\pi^2 \; Tdur}{4L^2}} \; e^{-Tdur * kdeg} \tag{6}$$

where:

E_{short}	=	emission rate at short times (g/day)
E_{long}	=	emission rate at long times (g/day)
Keq	=	partitioning coefficient between air and soil phases (L-air/L-tot)
De	=	effective vapor diffusion coefficient (cm^2/s)
fac2	=	unit conversion factor, 8.64 m2-s/cm2-day
kdeg	=	first order degradation constant (1/day)
M_0	=	initial mass of material present (g)

The other variables appearing in Equations 5 and 6 have been previously defined. The range of times for which each equation is applicable is discussed later.

The partitioning coefficient, Keq, describes the partitioning of the chemical between soil solids, water, and air and is the ratio of the vapor phase concentration in the soil to the total concentration of the chemical in the soil, that is:

$$Keq = \frac{Cg}{Ct} \tag{7}$$

where:

Cg	=	concentration of chemical in soil gas (mg/L-air)
Ct	=	total concentration of chemical (mg/L-tot)

The total concentration of the chemical in the soil depends on the concentration in the solid, water, and gaseous phases according to the following equation:

$$Ct = pb * Css + nw * Cw + na * Cg \tag{8}$$

where:

pb	=	bulk density (kg/L)
nw	=	volumetric water content (L-water/L-tot)
na	=	volumetric air content (L-air/L-tot)
Css	=	concentration of chemical sorbed to soil solids (mg/kg)
Cw	=	concentration of chemical in water (mg/L-water)

If the chemical is assumed to be in equilibrium with the soil solids, liquid, and gas phases, then the concentration of the chemical in the soil solids and soil water can be expressed in terms of the concentration of the chemical in the soil gas:

$$Css = \frac{Kp}{Kaw} * Cg \tag{9}$$

$$Cw = \frac{1}{Kaw} * Cg \tag{10}$$

where:

Kp	=	soil solids to water partitioning coefficient [(mg/Kg)/(mg/L-water)]
Kaw	=	soil air to water partitioning coefficient [(mg/L-air)/(mg/L-water)]

With this equilibrium assumption, Keq becomes:

$$Keq = \frac{1}{pb * \frac{Kp}{Kaw} + \frac{nw}{Kaw} + na} \tag{11}$$

The soil solids to water partitioning coefficient typically depends on the organic carbon content of the soil and a chemical-specific coefficient describing the partitioning between the soil organic carbon and water.

$$Kp = foc * Koc \tag{12}$$

where:

foc	=	fraction of organic carbon in soil (kg-oc/kg-tot)
Koc	=	organic carbon to water partitioning coefficient of the chemical [(mg/kg-oc/(mg/L-w)]

The soil air to water partitioning coefficient depends on the Henry's Law Constant for the chemical:

$$Kaw = \frac{H}{R * Tm} \tag{13}$$

where:

H	=	Henry's Law Constant (atm-m^3/mol)
R	=	gas constant, 8.2 x 10^{-5} atm-m^3/mol-°K
Tm	=	temperature (K)

The effective vapor diffusion constant, De, depends on the porosity of the soil and the pore space containing air, and is given by:

$$De = Dv * \frac{na^{3.33}}{(na+nw)^2} \tag{14}$$

where:

Dv	=	vapor diffusion constant for the chemical (cm^2/s)

By defining the volatilization constant, Kv as:

$$Kv = \frac{Keq * De}{L^2} \tag{15}$$

Equations 15 and 16 can be rewritten as:

$$\frac{E_{short}}{M_0} = \frac{1}{\sqrt{\pi}} \left(\frac{fac2 * Kv}{Tdur}\right)^{1/2} e^{-kdeg * Tdur} \tag{16}$$

and

$$\frac{E_{long}}{M_0} = 2 * fac2 * Kv * e^{-\left(\frac{\pi^2}{4} * fac2 * Kv + kdeg\right) * Tdur} \tag{17}$$

The quantities E_{short}/M_0 and E_{long}/M_0 represent the fractional emission rate, at short times and long times, respectively. They have units of 1/day. To determine the fraction volatilized as a function of time, Fv (unitless), one has to integrate equations 16 and 17 with respect to time. Integration of equation 16 yields:

$$Fv_{short} = \sqrt{\frac{fac2 * Kv}{\pi}} \int_0^x Tdur\, t^{-1/2} e^{-t * kdeg} dt = \left(\frac{fac2 * Kv}{kdeg}\right)^{1/2} erf\left(\sqrt{kdeg * Tdur}\right) \tag{18}$$

Fv_{short} represents the fraction volatilized at short times.

The function erf(x), the error function, is defined as:

$$erf(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-y^2} dy \tag{19}$$

It should be noted that Equation 18 is only valid at short times, or times less than the time at which the solution for the emission rate switches to Equation 17. This time will be referred to as t^*, and will be calculated in the following.

The fraction volatilized at times greater than t^* is equal to the sum of the fraction volatilized at times less than or equal to t^* plus the fraction volatilized between times t^* and Tdur. Using Equations 16 and 17, we obtain:
The integral in Equation 20 can be easily carried out analytically, with the result:
where we have defined:

$$Fv_{long} = \left(\frac{fac2*Kv}{kdeg}\right)^{1/2} erf\left(\sqrt{kdeg*t^*}\right) + \int_{t^*}^{Tdur} 2*fac2*Kv*e^{-\left(\frac{\pi^2}{4}*fac2*Kv+kdeg\right)t}\,dt \qquad \textbf{(20)}$$

$$Fv_{long} = Fv0 + \frac{2}{A} e^{-A*t^**fac2*Kv}\left[1 - e^{-A(Tdur-t^*)*fac2*Kv}\right] \qquad \textbf{(21)}$$

$$Fv0 = \left(\frac{fac2*Kv}{kdeg}\right)^{1/2} erf\left(\sqrt{kdeg*t^*}\right) \qquad \textbf{(22)}$$

and

$$A = \frac{\pi^2}{4} + \frac{kdeg}{fac2*Kv} \qquad \textbf{(23)}$$

The value of t^* is still undetermined. It can be determined based on the physical argument that without biodegradation the fraction volatilized at very long times (t approaching infinity) must equal 1, meaning that, in the absence of all other removal mechanisms, all the mass of chemical present in the soil is lost to the atmosphere.

The absence of biodegradation is expressed mathematically by taking kdeg equal to 0. The error function of a null argument is also null, but the expression $(fac2*Kv/kdeg)^{1/2}$ diverges for kdeg equal to 0. In order to evaluate Equation 18 for vanishingly small values of kdeg, a limit has to be taken. It can be shown that for vanishingly small values of the argument, the error function is given by:

$$erf\left(\sqrt{kdeg*Tdur}\right) = \frac{2}{\sqrt{\pi}}\sqrt{kdeg*Tdur} \qquad \textbf{(24)}$$

By substituting Equation 24 into Equation 18, the fraction volatilized for times less than t^* and no biodegradation is given by:

$$Fv_{short} = \frac{2}{\sqrt{\pi}}(fac2*Kv*Tdur)^{1/2} \qquad \textbf{(25)}$$

The value of t^* is then determined by solving the following equation:

$$F_v(kdeg = 0;\ Tdur = \infty) = 1 = \frac{2}{\sqrt{\pi}} x^{1/2} + \frac{8}{\pi^2} e^{-\frac{\pi^2}{4}x} \quad \textbf{(26)}$$

where x = (fac2*Kv*t^*). In order to derive Equation 26, we assumed t approached infinity in Equation 21, and used the fact that

$$A(kdeg = 0) = \frac{\pi^2}{4} \quad \textbf{(27)}$$

Equation 26 can be solved numerically, with the result x=0.2113, or

$$t^* = \frac{0.2113}{fac2 * Kv} \quad \textbf{(28)}$$

By substituting Equation 28 into Equation 25, we obtain the value of Fv0 when no biodegradation is present:

$$Fv0 = \frac{2}{\sqrt{\pi}} \sqrt{0.2113} = 0.5187 \quad \textbf{(29)}$$

Recapitulating, we can write the following equations describing the fraction of chemical volatilized according to the Clark Allen model.

For Tdur < t^*

$$Fv(kdeg = 0) = \frac{2}{\sqrt{\pi}} (fac2 * Kv * Tdur)^{1/2} \quad \textbf{(30)}$$

$$Fv(kdeg > 0) = \left(\frac{fac2 * Kv}{kdeg}\right)^{1/2} erf\left(\sqrt{kdeg * Tdur}\right) \quad \textbf{(31)}$$

For t > t^*

$$Fv = Fv0 + \frac{2}{A} e^{-A * fac2 * Kv * t^*} [1 - e^{-A(Tdur - t^*) * fac2 * Kv}] \quad \textbf{(32)}$$

where Fv0 is given by Equation 22 or 29, and A and t^* are given by equations 23 and 28, respectively.

1.3 Fugitive Dust Emissions

The average rate of fugitive dust emissions from the soil depends on the rate at which dust is blown into the air and the average concentration of the chemical in the dust over the period of exposure.

$$\langle Ed \rangle = ed \cdot \langle Cs \rangle \quad \textbf{(33)}$$

where:

ed	=	rate of dust emissions (kg/m^2-s)
<Cs>	=	average concentration of the chemical in the soil (mg/kg)

The average concentration of the chemical in the soil is the measured concentration since the chemical is conservatively assumed to not degrade by natural means in this analysis. The rate of dust emissions was estimated using the fugitive dust emissions model of Cowherd (1984) as described in GRI (1988). The emission of particles less than 10 μm in diameter (the respirable fraction) are estimated using:

$$ed = edf \cdot (1 - fvg) \cdot \left(\frac{u10}{ut}\right)^3 \cdot F(x) \quad \textbf{(34)}$$

where:

edf	=	emissions factor, 1 x 10^{-8} Kg/m^2-s
fvg	=	fraction of contaminated area that is vegetated
u10	=	windspeed at 10 m (m/s)
ut	=	erosion threshold windspeed at 7m (m/s)
F(x)	=	function of ratio of threshold windspeed to annual windspeed (dimensionless)

The variables fvg and u10 are determined during the site investigation. The variable ut is determined with the following equation:

$$ut = 2.5 \cdot \ln\left(\frac{700}{zo}\right) \cdot u^* \quad \textbf{(35)}$$

where:

u*	=	friction velocity (m/s)
zo	=	roughness height (cm)

The friction velocity is determined by determining the particle size distribution of the soil and utilizing Figure 1. The roughness height depends on the type of vegetation or structures on the site and can be obtained using Figure 2. The function F(x) has an independent variable, x, given by:

$$x = 0.886 \cdot \frac{ut}{u10} \tag{36}$$

Once x is determined, F(x) is determined from Figure 3.

1.4 Concentrations in Soil

The concentrations of compounds of interest in soil were estimated using measured site concentrations. For each location and medium, the data was assembled and statistics were calculated. In particular, the 95% upper confidence limit (UCL) on the mean was estimated assuming the data was lognormally distributed, using a procedure outlined in EPA (1992). If the 95% UCL exceeded the maximum detected concentration then the maximum detected concentration was used as the exposure point concentration for these media. Otherwise, the 95% UCL was used as the exposure point concentration. The exposure point concentrations for the North and South Site are presented in Table 11-32 of the main report.

1.5 Concentrations in Air

1.5.1 Overview of Model Assumptions

Air concentrations were estimated by applying the soil to air model to the relevant areas of the site. Table 1 summarizes the inputs required to execute the model. Three types of inputs are needed: input concentrations, chemical properties and system variables. The input concentrations for a specific location are provided in Table 1. The chemical properties are provided in Table 2 and the system variables are given in Table 1. All the system variables were the same for the five receptors except for Tdur. The inputs for these variables were divided into three sets as discussed shortly.

TABLE 1
VARIABLES USED TO SOLVE THE ON-SITE SURFACE SOIL TO AIR MODEL

Input Concentrations

Csz	=	initial concentration of in soil (mg/kg)

Properties

Koc	=	organic carbon to water partition coefficient [(mg/kg)/(mg/L)]
Hen	=	Henry's Law Constant (atm-m^3/mol)
kdeg	=	first order rate constant for natural biodegradation (1/day)
Dv	=	vapor phase diffusion coefficient (cm^2/s)

(See properties of compounds of interest in Section 4.0 of this appendix.)

System Variables

R	=	gas constant, 8.2 x 10^{-5} atm-m^3/mol-K
fac1	=	unit conversion factor, 0.0116 L-day/m^3-s
fac2	=	unit conversion factor, 8.64 m^2-s/cm^2-day
Tdur	=	duration of exposure (days)
pb	=	bulk density of soil (g/cm^3 or Kg/L)
nw	=	volumetric water content (L-w/L-tot)
na	=	volumetric air content (L-a/L-tot)
foc	=	fraction of organic carbon (Kg-oc/Kg)
L	=	depth of soil (m)
Lb	=	length of air space box (m)
Wb	=	width of air space box (m)
Ac	=	area of areal source (m^2)
u10	=	windspeed at 10m height (m/s)
Tm	=	air temperature (K)
edf	=	dust emission factor, 1 x 10^{-8} kg/m^2-s
fvg	=	fraction of contaminated area that is vegetated (m^2/m^2)
ut	=	threshold velocity (m/s)
F(x)	=	function of u10 and ut (dimensionless)
R	=	8.2 x 10^{-5} atm-m^3/mol-K
fac1	=	0.0116 L-day/m^3-s
fac2	=	8.64 m^2-s/cm^2-day
Tdur	=	6 years
pb	=	1.3 Kg/L
nw	=	0.23 L-w/L-tot
na	=	0.28 L-a/L-tot
foc	=	0.01 kg-oc/kg-soil
L	=	0.3 m
Lb	=	944.88 m
Wb	=	213.36 m
Ac	=	201,599 m^2
u10	=	3.88 m/s
Tm	=	298 K
edf	=	1.0 x 10^{-8} kg/m^2-s
fvg	=	0.1 m^2/m^2
ut	=	12.8 m/s
F(x)	=	0.0743

The following values for soil porosity, volumetric water content and volumetric air content were used in this analysis. The soil at the site is classified as silty clay. Table 4-47 of The Water Encyclopedia (van der Leeden et al, 1990) indicates that a porosity of 0.51 is typical for this type of soil. The volumetric water content is assumed to be at 75% of field capacity and since the field capacity is 0.31, the volumetric water content is 0.23. The volumetric air content is therefore, 0.28 (i.e., 0.51-0.23). The bulk density for this soil is 1.3 kg/l. There are no values for organic carbon content in the surface soil, but the site is highly vegetated so it is likely that the organic carbon content exceeds 1%. A conservative value of 1% was chosen for this analysis.

The thickness of the soil layer for volatilization and fugitive dust emissions was assumed to be fifteen feet (4.57 m), which is the definition of surface soil in this study.

The windspeed through the box is assumed to be 3.88 m/s which is the average windspeed reported for the site. The temperature was assumed to be 298K (25 C or 77 F). This temperature is higher than the average temperature for Seattle, and, therefore, should be conservative. The fraction of each area that is assumed to be vegetated is 10%, which is an assumed value from visual inspection.

The variable ut was calculated using the following equation:

$$ut = 2.5 \ln\left(\frac{700}{zo}\right) \cdot u^* \tag{37}$$

where:

u*	=	friction velocity (m/s)
zo	=	roughness height (cm)

The friction velocity was determined using Figure 1 in this appendix. This parameter depends on the mode of the particle size distribution of the soil. For this soil, the aggregate size distribution mode used was 1.0 mm and, based on this value, a friction velocity of 65 cm/s (0.65 m/s) was selected. The roughness height was determined from Figure 2 in this appendix. For plowed fields, the median of the range for the roughness height was 1.0 cm, which was the value selected for this analysis. With these values for zo and u*, ut was 10.64 m/s.

The variable F(x) depends on the quantity x which is defined as:

$$x = 0.886 \cdot \frac{ut}{u10} \qquad (38)$$

In this analysis, x took on the value 2.39. Using Figure 3 in this appendix, F(x) becomes 0.3.

1.6 Chemical Properties of Compounds of Interest

This section provides a list of physical and chemical properties obtained for the compounds of interest. These properties are listed in Table 1 and include the partition coefficient for organic carbon to water [KOC], the Henry's law constant [HEN], the half life of the chemical in soil [TSHLF] and the vapor phase diffusion coefficient [DVAP]. The values for the organic carbon partition coefficient were taken from the *Superfund Public Health Evaluation Manual* (EPA, 1986), unless otherwise specified. The values for the Henry's law constant, and the vapor phase diffusion coefficient were taken from *TSDF Air Emissions Models* (EPA, 1989a). The soil half lives were conservatively assumed to be 1 million days which is almost 3,000 years. Such a half-life is effectively infinite, with the effect that no chemical is lost via natural biodegradation.

1.7 Summary of Results

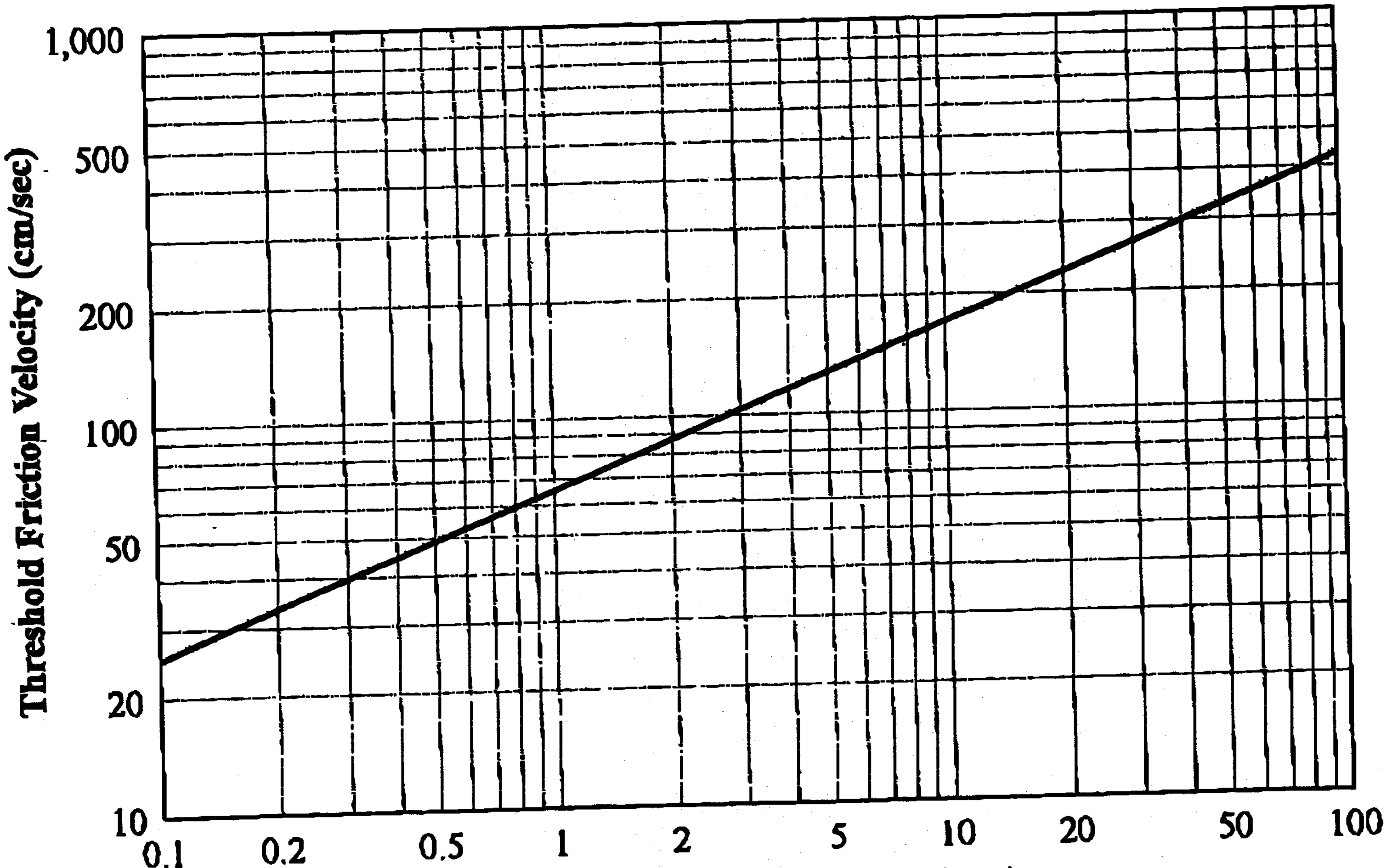
The air concentrations for the receptor groups are presented in Table 1.

TABLE 1
CHEMICAL PROPERTIES FOR FATE AND TRANSPORT MODELS
BNRR FORMER MAINTENANCE AND FUELING FACILITY
SKYKOMISH, WASHINGTON

	Chemical Properties				
Compound	Molecular Weight (g/g-mol)	Vapor Phase Diffus (cm^2/s)	Henry Law ($atm-m^3/mol$)	Org Car Part-Koc (mg/kg / mg/L)	Half-life Soil (days)
Antimony	121.8	0.00E+00	0.00E+00	0	0
Arsenic	74.91	5.50E-02	1.00E-15	1	0
Beryllium	9.012	0.00E+00	0.00E+00	0	0
Cadmium	112	5.50E-02	1.00E-15	1	1.00000E+15
Chromium	52	5.50E-02	1.00E-15	1	0
Copper	64	5.50E-02	1.00E-15	1	0
Lead	207.19	5.50E-02	1.00E-15	1	1.00000E+15
Mercury	200.59	2.76E-02	1.14E-02	0	0
Nickel	58.7	0.00E+00	0.00E+00	0	0
Selenium	78.96	0.00E+00	0.00E+00	0	0
Thallium	204.4	0.00E+00	0.00E+00	0	0
Zinc	65	5.50E-02	1.00E-15	1	0
PCBs	328	1.04E-01	1.07E-03	530000	0
PCBs	328	1.04E-01	1.07E-03	530000	0
2-Methylnaphthalene	142.19	4.80E-02	5.80E-05	0	0
Phenanthrene	178.22	3.33E-02	6.05E-03	14000	60
Di-n-butyl phthalate	278.3	4.38E-02	2.80E-07	170000	0
Butyl benzyl phthalate	312.39	1.72E-02	1.08E-02	0	0
Di-n-octyl phthalate	391	0.00E+00	0.00E+00	0	0
Toluene	92.4	8.70E-02	6.68E-03	300	60
Ethylbenzene	106.2	7.50E-02	6.44E-03	1100	60
Xylenes	106	7.60E-02	7.04E-03	240	20

Figure 1

Relationship of Threshold Friction Velocity To Size Distribution Mode



Source: U.S. EPA. 1985. Rapid Assessment of Exposure to Particulate Emissions From Surface Contamination Sites.

Figure 2

ROUGHNESS HEIGHTS FOR VARIOUS SURFACES

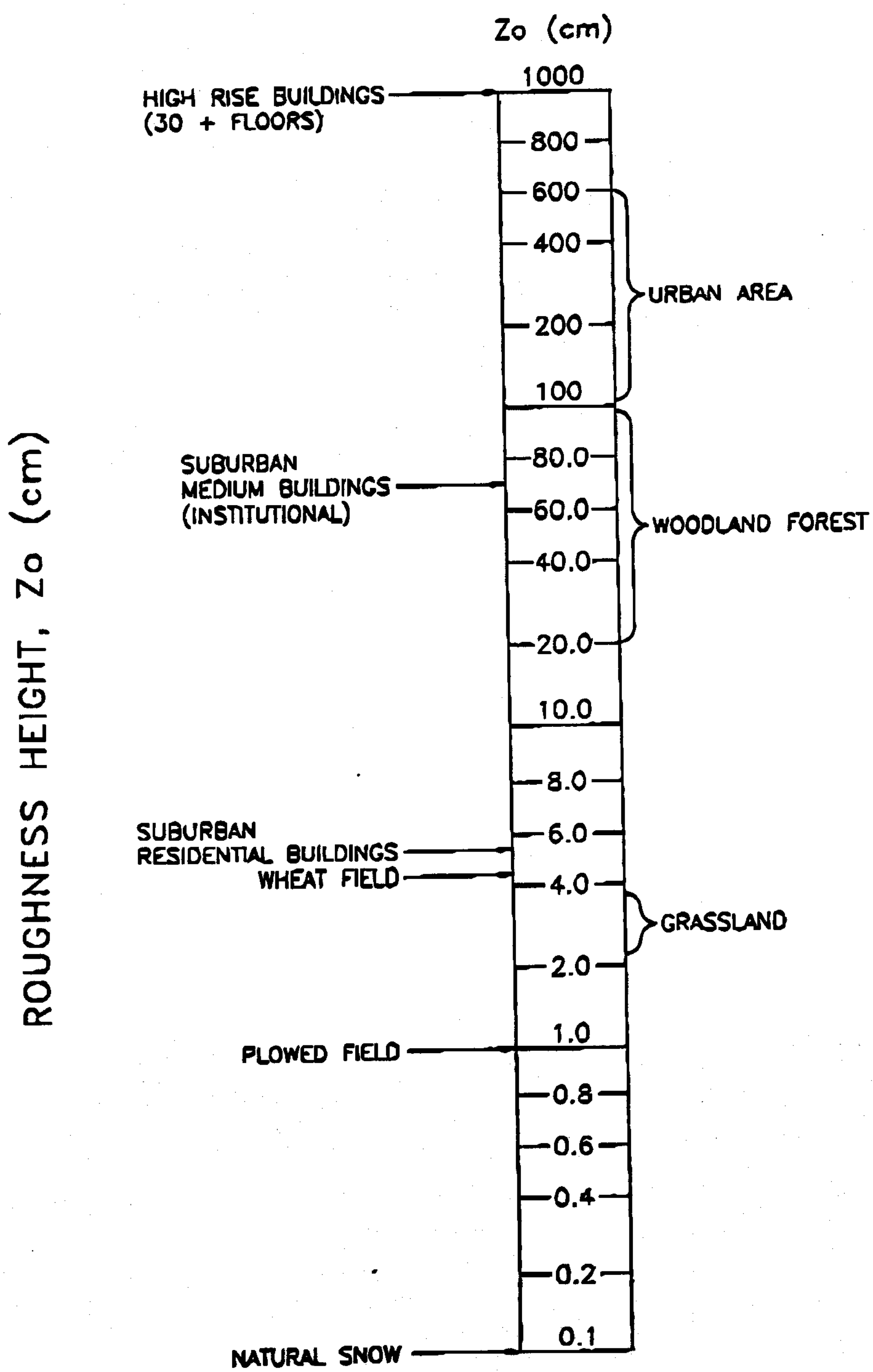
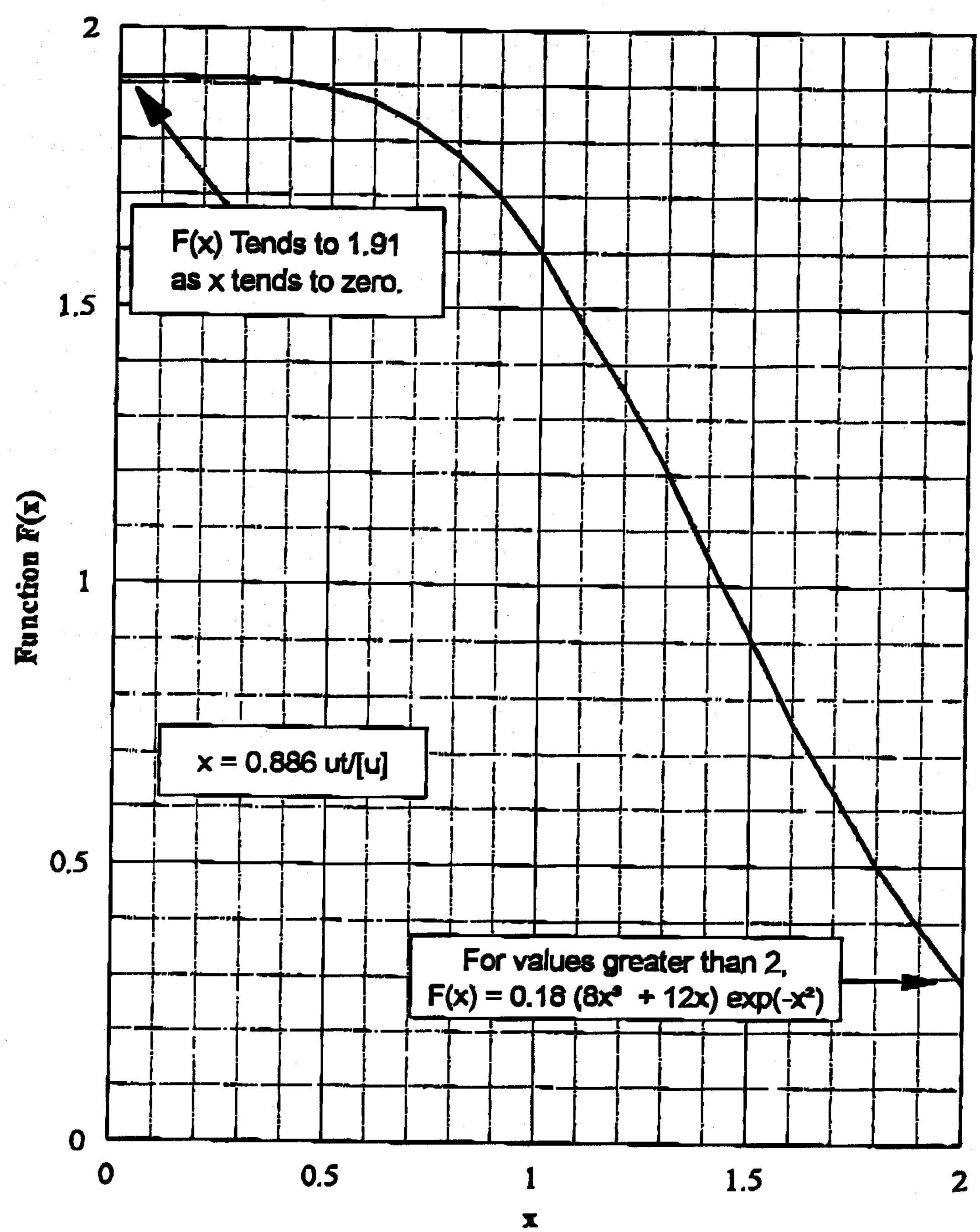


Figure 3
Function F(x) Needed to Estimate Unlimited Erosion



Source: U.S. EPA. 1985. Rapid Assessment of Exposure to Particulate Emissions From Surface Contamination Sites.

APPENDIX K

INTERIM ACTION SOIL ANALYTICAL

Analytical Resources, Incorporated
Analytical Chemists and Consultants

22 November 1995

Shelly Birch
Remediation Technologies Inc.
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134

RE: Client Project: 3-1161-520 BNRR Skykomish;
ARI Project: #M191

Dear Ms. Birch,

Please find enclosed the original chain-of-custody (COC) record and results for samples from the above referenced project. Two soil samples were received on 10/30/95. The samples were in good condition upon receipt, however the cooler temperature was 8 degrees C. There were no discrepancies between the COC and sample containers, and they were logged into the laboratory without incident.

The requested tph analysis was routine, and was performed within the required holding time, however both samples required reanalyses at dilution due to hydrocarbon concentrations above the range on instrument calibration. Both sets of results are included on the report. Please note that the patterns do not match the standards used for quantitation; sample chromatograms are included to assist with your evaluation of the results.

A Laboratory Control Sample was extracted and analyzed; spike recovery results are reported as QC documentation for the project.

A copy of this package, as well as the raw data and lab benchsheets, will be kept on file with ARI should you require any further information or copies of additional documentation. Also, if you have any questions please feel free to call me any time.

Sincerely,

ANALYTICAL RESOURCES, INC.

Kate Stegemoeller
Project Manager
206-340-2866, ext. 117

Enclosures
cc: file #M191

10070

M191

CHAIN OF CUSTODY RECORD

PROJ. NO.: 3-1161-520
PROJECT NAME: BNRR SKYKOMISH
SAMPLERS: Shelley S. Birch
RECEIVING LABORATORY: ARI
SEND RESULTS TO: Shelley S. Birch

LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS	C9-C36 WTPH-Dextended							REMARKS
	10-27-95	1600	SO-1	1	✓							
	"	1620	SO-2	1	✓							

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Shelley S. Birch	10-30-95 / 12:00			/	

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time
	/	Jan Fellkins	10/30/95 / 14:30

Shipper Information
Sent via Courier to ARI

REMEDIATION TECHNOLOGIES INC
REMEDIATION TECHNOLOGIES
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PINK COPY - Sampler
YELLOW COPY - Laboratory
WHITE COPY - ReTeC

ANALYTICAL
RESOURCES
INCORPORATED

Analytical
Chemists &
Consultants

333 Ninth Ave. North
Seattle, WA 98109-5187
(206) 621-6490
(206) 621-7523 (FAX)

TOTAL DIESEL RANGE HYDROCARBONS
WA TPHd Range C12 to C24 by GC/FID
and Motor Oil

LIMS ID: 95-18440
Matrix: Soil

QC Report No: M191-Remediation Technologies, Inc.
Project: BNRR Skykomish
3-1161-520

Data Release Authorized: [signature]
Reported: 11/21/95

Date Received: 10/30/95

Lab ID	Sample ID	Date Analyzed	Dilution Factor	Diesel Range	*HC ID	Motor Oil Range	Surrogate Recovery
M191MB	Method Blank	11/10/95	1:1	5.0 U	---	10 U	111%
M191A	**SO-1** 5 feet bgs	11/13/95	1:1	**1,400 E**	NO	**1,200 E**	73.7%
M191A	**SO-1** 5 feet bgs	11/14/95	1:10	**1,400**	NO	**1,300**	106%
M191B	**SO-2** 6.5 feet bgs	11/11/95	1:1	**590 E**	NO	**68**	119%
M191B	**SO-2** 6.5 feet bgs	11/11/95	1:10	**470**	NO	**330**	71.5%

Surrogate is Methyl-Arachidate.

* ID indicates, in the opinion of the analyst, the petroleum product with the best pattern match. 'NO' indicates that there was not a good match for any of the requested products.
Values reported in ppm (mg/kg) on a dry weight basis.
Diesel quantitation on total peaks in the range from C12 to C24.
Motor Oil quantitation on total peaks in the range from C24 to ~~C32~~ C36.

verified w/ Kate Stegemoeller 11-27-95

Data Qualifiers

- U Compound not detected at the given detection limit.
- E Value detected above linear range of instrument. Dilution required.
- J Indicates an estimated value below the calculated detection limit.
- S No value reported due to saturation of the detector. Dilution required.
- D Indicates the surrogate was not detected because of dilution of the extract.
- E Indicates a value above the linear range of the detector. Dilution required.
- NR Indicates no recovery due to matrix interference.

FORM-1 WA TPHD

ANALYTICAL
RESOURCES
INCORPORATED

Analytical
Chemists &
Consultants

333 Ninth Ave. North
Seattle, WA 98109-5187
(206) 621-6490
(206) 621-7523 (FAX)

TOTAL DIESEL RANGE HYDROCARBONS
WA TPHd Range C12 to C24 by GC/FID

Lab Sample ID: M191SB
LIMS ID: 95-18440
Matrix: Soil

QC Report No: M191-Remediation Technologies, Inc.
Project: BNRR Skykomish
3-1161-520

Data Release Authorized:
Reported: 11/21/95

LABORATORY CONTROL SAMPLE RECOVERY REPORT

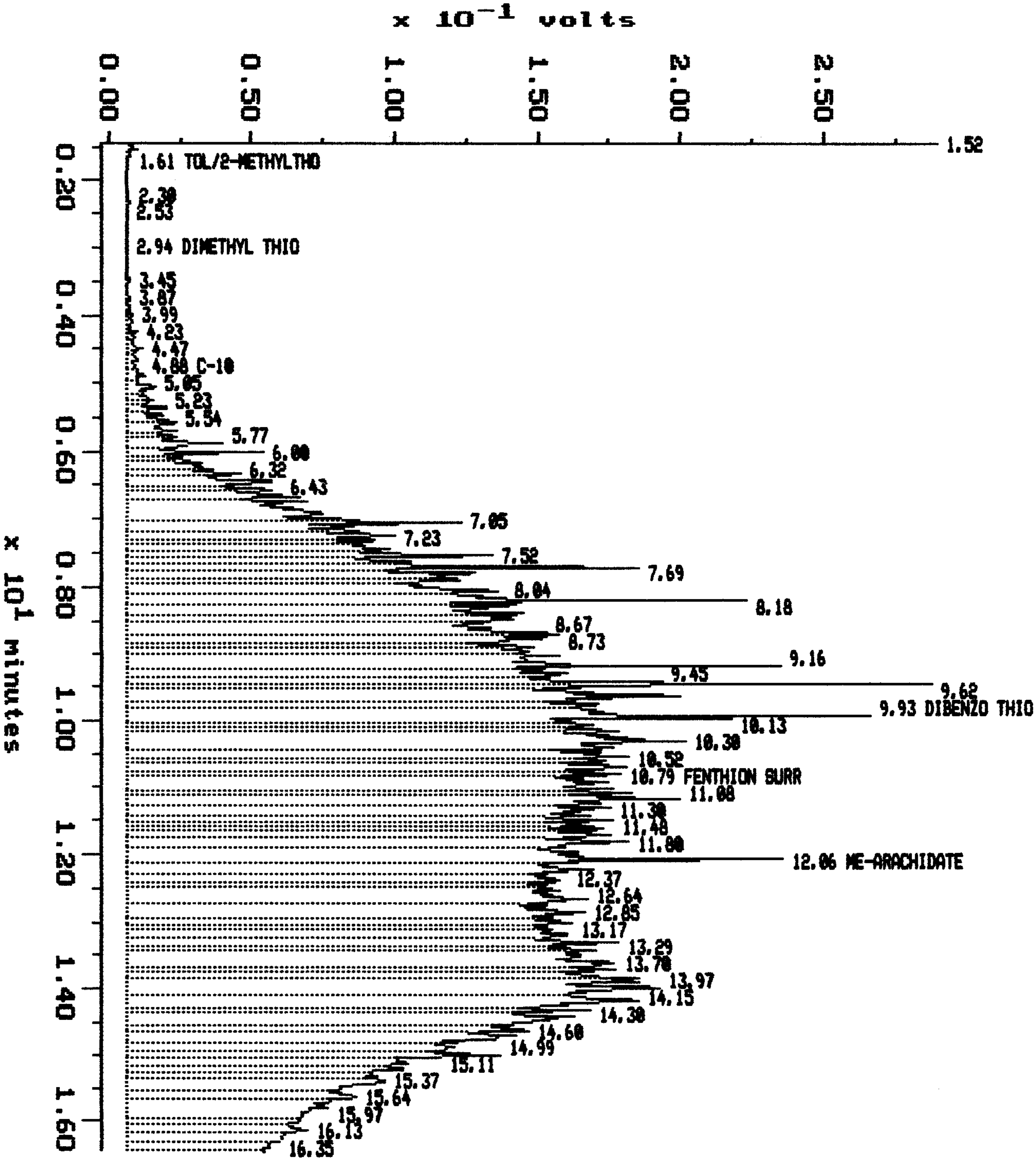
CONSTITUENT	SPIKE FOUND	SPIKE ADDED	% RECOVERY
Diesel Range Hydrocarbons	88.8	100	88.8%

TPHd Surrogate Recovery

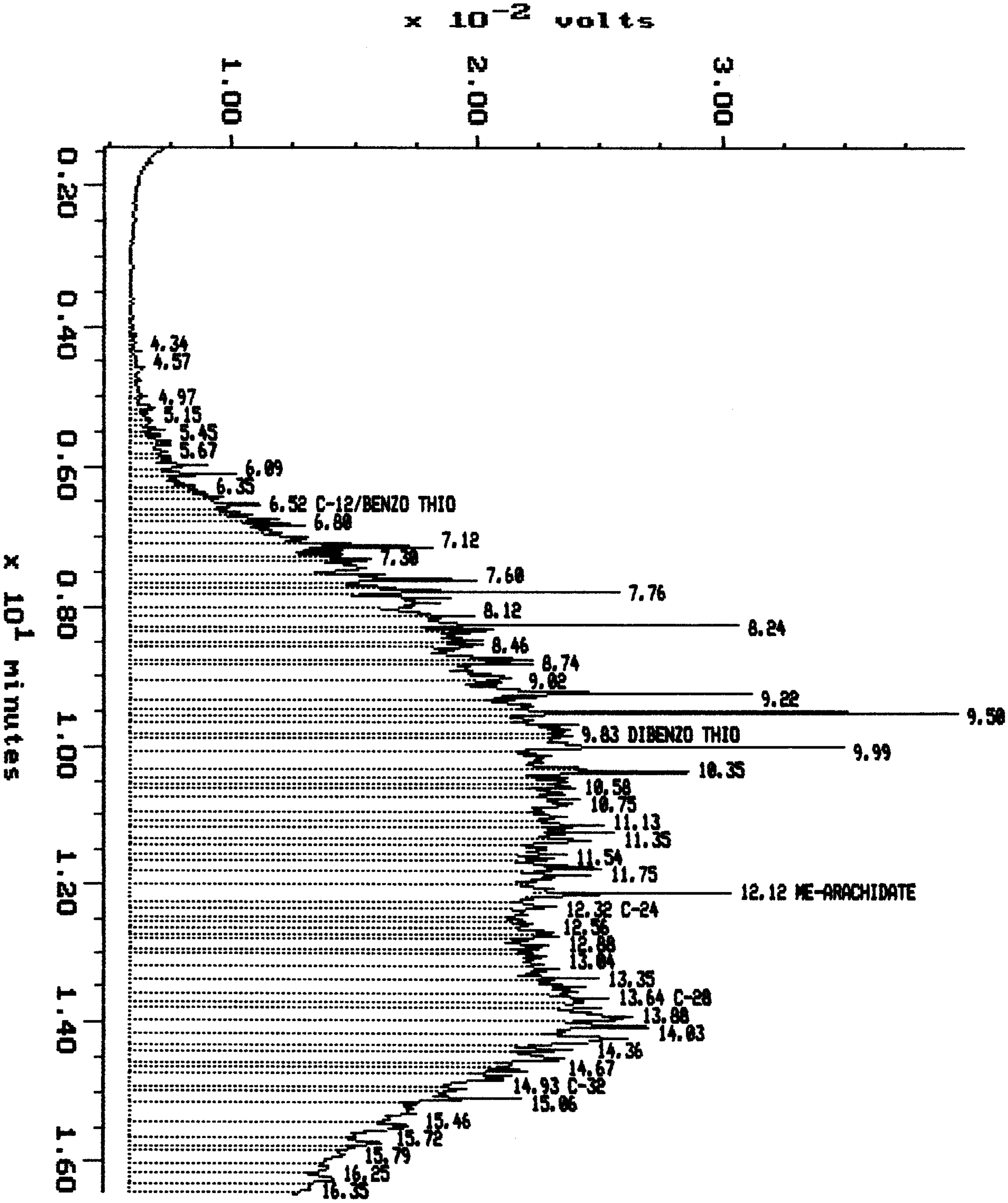
Methylarachidate 119%

Values reported in parts per million (mg/kg)

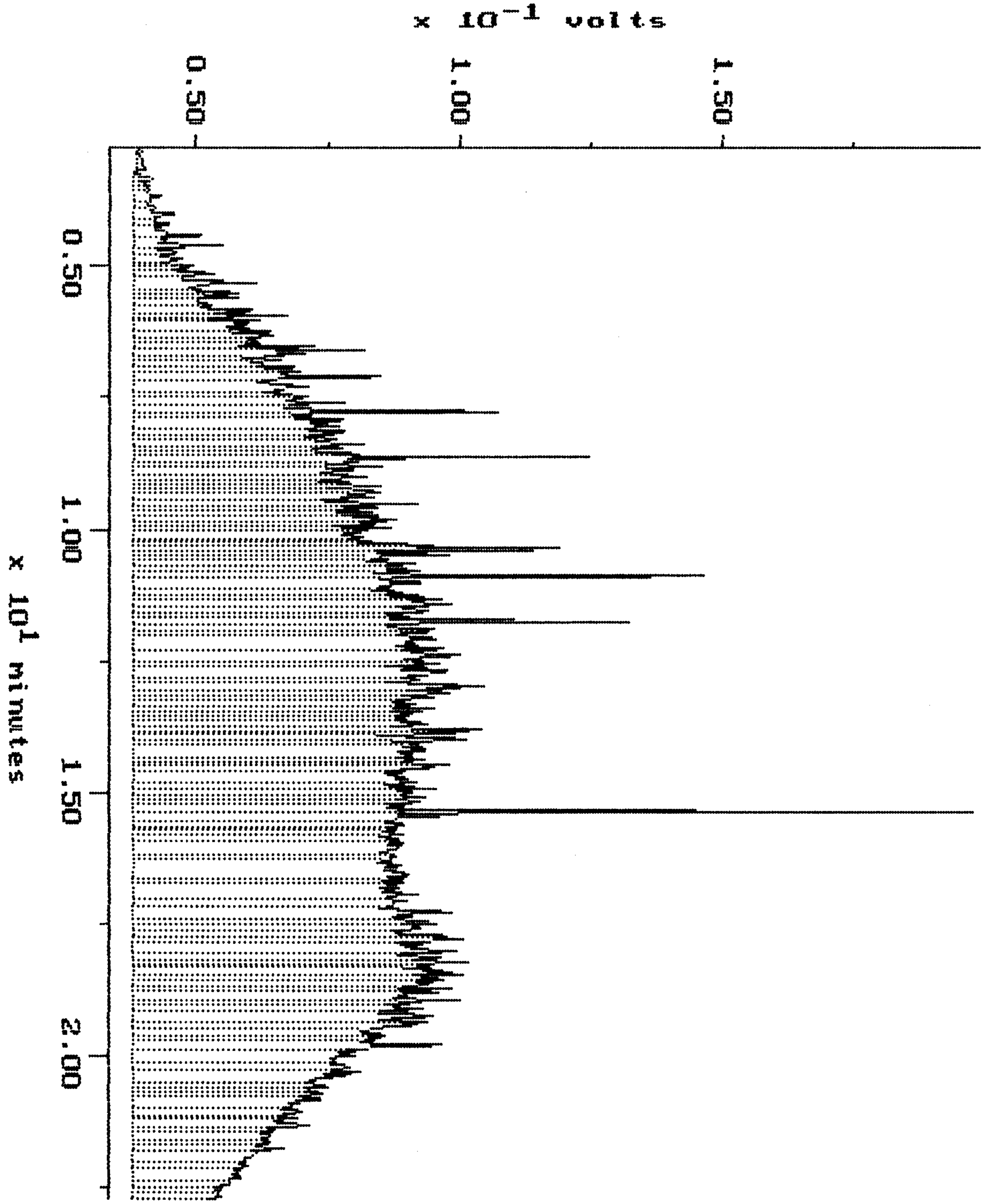
Sample: M191A Channel: FID 2-DB5 .32 Filename: 1106302
Acquired: 13-NOV-95 7:31 Method: C:\MAX\HCIDMTH\NOV06-7 Operator: BC



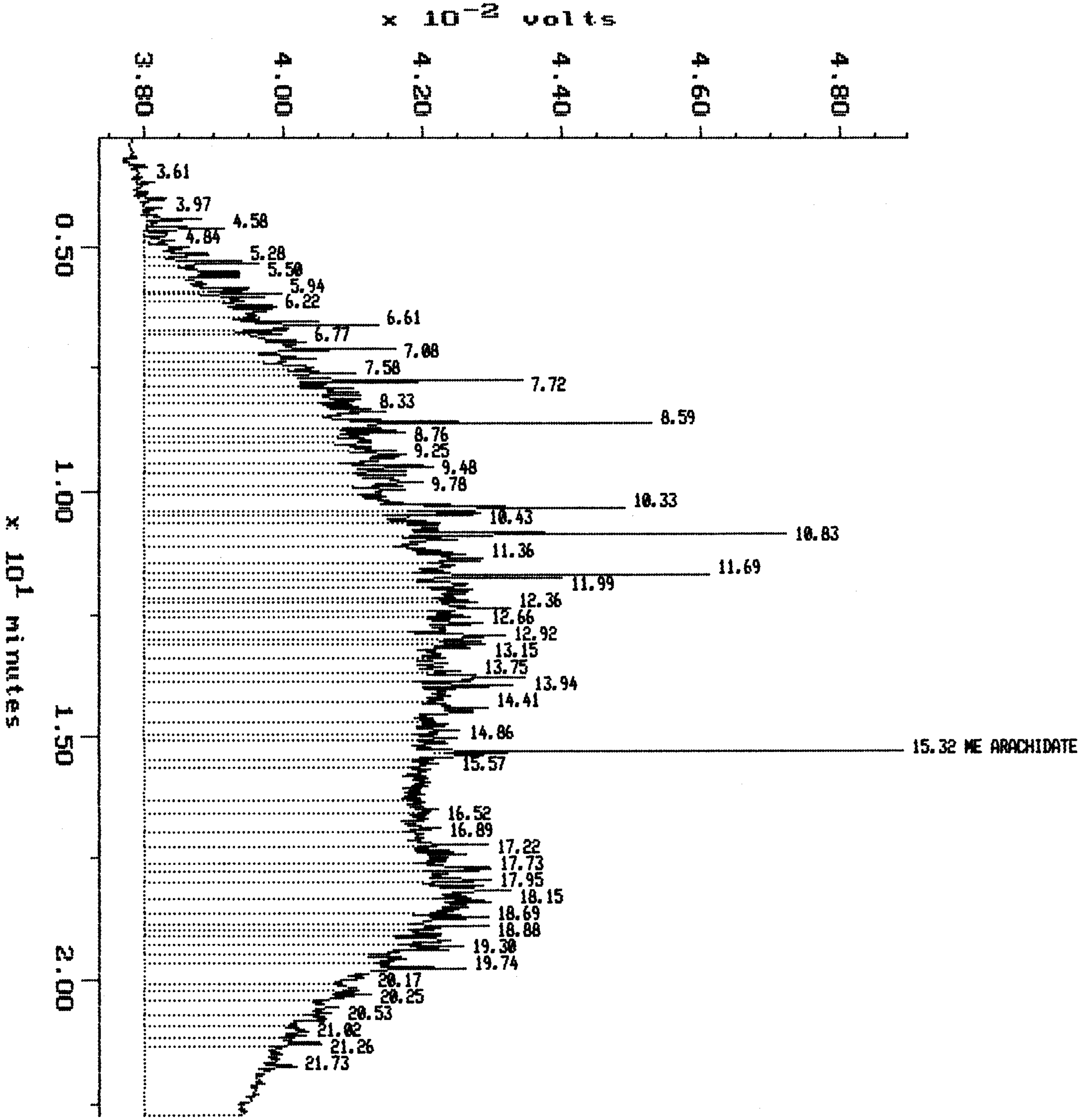
Sample: M191A*10 Channel: FID 2-DB5 .32 Filename: 1106341
Acquired: 14-NOV-95 8:01 Method: C:\MAX\HCIDMTH\NOV06-8 Operator: BC



Sample: M191B　　Channel: DB-1W 3ul　　Filename: 110972
Acquired: 11-NOV-95　4:13　　Method: C:\MAX\AKD\NOV09-2　　Operator: TW



Sample: M191B*10 Channel: DB-1W 3ul Filename: 1109100
Acquired: 11-NOV-95 19:35 Method: C:\MAX\AKD\NOV09-3 Operator: TW



10070

CHAIN OF CUSTODY RECORD

PROJ. NO.: 3-1161-520

PROJECT NAME: BNRR SKYKOMISH

SAMPLERS: Shelly S. Bird

RECEIVING LABORATORY: ARI

SEND RESULTS TO: Shelly S Bird

LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS	WTPH-D extended C9-C36							REMARKS
	10-27-95	1600	SO-1	1	✓							
	"	1620	SO-2	1	✓							

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Shelly S Bird	10-30-95 / 12:00				

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time

Shipper Information: Sent via Courier to ARI

RETEC
REMEDIATION TECHNOLOGIES INC
REMEDIATION TECHNOLOGIES
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

PINK COPY - Sampler YELLOW COPY - Laboratory WHITE COPY - ReTeC

Final Draft Feasibility Study and Environmental Impact Statement

Former Maintenance and Fueling Facility
Skykomish, Washington

Volume One: Text, Tables and Figures

Prepared by:

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, Washington 98134-1162

RETEC Project Number: BN050-16423-250

Prepared for:

The Burlington Northern and Santa Fe Railway Company
2454 Occidental Street, Suite 1A
Seattle, Washington 98134

Washington State Department of Ecology
3190 160th Avenue S.E.
Bellevue, WA 98008-5452

September 3, 2003

Executive Summary

The following is a summary of the cleanup alternatives presented in the Preliminary Draft Feasibility Study (FS) and Environmental Impact Statement (EIS) for the Former Maintenance and Fueling Facility in Skykomish, Washington (August 14, 2003). The draft of this document should be released in September 2003 for a 60-day public comment period. The Department of Ecology will carefully consider public comment during preparation of the draft Cleanup Action Plan. BNSF believes that each alternative, except the No Action alternative, can achieve cleanup standards and protect public health and the environment. Ecology will evaluate each alternative during remedy selection. Selecting a final cleanup action from among the alternatives requires balancing several factors, including the restoration time frame, degree of permanence (including cost), and adverse impacts to the community and natural environment. In general, more aggressive technologies cost more, work faster, and are more permanent, but they have greater adverse impacts on the community and natural environment. Public comment on the FS/EIS is intended to let Ecology and BNSF know how the public would balance these same factors.

A glossary of terms is included for reference at the end of this summary.

Site Background

The former railway maintenance and fueling facility in the east King County town of Skykomish is now owned and operated by The Burlington Northern and Santa Fe Railway Company (BNSF). Historical activities since the facility opened in the late 1890s included refueling and maintaining locomotives and operating an electrical substation for electric engines. These activities released contaminants to the surrounding environment. BNSF has accepted responsibility for cleaning this historical contamination at the site consistent with the Model Toxics Control Act (MTCA).

Fuel was stored in underground storage tanks at the site until 1974, when BNSF discontinued most fuel handling activities at its Skykomish facility. The BNSF facility is currently used as a base of operations for track maintenance and snow removal crews.

Railroad Avenue separates BNSF property from the main commercial district of the town. Maloney Creek flows south of BNSF property and west to the South Fork of the Skykomish River. The site encompasses an area of about 40 acres and includes BNSF property and adjacent property. The approximate boundaries of the study area are as follows: the Skykomish River to the north, approximately the Old Cascade Highway to the south, Maloney Creek to the west, and Skykomish city limits to the east.

In early 1991, Washington Department of Ecology (Ecology) designated the former maintenance and fueling facility a high priority cleanup site. Later that year, BNSF indicated a desire to initiate a Remedial Investigation/Feasibility Study (RI/FS) in accordance with MTCA. At that time, formal negotiations for a legal agreement (called an Agreed Order) were initiated. Negotiations were completed in mid-1993. Following a public comment period, the Agreed Order, which includes detailed work plans for the RI/FS process and early interim cleanup work, was signed by Ecology and BNSF. BNSF and Ecology signed a separate agreed order in 2001 for additional interim cleanup work near the Skykomish River and the levee west of Fifth Avenue.

Contaminants of Concern

Investigations performed by BNSF in cooperation with Ecology since 1993 have revealed petroleum contamination in soil, groundwater, the River and old Maloney Creek that exceeds state standards. The contamination has migrated beyond the railroad property and has been found underneath homes and businesses in Skykomish and in “seeps” on the banks of the Skykomish River. In addition, the investigation found lead and arsenic in soils to a depth of approximately six inches.

Based on available data, the site contamination consists of the following:

- **Soils –** Surface soils on the railyard contain petroleum (diesel and Bunker C), lead and arsenic above state cleanup standards. Lead and arsenic was also found above cleanup standards in surface soils off of BNSF property, but the source of these contaminants in unknown. In some areas of the site, including areas off the railyard, subsurface soils contain petroleum and its components (e.g., polynuclear aromatic hydrocarbons or PAHs) to an approximate 15-foot depth.

- **Groundwater –** Mixtures of both floating and dissolved diesel and Bunker C are present in groundwater beneath the site at levels greater than allowed under state law.

- **Surface Water –** Diesel and Bunker C from upland areas are seeping into the river after being transported underground by groundwater.

- **Sediments –** Petroleum and PAHs are present in sediments along the riverbank at seep locations and below the old Maloney Creek channel.

Cleanup Process

BNSF and Ecology are working with the local community to ensure all exposure pathways are evaluated and the site is cleaned up. The contaminants are known to be toxic above certain concentrations, and some components are known human carcinogens. The material seeping into the Skykomish River and floating on the groundwater north of the railyard are primary concerns. Although the seep contamination poses little immediate risk to human health, cleanup is necessary to minimize any long-term risk and improve the overall environmental health of the town of Skykomish and the Skykomish River. Cleanup actions will include activities to stop contaminants from seeping into the River.

Additional Interim Action to Address Seeps to the River in 2001

BNSF enhanced its product recovery system to halt contaminants from seeping into the Skykomish River through the levee from the uplands area through an Interim Action during 2001. An Interim Action is any action that partially addresses the final cleanup of a site. The Interim Action resulted in construction of an underground barrier wall west from the bridge along West River Road to stop seeps from reaching the River. Monitoring wells were installed behind (upgradient of) the wall and at the ends of the wall to determine where contaminants accumulate. Temporary recovery operations are conducted from these wells. During the second phase, the wells that contain the most petroleum products were converted into product recovery wells such as the recovery wells that currently skim petroleum from groundwater, and additional wells were installed.

Remedial Investigation, Feasibility Study, and Environmental Impact Statement Reports

BNSF submitted a Remedial Investigation Report (RI) to Ecology in 1996 and a Supplemental RI Report in 2002. These studies provide baseline data about soil, groundwater, surface water, air and river sediments throughout the site that are being used to develop cleanup options that are physically, economically, socially and scientifically feasible.

Based on the findings of the RI, BNSF prepared a Preliminary Draft Feasibility Study and Environmental Impact Statement (June 13, 2003) to evaluate cleanup alternatives and the potential impacts of those alternatives on the Skykomish site. The Preliminary Draft FS/EIS was revised based on comments from Ecology and in September 2003 the Draft FS/EIS, along with the 1996 Remedial Investigation report and 2002 Supplemental RI report, will be released by Ecology for public review and comment. Ecology will carefully consider public comment during preparation of the draft Cleanup Action Plan.

Draft Cleanup Action Plan

After public input is received on the FS/EIS, a cleanup alternative will be selected by Ecology. Ecology will issue the Draft Cleanup Action Plan (CAP) with the draft Consent Decree for public comment. The draft CAP will outline the work to be performed during the actual cleanup of the site. Once comments are received and reviewed and any necessary changes are made, BNSF and Ecology will negotiate a consent decree to implement the Final CAP. The Final CAP will be an exhibit to the Consent Decree. The consent decree is a legal agreement between Ecology and BNSF that establishes their rights and obligations with respect to the Final CAP. The Final CAP will contain cleanup details, cleanup levels and points of compliance where BNFS must achieve cleanup. The Cleanup Action Plan and the consent decree will also be available for public comment.

Cleanup Zones

One of the first steps in developing the remedial alternatives described in the FS/EIS was to divide the site into cleanup zones based on land use (railyard, commercial, residential), land type (wetland, levee, upland), exposure pathways, and distribution and chemical composition of the hazardous substances. The cleanup zones are described below.

1) Aquatic Resource Zones

   - Skykomish River and Levee
   - Former Maloney Creek channel

2) Developed Zones (land that has been or will likely be developed for commercial or residential use)

   - Northwest (NW) – affected by petroleum plume composed of diesel and bunker C
   - South – affected by petroleum plume composed of diesel and bunker C
   - Northeast (NE) – affected by petroleum plume of which 75% or greater is diesel (less viscous, more soluble, more biodegradable)

3) Railyard Zone

   - BNSF property
   - Two small areas immediately adjacent to the yard that are contaminated with surface soil metals, one of which is also contaminated with surface and subsurface TPH.

Figure 6-1 of the FS/EIS shows the locations of the cleanup zones.

For each suggested remedial alternative, technologies and approaches are described for each cleanup zone.

Cleanup Standards

Cleanup standards establish:

1) The cleanup level, which is the concentration of a hazardous substance that protects human health and the environment under specific exposure conditions;

2) The location on the site where that cleanup level must be reached, called the point of compliance;

3) Other regulatory requirements that apply due to the type of cleanup action and/or location of the site.

Cleanup levels and points of compliance are established for each type of contaminated media. At the site, there are four media with contamination: soil, sediments, surface water, and groundwater.

For all remedial alternatives presented in the FS/EIS, the points of compliance are the same for soils, sediments, and surface water. However, three different points of compliance were developed for groundwater.

Groundwater Points of Compliance:

1) **Standard Point of Compliance –** Groundwater must meet cleanup levels throughout the site, from the uppermost level of the saturated zone and extending to the lower-most depth that could potentially be affected by the site.

2) **Conditional Point of Compliance, On-Property –** Groundwater must meet cleanup levels at the BNSF property boundary.

3) **Conditional Point of Compliance, Off-Property –** Groundwater must meet cleanup levels at the point it discharges to the Skykomish River and the former Maloney Creek channel, or as close as practicable to the source. (Note: affected property owners between BNSF's property boundary and the Skykomish River must agree in writing to setting this conditional point of compliance.)

Institutional Controls

Institutional controls are part of some of the cleanup action alternatives in the Draft FS/EIS. Institutional controls, which are legal or administrative measures designed to limit or control activities that could result in exposures. They are particularly used in situations where contaminant residues are likely to remain above cleanup levels for an extended period of time. A Restrictive Covenant is one common type of institutional control; it limits or restricts the use of a property and is binding for all current and future owners of the property. Another common institutional control is a local ordinance or state regulation that limits installation of groundwater wells or requires special permits before excavation or drilling in contaminated soil. For example, Skykomish currently has an ordinance limiting installation of groundwater wells. Although this was not adopted as part of the cleanup, it is an example of a local ordinance that limits exposure to contaminated groundwater.

Some type of institutional controls will be required for all alternatives, except the Standard, to ensure protection from residual contaminated soil and groundwater.

Remedial Alternatives

The site-wide remedial alternatives were developed to meet the cleanup standards for the three groundwater points of compliance described above. The Standard alternative uses the standard groundwater point of compliance described above. The PB, or BNSF Property Boundary, alternatives (PB1 through PB4) use the on-property groundwater point of compliance, while the SW, or Surface Water, alternatives (SW1 through SW4) use the off-property groundwater point of compliance. In addition, a No Action alternative is evaluated, as required by environmental regulations.

Individual technologies were selected for each cleanup zone and then grouped based on their ability to comply with cleanup standards and attain remediation levels. Each technology is described in Section 6.4.1 of the FS/EIS.

All alternatives, except the No Action alternative, can achieve cleanup standards and protect public health and the environment. Selecting a cleanup action from among the alternatives will require balancing several factors, including the restoration time frame, degree of permanence (including cost), and adverse impacts to the built and natural environment. In general, more aggressive technologies cost more, work faster, and are more permanent, but they have greater adverse impacts on the built and natural environment. Table 6-4 in the FS/EIS is a matrix that shows which technology is used in each cleanup zone and for each medium by alternative.

- **No Action –** A No Action alternative must be evaluated in the FS/EIS for comparison with the other alternatives. It would entail continuing the actions already in progress at the site: the barrier wall, free product skimming system, dust suppressant on metals-impacted surface soils in the railyard, oil recovery booms, and long-term groundwater monitoring. Although the No Action alternative would not protect people or ecological receptors from contamination, it would not disrupt the built environment in the same way that the other alternatives will. The natural environment, however, would continue to be significantly and adversely impacted by the contaminants, and long-term presence of contamination could deter future investment in the community.

- **Standard (STD) –** Cleanup levels will be met at standard points of compliance throughout the site for all media. As such, the Standard alternative represents the most permanent alternative. Sediment will be cleaned by some combination of recovery, removal, and enhanced bioremediation. All free product and contaminated soil will be removed. Groundwater will undergo free product and soil removal and then be restored to drinking water quality through natural attenuation. Long-term maintenance, inspection, and monitoring are not required. The Standard alternative is included in the FS/EIS to satisfy the MTCA requirement that there be one alternative that achieves cleanup levels for all media at standard points of compliance. It relies on excavation of all free product, all impacted soil, and all sediment above cleanup levels. The River and Maloney Creek would be restored, the levee would be rebuilt, and structures, roads and utilities would be removed, replaced or rebuilt.

- **SW (Surface Water) –** The SW alternatives meet cleanup standards for groundwater at an off-property, conditional groundwater point of compliance. In other words, groundwater must be clean before it discharges into the Skykomish River and former Maloney Creek channel or as close to the source as practicable. The SW alternatives will improve groundwater at the site but will not meet groundwater or soil cleanup levels on BNSF property or on properties between the BNSF property and the River. All free product will be removed, petroleum discharges to the River will be eliminated, and surface soil metals contamination will be excavated. Subsurface soil contamination of the railyard and areas between the railyard and the River will continue to exceed cleanup levels. Protection is achieved in areas where soil or groundwater exceed cleanup levels through a protective soil cap, institutional controls, and a long-term maintenance and monitoring program.

- **PB (Property Boundary) –** The PB alternatives meet cleanup standards for groundwater at an on-property, conditional groundwater point of compliance at the railyard property boundary. This means that groundwater must be clean at the BNSF property boundary. All free product will be removed, petroleum discharges to the River will be eliminated, surface contamination will be removed and groundwater between the railyard and River will be restored to levels protective of human health. Subsurface soil on and off the railyard and groundwater on the railyard will continue to exceed cleanup levels. Protection from this material will be achieved through containment, institutional controls, and a long-term maintenance, inspection and monitoring program.

Estimated Cost of Remedial Alternatives

Table 7-6 of the FS/EIS lists the estimated costs of each remedial alternative, broken into cost per technology for each cleanup zone. Figure 7-1 displays this information graphically. Detailed bases for cost estimates are in Appendix L. Totals for each alternative are as follows.

Remedial Alternative	Total Cost
No Action	$1,500,000
SW1	$4,400,000
SW2	$7,700,000
SW3	$10,400,000 - $10,900,000
SW4	$19,400,000 - $29,500,000
PB1	$10,500,000
PB2	$16,200,000 - $22,800,000
PB3	$20,900,000 - $31,600,000
PB4	$31,700,000 - $48,700,000
Standard	$49,600,000

The most expensive elements of cleanup are the NW Developed Zone, the levee, and the railyard. In general, cost increases as the amount of contaminated material removed increases. For each remedial alternative, Figure 8-2 shows both the total cost and the volumes of material removed or treated. The other factor to consider is degree of permanence of the alternative, which correlates with the amount of material removed, and thus cost as well. The "cost effectiveness" of each remedial alternative can be approximated by comparing cost per soil removal volumes, as illustrated in Figure 8-3.

Since a high level of protection can be achieved by all remedial alternatives, the key differences influencing decisions on a remedial alternative are permanence, restoration time frame and adverse impacts on the built and natural environment.

Restoration Time Frames

Figures 8-10, 8-11 and 8-12 of the FS/EIS illustrate the time frames estimated for removal of free product, restoration of groundwater to cleanup levels at the point of compliance, and restoration of soil to cleanup levels at the point of compliance, respectively. For each media addressed, the figures show time frame per cleanup zone.

Free product will be removed from all off-railyard areas within 10 years for six of the nine alternatives. Free product is removed within 30 years from the railyard for 3 of the alternatives. All alternatives except one achieve cleanup standards for soil and groundwater within 10 years. Three of the alternatives achieve cleanup standards within 5 years, however five of the remaining alternatives exceed the 5 years because they rely on destruction or detoxification technologies that provide a greater degree of long-term effectiveness.

Selecting a Preferred Remedial Alternative

Section 8 of the FS/EIS guides the selection of a preferred remedy by summarizing how each alternative complies with MTCA's minimum and "other" requirements. This section also provides a comparison of the significant adverse environmental impacts and reasonable mitigation measures of the alternatives, consistent with SEPA.

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List of Acronyms

ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
BMP	Best Management Practices
BNSF	The Burlington Northern and Santa Fe Railway Company
BNRR	Burlington Northern Railroad
BTEX	benzene, toluene, ethylbenzene, and xylenes
BTU	British Thermal Unit
CAO	Critical Areas Ordinance
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm	centimeter
cm/sec	centimeters per second
CO	carbon monoxide
cP	centipoise
cPAH	carcinogenic polynuclear aromatic hydrocarbon
CSM	Conceptual Site Model
CWA	Clean Water Act
cy	cubic yard
dB	decibel (measurement of noise volume)
dBA	decibels at equivalent A-weighted sound levels
dbh	diameter at breast height
DO	dissolved oxygen
DOD	United States Department of Defense
DOE	United States Department of Energy
dynes/cm	dynes per centimeter
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
EPH	extractable petroleum hydrocarbon
EPH/VPH	extractable and volatile petroleum hydrocarbon fractions
f_{oc}	fraction of organic carbon

List of Acronyms

FRTR	Federal Remediation Technologies Roundtable
FS	Feasibility Study
FS/EIS	Feasibility Study and Environmental Impact Statement
ft^2	square feet
g/kg	grams per kilogram
GNR	Great Northern Railroad
gpm	gallons per minute
HDPE	high-density polyethylene
IHS	Indicator Hazardous Substances
LD50	lethal dose for 50 percent kill
LNAPL	light nonaqueous phase liquid
MACT	maximum acceptable concentration threshold
MCL	maximum contaminant level
MCLG	maximum contaminant level goal (formerly RMCL)
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
msl	mean sea level
MTCA	Model Toxics Control Act
NAAQS	National Ambient Air Quality Standards
NAPL	nonaqueous phase liquid
NMFS	National Marine and Fisheries Service
NO_x	nitrous oxides
NRWQC	National Recommended Water Quality Criteria
ORP	oxygen reduction potential
OSHA	Occupational Safety and Health Administration
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
pH	measure of acidity or alkalinity
POC	point of compliance
Poise	A unit of [dynamic] viscosity. One poise is the viscosity of a liquid in which a force of one dyne is necessary to maintain a velocity

List of Acronyms

	differential of one centimeter per second per centimeter over a surface one. [Poise is a measure of absolute or dynamic viscosity.]
PPE	personal protective equipment
ppm	parts per million
PQL	practical quantitation level
PSCAA	Puget Sound Clean Air Agency
RCW	Revised Code of Washington
RI	Remedial Investigation
RI/FS	Remedial Investigation and Feasibility Study
SAP	Sampling and Analysis Plan
scfm	standard cubic feet per minute
SDWA	Safe Drinking Water Act
SEPA	State Environmental Policy Act
site	BNSF Skykomish site
SMS	Sediment Management Standards
SOW	Scope of Work
Stokes	A unit of kinematic viscosity (dynamic viscosity divided by the density). In the SI system the accepted unit is square meter per second (m^2/s). To convert one stokes to (m^2/s) multiply by 1.0×10^{-4}.
SVOC	semivolatile organic compound
su	standard unit
TEE	terrestrial ecological evaluation
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TPH-D	total petroleum hydrocarbons – diesel
TPH-Dx	total petroleum hydrocarbons – diesel extended
TPH-MO	total petroleum hydrocarbons – motor oil
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
µmhos/cm	micromhos per centimeter
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service

List of Acronyms

USFS	United States Forest Service
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbon
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WDOH	Washington State Department of Health
WET	whole effluent toxicity
WSDOT	Washington State Department of Transportation
ºC	degrees Celsius
ºF	degrees Fahrenheit

List of MTCA Definitions

Free Product	[173-340200]	"a NAPL that is present in the soil…gw or sw as a distinct separate layer. Under the right conditions, if sufficient free product is present, free product is capable of migrating independent of the direction of flow of the gw or sw."
NAPL	[---200]	"a hazardous substance that is present in the soil, groundwater, surface water as a liquid not dissolved in water. The term includes both LNAPL and DNAPL."
Residual Saturation	[---747(10)(b)]	"When a NAPL is released to the soil, some of the NAPL will be held in the soil pores or void spaces by capillary force. …., the concentration of hazardous substances in the soil at equilibrium conditions is called residual saturation. At concentrations above residual saturation, the NAPL will continue to migrate due to gravimetric and capillary forces and may eventually reach the gw, provided a sufficient volume of NAPL is released."

1 Introduction

This report presents the integrated Feasibility Study and Environmental Impact Statement (FS/EIS) for BNSF's Former Maintenance and Fueling Facility located in Skykomish, Washington (site). Figure 1-1 shows the site boundary, which is not limited to BNSF's property. This integrated FS/EIS evaluates alternatives for cleanup action at the Skykomish Site.

In 1993, The Burlington Northern and Santa Fe Railway Company (BNSF) entered into an Agreed Order (No. DE91TC-N213) (1993 Agreed Order) with the Washington State Department of Ecology (Ecology) to conduct a Remedial Investigation and Feasibility Study (RI/FS) and to implement certain interim cleanup actions. BNSF and Ecology entered into a second Agreed Order in 2001 (No. DE 01TCPNR-2800) under which BNSF implemented additional interim actions.

Cleanup of the site is being done under the authority of Chapter 70.105D Revised Code of Washington (RCW), *Hazardous Waste Cleanup – Model Toxics Control Act* (MTCA), and its implementing regulations, Chapter 173-340 Washington Administrative Code (WAC), *The Model Toxics Control Act Cleanup Regulation*. This statute and its implementing regulations apply to the site in their entirety and govern all remedial actions at the site.

1.1 Purpose and Objectives

The purpose of a Feasibility Study (FS) is to proceed with cleanup of the site in accordance with the MTCA Cleanup Regulation, [Chapter 173-340 WAC]. An FS presents and evaluates alternatives for a cleanup and is used to enable a cleanup action to be selected for the site under WAC 173-340-360 through 173-340-390.

An Environmental Impact Study (EIS) is generally required when one or more of the alternatives in the FS will have probable, significant, adverse environmental impacts. The EIS analyzes the probable significant adverse environmental impacts of each reasonable alternative to clean up the site consistent with MTCA, and the reasonable measures that could reduce or mitigate those impacts (WAC 197-11-400). These impacts include short- and long-term impacts, direct and indirect impacts and cumulative impacts.

Under the State Environmental Policy Act (SEPA), if the lead agency determines that a project or proposal is likely to result in a significant adverse impact on the environment (i.e., Determination of Significance [DS]), then the process of preparing an EIS is initiated to evaluate potential associated impacts and consider various remedial alternatives. In September 2002, BNSF that Ecology issue a DS for the cleanup of the site. BNSF and Ecology agreed that the FS and EIS should be integrated into a single document consistent with WAC 197-11-250 and 262. This FS/EIS is intended to improve decision-making and reduce duplication and paperwork related to selecting a final cleanup action.

Ecology has determined (WAC 197-11-430(2)) that a format integrating the presentation of alternatives and environmental analyses is encouraged under MTCA and allowed by SEPA. A Draft *Guide for the Integration of MTCA with SEPA* (Ecology, 2002a) was consulted for the preparation of this document.

The EIS process is used to analyze alternatives and possible mitigation measures to reduce the environmental impacts of the proposal. The process contains the following steps:

1) Scoping

2) Preparing the draft EIS

3) Issuing the draft EIS for public, tribe and agency review and comment

4) Preparing and issuing the final EIS

5) Using the EIS information in decision-making

Ecology issued a DS for the site on October 21, 2002. When preparing the EIS, Ecology is required to involve the public in what is known as "scoping," or the process of determining the range of remedial alternatives, areas of impact, and possible mitigation measures that should be evaluated as part of the environmental impact statement. Scoping and community outreach activities have been performed by Ecology and BNSF during the recent site activities and investigations. These have included information sheets, meetings and presentations. During these meetings and presentations, public comment has been requested and obtained. This comment has helped to guide the RI/FS/EIS process. Further details are presented in Appendix A.

Figure 1-2 presents a general flow diagram of the MTCA process. This shows that the FS is one of several sequential requirements leading to site cleanup under MTCA. The FS uses data collected during the Remedial Investigation (RI) and additional data collected for the FS to develop and evaluate cleanup action alternatives. After the FS is complete, Ecology will issue a cleanup action plan (WAC 173-340-380); this plan will present the selected cleanup action(s) that will be used to address site contamination.

Figure 1-3 presents a diagram that summarizes the information presented in a Feasibility Study under MTCA. This information is presented in this FS/EIS for the BNSF Skykomish site; however this FS/EIS also contains additional data that are required for an EIS under SEPA (WAC 173-802). As shown on Figure 1-3, an FS uses general facility information, and data collected from field investigations. Some of the key elements of this FS/EIS are described below.

- **Indicator Hazardous Substance (IHS).** IHSs are typically a subset of substances that contribute the majority of the overall threat to human health and the environment. These are used to define site cleanup requirements and are defined in the FS.

- **Conceptual Site Model (CSM).** The CSM provides the nature and extent of contamination, fate and transport characteristics of the IHSs, current and potential contaminant migration pathways and receptors of site contamination, and current and potential land use and resources. The CSM is intended to further refine the definition of risk posed by site contaminants and assist with the definition of cleanup requirements.

- **Cleanup Standards.** Cleanup standards are defined in an FS for all media, such as soil and groundwater, that have been impacted by contamination and that could pose a risk to human health or the environment. Cleanup standards consist of the cleanup levels for hazardous substances present at the site and the location where these cleanup levels must be met (point of compliance).

- **Cleanup Action Alternatives.** Cleanup action alternatives are developed and presented in the FS. These alternatives consist of technologies that clean up site contaminants by reuse or recycling, destruction or detoxification, immobilization or solidification, disposal, containment with engineering controls or institutional controls and monitoring. These cleanup action alternatives must meet the following MTCA requirements (WAC 173-340-360): (1) protect human health and the environment, (2) comply with cleanup standards and applicable federal and state laws, (3) provide for compliance monitoring, use permanent solutions to the maximum extent practicable, (4) provide for a reasonable restoration time frame, and (5) consider public concerns.

- **Remediation Levels.** Remediation levels are proposed in an FS, as required remediation levels always exceed cleanup levels and are concentrations of a hazardous substance above which a particular cleanup action component will be required as part of a cleanup action at a site. Remediation levels may be used at sites where a combination of cleanup action components are used to achieve cleanup levels at the point of compliance.

The FS/EIS is intended to provide enough information to allow Ecology to select a cleanup action. The procedures for conducting a feasibility study are set forth in WAC 173-340-350(8). The selection of a final cleanup action is documented in the Cleanup Action Plan.

2 Background

This section presents an overview of current conditions at the site, including the natural and built environment, historical information, and key environmental conditions. The objective is to present the information on the affected environment pursuant to the requirements of SEPA (WAC 197-11-440(6)) as well as MTCA. The goal is to present an integrated site description intended to avoid duplication and delay, as specified in WAC 197-11-250 to 268. Significant elements of the environment identified in the Determination of Significance are included, as are key elements of the natural and physical background environment pertaining to the MTCA FS.

2.1 Town and Site Description and History

This section first describes the Town of Skykomish, Washington, and then locates the site within the town. It is important to not only understand the layout of the site, but also the town because the alternatives for cleanup of the Former Maintenance and Fueling Facility will impact areas of the town that are not on BNSF property. In addition to describing the town and site, the operational history of the Former Maintenance and Fueling Facility is also summarized. Sections 2.2 and 2.3 describe the natural and built environment of the town and the site.

2.1.1 Town Description

Historically, Skykomish was the commercial center of the Upper Skykomish Valley. The Town of Skykomish was incorporated in 1909, and mining, lumbering, milling, and the railroad were its economic mainstays. In 1929 the town had a population of 929, but it has since declined to its current level of 214 (U.S. Census Bureau, 2001). It is estimated that seasonal residents bring the total population to between 250-300 people (Blanck, 2003). Skykomish is located in King County, Washington at an altitude of 950 feet above mean sea level (msl).

In 1893, train service to Seattle started along the Great Northern Railroad (GNR), and the Town of Skykomish became a center for railroad operations, including a roundhouse, turntable, and electrical generating substation. Active railyard operations in Skykomish had ceased by 1974. The BNSF railroad still runs through town, but railyard activities are limited to track maintenance and snow removal. The railroad continues to be a BNSF main transcontinental route with approximately 24 trains passing through Skykomish daily (Yates, pers. comm., 2003a).

Skykomish was built near the mouth of Maloney Creek where it connects to the South Fork of the Skykomish River. Maloney Creek was diverted from its original course in approximately 1912, and many channel modifications have occurred since then (USFS, 1991). The original course of Maloney Creek was located along the southern boundary of the railyard, and developed into a marshy area collecting stormwater drainage from the railyard and the southern part of town. This area is marked on Figure 2-1. The current course of Maloney Creek runs south of town.

To protect the town from flooding from the Skykomish River, the United States Army Corps of Engineers (USACE) constructed a flood control levee in 1951 along the riverfront east and west of the Skykomish Bridge, which was built in 1939. The levee is marked on Figure 2-1.

No logging or mining activities are ongoing in the Skykomish area. The town is surrounded on all sides by the Snoqualmie-Mount Baker National Forest (Figure 1-1). This portion of the National Forest is in Management Area 27-SF, part of which is Scenic Forest. Scenic Forest is managed to enhance viewing and recreational experiences (USFS, 1990 and USFS/USDI BLM, 1994.)

Today the town is dependent on tourism and on the Forest Service maintenance yard and ranger station. The other major employer is the Skykomish School District.

2.1.2 Site Description

The BNSF Former Maintenance and Fueling Facility in Skykomish, Washington, operated from the inauguration of the GNR line to Seattle in 1893 until 1974. The railroad line still runs through the facility, the property of which is owned by BNSF. The historical activities at the facility resulted in a release of hazardous substances that has impacted the railyard, adjacent properties, and natural features in the area such as the former Maloney Creek channel. The affected areas subject to potential cleanup action, whether BNSF property or otherwise, are collectively referred to as “the site” in this FS/EIS. BNSF’s property is referred to as “the facility” and “the railyard.” Figure 2-1 shows the general layout and boundaries of the site and the facility. The site covers approximately 40 acres, and the facility covers approximately 22 acres.

For purposes of this FS/EIS, the site is defined by contamination detected in soil, sediment, or groundwater samples exceeding the levels below. Boundaries were adjusted to avoid cutting through properties as much as possible. The precise boundaries may be adjusted based on additional sampling that will occur during remedial design and compliance monitoring, after a final cleanup action is selected. The outline contains all areas with:

- Greater than 0.5 milligrams per liter (mg/L) of total petroleum hydrocarbons (TPH) as diesel (by NWTPH-Dx Method) in groundwater. TPH-oil (by NWTPH-Dx method) was not detected in groundwater and therefore, no allowance was made for TPH-oil in the outline.

- Any presence of free product
- Soil exceeding 20 milligrams per kilogram (mg/kg) for arsenic and 250 mg/kg for lead
- Soil TPH-Dx exceeding 50 mg/kg

The site has been subdivided into several distinct Cleanup Zones (based on RI and Supplemental RI sampling) for this FS/EIS (see Section 6 for further discussion of Cleanup Zones):

1) **The Railyard Zone.** This area includes the former maintenance facility, together with two small adjacent areas, and covers approximately 22 acres. It has historically been used for industrial purposes. Surface and subsurface impacts are present.

2) **The Developed Zones.** These areas are or are likely to be developed for residences, commercial buildings, public buildings, or roads. These areas are primarily affected by contaminants in groundwater and surrounding subsurface soil. Hydrocarbon plumes consisting of a mixture of diesel and bunker C affect the NW Developed Zone and the South Developed Zone (Figure 2-1). The NE Developed Zone is affected primarily by diesel. In addition, there are some isolated elevated occurrences of lead in the surface soil north of the railyard.

   Diesel oil is a complex combination of hydrocarbons, having carbon numbers predominantly in the range of C9 to C20. The formulation and composition of diesel varies according to its intended use. There are two main types of diesel; these are Type 1 (kerosene and marine fuel) and Type 2 (automotive and locomotive fuel). Diesel fuel generally contains low concentrations of PAH compounds.

   The composition of Bunker C fuels is less consistent than that of diesel fuel. Bunker C represents a fuel mixture which generally contains both diesel-range (C9 to C24) and oil-range (C20 to greater than C32) hydrocarbons. Bunker C fuels generally contain higher concentrations of PAH compounds than diesel fuels. The viscosity of Bunker C is higher than that of diesel and when the two types of hydrocarbon are present together they form an emulsion.

3) **The Aquatic Resource Zones.** There are two Aquatic Resource Zones. The Skykomish River and Levee includes the flood control levee downgradient of the NW Developed Zone, and the interface between land and the Skykomish River. This area is affected by seepages of hydrocarbon reaching the river. The second Aquatic Resource Zone is the former Maloney Creek channel. This area occupies a wetland area centered around the former Maloney Creek channel, which now functions as a stormwater conduit. This area has impacted surface sediment and also contaminated subsurface (smear zone) soil contiguous with Railyard Zone subsurface soil.

2.1.3 Railyard Operational History

As mentioned above, the facility was originally owned and operated by the GNR, starting in the summer of 1893. GNR owned the property from the late 1890s until 1970 when GNR merged with four other railroads and became the Burlington Northern Railroad (BNRR). The facility is currently owned and operated by BNSF that was formed with the merger of BNRR and the Santa Fe Railway in 1994.

A detailed history of the facility has been conducted (Berryman, 1990). The facility has gone through five overlapping operational eras. Each era is discussed below in terms of the activities conducted and the products used during the era. Figure 2-2 shows the location at the facility of the major elements discussed below.

2.1.3.1 Coal and Steam Era

Steam produced by coal heat was used to power locomotives operating out of the facility during this era. Structures reportedly present during this time period included an engine house and turntable, sandhouse, blacksmith and machine shop, coal tower and chute, depot, and water tower. The engine house originally had nine stalls for repair work but, by 1902, only six stalls were being used. Each stall had a pit where a repairperson could service the underside of a locomotive.

Repair activities reportedly performed during this era included insulation of engine parts and boilers, cleaning and rebuilding seals, cleaning and repairing boilers, testing gauges, oil and degreasing, painting, and cleaning engine parts. The turntable was used to turn the locomotives around. The sand tower dispensed sand that the locomotives used for traction on steep grades. The machine and blacksmith shops were used to manufacture parts for repairs. Petroleum-related products reportedly used during this period included grease, lubricating oil, and fortnite oil (kerosene-like petroleum product used to clean parts).

2.1.3.2 Oil and Steam Era

Bunker C oil replaced coal as the heat source in steam locomotives in about 1908. An oil-unloading shed and sump and an aboveground oil storage tank replaced the coal tower and chute. Bunker C oil was stored at the facility in below-grade wooden, concrete, and steel sumps, and aboveground steel tanks. Fortnite oil was the only cleaning fluid reported to be used during this period. The depot was moved from the south side of the tracks to its present location north of the tracks on Railroad Avenue.

2.1.3.3 Electric Era

Construction of an 8-mile-long tunnel between Skykomish and Leavenworth and of an electric substation was completed in 1929. Electric-powered locomotives replaced bunker-C oil-powered locomotives through the tunnel to eliminate exhaust fumes. The facility became the transition point for bunker-C-oil- to electric-powered locomotives.

The engine house was used for repairs on both road and helper engines, until it was destroyed by a fire in 1943. However, evidence suggests that some elements of engine repair and maintenance continued at the facility through the mid-1950s.

2.1.3.4 Diesel Era

Diesel was used for locomotives traveling west of Skykomish as early as the mid-1940s and replaced both bunker C oil and electricity. In 1956, installation of a tunnel ventilation system permitted diesel locomotives to operate within the tunnel and electric locomotives were abandoned. The diesel was stored at the facility in aboveground and underground storage tanks until 1974 when BNRR discontinued fuel-handling activities at Skykomish.

2.1.3.5 Maintenance Era

Most engine repair and maintenance activities ceased in the mid-1950s. The electric substation building was used as a sandblasting facility for a period in the 1960s. The sandblasting facility is the probable source of the elevated concentrations of lead in the immediate vicinity of the former substation. BNRR discontinued all fueling operations at their Skykomish facility in 1974. At the same time, they also reportedly excavated and removed all known sources of petroleum product.

The former structures of the facility are shown on Figure 2-2. The substation was demolished in August 1992. The depot building and maintenance building are the only structures remaining at the facility. Three sets of railroad tracks and at least four spur lines surrounded by railroad ballast and gravel make up the remainder of the facility, which is currently used as a base of operations for track maintenance and snow removal crews.

2.2 Natural Environment

This section describes the natural environment of the Town of Skykomish and the site. The intention of this section is to describe the earth (geology, soil, and sediments) that exists under and around the town and site in order to understand the potential migration of contaminants through the earth (Section 2.2.1) and the impacts cleanup actions may have on the natural environment (Section 7).

Contaminants can potentially migrate through, and over, the earth via groundwater flow, surface water flow, stormwater runoff and infiltration, and floods. As such, to determine the movement of surface water and groundwater, one must first understand the soil environment (Section 2.2.1). Then one can understand how the soil either facilitates or limits the movement of water both horizontally and vertically. Some of the alternative cleanup actions will significantly impact the soil and amount of water within the soil. Thus, the next aspects of the natural environment that will be described in this section are water (Section 2.2.2) and air (including wind) (Section 2.2.3).

Finally, we will describe the plants, animals, and aquatic life that exist on and around the town and site to determine which ones may be impacted by the contamination (Sections 2.2.4 to 2.2.6). Potential impacts to the natural environment as a result of cleanup actions are discussed in Section 7.

The human (or built) environment of the town and site is described in Section 2.3. This includes features such as buildings, roads, bridges and railyard facilities. Adverse impacts to the built environment are described in Section 7.

2.2.1 Earth

This section describes the geology, soils, sediment, topography, and unique physical features of the town and the site.

2.2.1.1 Geology and Soils

The Former Maintenance and Fueling Facility is located in the Skykomish Valley on the southern bank of the Skykomish River in Washington State. The Skykomish Valley is a classic, glacially scoured valley with steep sidewalls and a relatively flat bottom. The Skykomish River, flowing from east to west adjacent to the site, now occupies the northern side of the valley at the railyard. Over geologic time, the river has meandered from the north side of the valley to the south side of the valley, as evident in the riverine deposits that dominate the geology on the valley floor.

The Skykomish River receives its water from small tributaries upstream and spring snowmelt. Further downstream from the site, the Skykomish and

Snoqualmie Rivers merge and form the Snohomish River, which flows into Puget Sound at Everett, Washington.

The Town of Skykomish is primarily underlain by highly heterogeneous glaciofluvial sediments. These glaciofluvial sediments consist mainly of sand and gravel, and underlie a generally thin layer of topsoil and/or fill. Figure 2-3 presents a typical cross section through the site that illustrates the variability of the soils underlying the site.

Sandy topsoil up to 4 feet thick is present throughout residential and commercial areas within the site. The topsoil is loose to medium dense, and consists of gravelly or silty sand containing trace amounts to abundant organic material ranging from leaf matter and twigs to logs.

Native soils generally underlie the topsoil although in places the topsoil is underlain by fill that was used to level the land surface or fill in marshy areas. The fill contains brick fragments, broken glass, nails, and is in some areas underlain by a distinct orange burn horizon that was produced when the land was being deforested for development. This burn horizon is present up to 5 feet below the ground surface, indicating that the top 5 feet of the ground in some areas consists of fill. The native soils consist primarily of sand and gravel, with shallow discontinuous lenses of silt and clay. The ratio of sand to gravel varies greatly with depth and laterally throughout the site, and the grain size of the sand and gravel is also highly variable. The sand is generally medium- to coarse-grained and the gravel is fine to coarse. There are frequent cobbles up to one foot in diameter and occasional boulders up to 3 feet across.

A layer of dense silt is present within the sand and gravel throughout the entire site. This is at least 4 feet thick and in places is greater than 10 feet in thickness. The top of the silt shows subsurface relief that probably results from irregular erosion by the Skykomish River; however, in general, the upper surface of the silt gently rises from an approximate elevation of 905 feet at the western part of the site to 925 feet at the eastern end. The silt is present at depths between 10 and 27 feet below the ground surface.

Previous site investigations have not reached bedrock; however, the base of the soils is estimated at an approximate depth of 200 to 250 feet according to local area well logs (GeoEngineers, 1993). Additional information on soil is provided in Section 3.2.1, which summarizes soil quality data collected as part of the site RI and Supplemental RI (RETEC, 1996 and RETEC, 2002a).

2.2.1.2 Sediment

The site includes two separate areas where sediment may be subject to cleanup activities. These are the former Maloney Creek channel and the south bank of the South Fork of the Skykomish River west of the Skykomish River

Bridge. These two areas have substantially different characteristics. The former Maloney Creek channel is discussed in more detail in the next section (Former Maloney Creek Channel/Wetlands). The Skykomish River is discussed below.

The South Fork of the Skykomish River is a high-energy river (gradient is approximately 27 feet per mile) carrying a relatively low load of suspended sediment. In general, depositional environments are few and ephemeral in the South Fork, and the riverbed is dominated by heavier glaciofluvial materials (sands, gravels, and cobbles), which are less subject to scour than the finer sand and silt typically considered "sediment." Sand occupies many of the interstices of the larger substrate materials in the channel.

In Skykomish, the River makes a significant bend at the Fifth Street Bridge (Fig. 2-2). Along the River's southern shoreline, adjacent to the levee and the locations of hydrocarbon seeps (Figure 2-4), finer sediment may be deposited as a result of lower river velocities, particularly during low seasonal flows. The sediment deposited in this area is typically eroded on at least a seasonal basis during higher flows and, as a result, these deposits are considered ephemeral in nature. In addition, large riprap and cobble substrates associated with the levee form a near-vertical shoreline edge along the south riverbank, approximately 1 to 2 feet in height, relative to the riverbed elevation, also indicating a non-deposited environment where hydrocarbon seeps have historically been observed.

The larger riprap and boulders present along this shoreline may reduce flow velocities near the bank by creating eddies where water flows around these larger substrates. At times, sediment accumulates in these areas. However, the sediment seldom appears to exceed a few inches in depth, except in the interstices between cobbles. This sediment grades into bank soils accumulated between cobbles in the riparian zone. The total width of this area is approximately 10 feet and represents the extent of the sediment resource in the Skykomish River.

A sediment impact zone was identified as part of the Supplemental RI (Figure 2-4). The Supplemental RI and subsequent sediment work detailed in the *Results of Supplemental Sediment Sampling – Toxicity Evaluation and Sediment Cleanup Levels* (RETEC, 2003a) identified an area of sediment concern covering approximately 440 feet along the bank, for a total area of approximately 8,117 square feet (see Appendix B). The actual extent of sediment accumulation areas affected by bank seepage is generally limited to transient accumulations in a strip less than 10 feet (generally 1 to 3 feet) wide inside the study area, for a total of 440 to 1,320 square feet.

The sediment accumulation is dominated by sand with lesser amounts of silt. The organic carbon content in the sediment appears to vary seasonally or vertically. Samples collected higher on the bank for the Supplemental RI during summer of 2001 had an average total organic carbon (TOC) of 1.1 percent. Samples collected lower on the bank during fall of 2002 had an average TOC content generally lower than 0.3 percent. The higher TOC samples are submerged only during high flows.

Further information on sediment quality in the Skykomish River is presented in Section 3.

2.2.1.3 Former Maloney Creek Channel

The former Maloney Creek channel is present along the southern boundary of the railyard to the east of 5th Street. A Wetland Detailed Study of the former channel appears in Appendix C. This former Creek channel has been impacted by former site conditions, and may be potentially affected by the cleanup actions. The eastern boundary of this area is from the culvert under Old Cascade Highway where the drainage ditch crosses to the north side of the road adjacent to the site. Stormwater drains into ditches adjacent to the road and flows through the culvert under Old Cascade Highway to the north side of the road adjacent to the site. Flow is intermittent through these ditches. The western boundary of the former Maloney Creek channel passes through a culvert under the intersection of 5th Street and Old Cascade Highway to a point downstream of the Fire Station, where the flow emerges before reaching the current channel of Maloney Creek (Figure 2-5).

Figure 2-5 is the only figure that shows the delineated wetland as determined in the Detailed Wetland Study. The preliminary delineation that is used in all other figures is larger than that shown in Figure 2-5. As such, the estimates of volume and cost in the Former Maloney Creek Aquatic Zone are conservative.

Maloney Creek occupied the former Maloney Creek channel prior to being rerouted to its current location in approximately 1912 (USFS, 1991). Wetlands may have existed in the riparian corridor along the borders of the former creek prior to being rerouted, but the former channel and associated wetlands are now classified as a depressional outflow wetland. The former Maloney Creek channel now receives runoff from roads and residential yards via a culvert from the ditches on the south side of the Old Cascade Highway (Figure 2-5). The Wetland Detailed Study contained in Appendix C provides additional description of the wetland.

In the area between the culverts the channel widens and forms a wetland covering approximately 0.95 acres. The area is wooded, with a healthy population of alder, cottonwoods, and other native and non-native water tolerant shrubs. The BNSF facility bounds the area to the north, and residential properties and Old Cascade Highway bounds it to the south. The complete Wetland Detailed Study contained in Appendix C provides the delineation, characterization, and functional analysis of this wetland. Water content is intermittent, fed primarily by runoff from the drainage ditches and the railyard, but probably also by groundwater recharge during times of high water tables. During times of water flow salmonid fish have been observed in the wetland as well as in the drainage ditches upstream of the wetland (Ecology 2002b).

Figure 2-5 shows the former Maloney Creek channel, with a longitudinal cross section illustrating its hydrogeologic relationship with the surrounding soil. The channel substrate consists of silt and sandy silt of varying depth, but generally extending a few feet, overlying the typical glaciofluvial deposits of the area. Groundwater levels generally are deeper than the bed of the channel by 1 foot or more.

Contaminated soils are present in the subsurface along portions of the channel, and may reach the surface locally near location 02SED-5. The biologically active top foot of the wetland is dominated by historical and current surface runoff via the stormwater collection systems described in Section 2.2.3, and probably some localized intermittent upwelling in the neighborhood of 02SED-5.

The sediment quality in the former Maloney Creek channel sediment will be discussed further in Section 3.2.4. Contamination present in the glaciofluvial deposits in the deeper subsurface is contiguous and congruent with the subsurface contamination in the railyard soil, and will be addressed separately from the surface wetland. The quality of the deeper zone is also discussed in Section 3.2.1.

2.2.1.4 Topography

The topography of the town and the surrounding area south of the river is shown on Figure 2-6. The east end of the town is generally the highest part of town, nearing 950 feet above sea level. The west end of town descends to 920 feet above sea level. The lowest portions of the town include the former Maloney Creek channel, Maloney Creek, and the Skykomish River. As seen on Figure 2-6, the railroad tracks are built up higher than the rest of the town. North of the railroad tracks, the topography is relatively flat, but gently slopes down from east to west towards the Skykomish River.

2.2.1.5 Unique Physical Features

Human activity has strongly modified three distinct areas in the town. These include residential and business areas, flood berms, and the railyard. The residential and business areas contain single-family homes, and commercial and public buildings. Areas that are not covered by buildings or roadways generally consist of grass lawns.

Fifteen-foot high levees (berms) have been installed near the Skykomish River for flood protection. These berms are composed of fill material made up of sand and gravel. Boulders armor the surface of the north side of the berms, but the percentage of boulders within the berm is unknown. The locations of the berms are shown on Figure 2-1.

The third distinct area is the railyard. Gravel up to 1 inch in diameter occupies the railyard on the majority of BNSF property (Figure 2-1).

The former Maloney Creek channel, along the southern boundary of the railroad yard, conveys stormwater draining from the railyard and street as well as runoff from residential yards south of the Old Cascade Highway. It includes a wetland that is described in detail in subsequent sections and Appendix C (see Figure 2-1). This area has a layer of silt or silty sand overlaying glaciofluvial area sediments.

2.2.2 Water

This section describes the volume of water moving through the geology and soils at the site and the town, and how the water moves. This section also introduces references to water quality; greater detail is provided in the analysis of nature and extent of contamination in Section 3. The water described in this section includes surface water, runoff and infiltration, floods, groundwater, and water supply wells.

2.2.2.1 Surface Water Movement, Quantity, and Quality

Surface waters in and nearby the town include the Skykomish River, the wetland in the former Maloney Creek channel, and Maloney Creek (Figure 2-1). These three surface water features are described below.

Additional information is provided in Section 3.2.5, which summarizes surface water quality data collected as part of the remedial investigations at the site.

Skykomish River

The Skykomish River is a fast flowing river with fluctuating flow and water levels throughout the year. It receives its water from small, upstream tributaries and spring snowmelt. The Skykomish River contains flowing water all year.

Water levels are lowest in the late summer (July, August, September, October). Table 2-1 summarizes mean river flow in cubic feet per second (cfs) and river height. River flow is gauged at the Gold Bar gauging station, located approximately 20 miles downstream of the town. River height is gauged at a USACE electronic water level gauge on the 5th Street Bridge over the Skykomish River. Gold Bar data can be accessed in real time while 5th

Street Bridge data is available on a time-delay basis. There is a correlation between the Gold Bar flow data and river depth at the 5th Street Bridge. Therefore, Gold Bar flow data can used to calculate water depths at the Skykomish Bridge in real-time (RETEC, 2002b). Tributaries flowing into the river between Skykomish and Gold Bar cause the flow at Gold Bar to be greater than the flow at Skykomish. A heavy storm event can cause the water level to rise several feet overnight as the water flow increases.

Low-velocity areas are present in the river margin along the base of the levee throughout much of the southern shoreline. Particularly downstream of the bridge, large riprap and cobble substrates form a vertical shoreline edge along the south riverbank which is approximately 1 to 2 feet in height, relative to the riverbed elevation. The larger riprap and boulders present along this shoreline reduce flow velocities near the bank by creating eddies where water flows around these larger substrates. Low-flow areas are also present within the interstices of the larger boulders and riprap. The base of this shoreline edge is at approximately 4.5 to 5 feet gauge height. During flows above this height, water adjacent to the shoreline edge is approximately 1 to 2 feet deep. Below this height, the river recedes from the base in most areas.

Substrates within the Skykomish River are dominated by cobbles, and vary in size from large boulders and large cobbles, to smaller gravels and sands. Larger boulder substrates are more frequent along the northern portions of the channel, with smaller cobbles, gravels, and sands occurring along the southern shore. Larger cobbles, boulders, and riprap associated with the base of the flood control levee are also present along the southern shoreline. Gravels and sands occupy many of the interstices of larger substrates within the river channel.

The Former Maloney Creek Channel

In about 1912, Maloney Creek was diverted to a new channel (USFS, 1991). This channel developed wetland characteristics fed primarily from stormwater runoff from surrounding areas. Subsequent infill has eliminated part of the southern portion of the channel, but the greater part remains a wetland with intermittent water flow. This is the former Maloney Creek wetland (Figure 2-5).

The topography of the land adjacent to the former Maloney Creek channel indicates that historically, discharges and runoff from the southern portion of the railyard as well as from the residential areas to the south probably flowed through the former Maloney Creek channel. Although no hydrologic studies are available for confirmation, it is likely that most of the intermittent flow during low water table conditions in the channel, and a significant portion of the water flowing through the channel during high water table conditions, is derived from surface runoff and drainage (see Appendix C). Sediment cores and samples were collected and analyzed as part of the Supplemental RI (RETEC, 2002a).

The former Maloney Creek channel can be described as three distinct segments, as described below:

- **The Upstream Segment.** This segment is south of the Old Cascade Highway. It is approximately 4 to 5 feet wide and is confined within a series of drainage ditches. Culverts convey flow beneath numerous roads and driveways along the south side of the highway. The substrate in this area is dominated by gravels and sands, with occasional small cobbles present.

- **Middle Section.** This segment is south of the railyard and north of the Old Cascade Highway and includes the wetlands described in App. P. Second-growth deciduous trees dominate this segment. The wetland, with its associated channel, is approximately 60 to 80 feet wide. The channel within the wetland is undefined throughout most of its length, with surface layers dominated by sands and silts overlain with varying amounts of organic debris. Small patches of gravel are also present in places. At lower flows, ponding occurs throughout this area.

- **The Downstream Segment.** This segment is downstream of the Old Cascade Highway culvert south of the firehouse. This segment is dominated by small cobbles and gravels, with areas of sand deposition. The channel is approximately 3 to 5 feet wide. The entrance to the culvert beneath the firehouse is approximately 400 feet upstream of the confluence, and the culvert itself is approximately 220 feet long.

The plant and animal species that live in these three areas will be discussed in Sections 2.2.4 and 2.2.5. The geology of this area is discussed in Section 2.2.1.

Maloney Creek (current channel)

Maloney Creek receives runoff from its catchment area, which includes the former Maloney Creek channel. Its catchment area is estimated to be approximately 1,914 acres and is shown on Figure 2-7. Maloney Creek drains into the South Fork of the Skykomish River to the west of the city. Maloney Creek contains flowing water all year; however, no gauging data is available. It demonstrates a pattern similar to that of the Skykomish River. Maloney Creek is also considered shoreline under the Shoreline Management Act of 1971 (Chapter 90.58 RCW).

2.2.2.2 Stormwater Runoff and Infiltration

There are three catchments that capture and pipe stormwater in the Town of Skykomish: the town catchment, the former Maloney Creek catchment, and the railyard catchment. The town catchment captures stormwater runoff north of the railroad tracks; the former Maloney Creek catchment, south of the railroad tracks; and the railyard catchment, from the south side of the railroad tracks. These three catchments are described below and illustrated on Figure 2-8.

Surface water infiltrates in unpaved areas on the north side of the railroad tracks.

Town Catchment

North of the railroad tracks, stormwater accumulates in one of four collection basins that flows by way of one of three culverts through the berms to the west of the Skykomish River Bridge and directly into the Skykomish River. The locations of these features are shown on Figure 2-8. In unpaved areas on the north side of the railroad tracks, stormwater does not accumulate in these collection basins but infiltrates through surface soil.

There is no municipal storm sewer system in Skykomish.

Former Maloney Creek Catchment

The catchment area for the former Maloney Creek channel is approximately 42 acres, as shown on Figure 2-7. It is bounded by 5th Street to the west, the railroad tracks to the north, and extends no further than the residential areas to the east and south.

Stormwater runoff passes along ditches and through culverts in the former Maloney Creek catchment area. Figure 2-8 illustrates the locations of the culverts. Twenty-four-inch culverts generally pass in the east/west direction under streets and driveways along the Old Cascade Highway. The easternmost culvert passes under 4th Street and passes under each street and driveway to the west until it passes under the Old Cascade Highway in the northwest direction, connecting the flow to the former Maloney Creek channel. Water then flows through the channel to the west, receiving runoff from the railyard (discussed below).

Flow from the former Maloney Creek channel then passes through a 36-inch culvert under the fire station to the southwest. After the culvert, the stream runs approximately 400 feet until it joins the current Maloney Creek channel, leading to the South Fork of the Skykomish River.

Railyard Catchment

The former Maloney Creek channel receives runoff from the railyard. Stormwater on the southern side of the railyard flows to the west along the tracks to a depression just east of 5th Street. This depression or catch basin (cb) may be seen on Figure 2-8. At this depression, one culvert passes from this depression to the south where it discharges into the former Maloney Creek channel. Another culvert historically transferred stormwater from this depression to the north under the tracks, but has since been blocked by a telephone pole, which stops flow through this culvert.

2.2.2.3 Floods

The 100-year and 500-year flood map is provided as Figure 2-9. A flood protection levee is located along the southern side of the Skykomish River to the west of the Skykomish River Bridge (Figure 2-1).

The 100-year flood is anticipated to flood all of the areas to the west of 5th Street and north of the railroad tracks, with the exception of the railroad tracks; the railroad tracks are elevated above the rest of the town, preventing much flooding in a 100-year flood on and to the south of the railroad tracks. The area north of East River Road and portions of the block between Railroad Avenue and East River Road will likely also be inundated in a 100-year flood. However, flooding would follow the Maloney Creek drainage corridor and flood the areas south of the creek.

A 500-year flood would cover the entire town north of the railroad tracks, but the entire portion south of Old Cascade Highway would be safe from flooding.

2.2.2.4 Groundwater Movement, Quantity, and Quality

To demonstrate the movement of groundwater, one must understand the types of soil that exist at a site because groundwater exists in the ground in spaces between soil particles. Water moves easiest through soil with larger grain sizes because these soils cause larger spaces between them. Water has a more-difficult time moving through soils with smaller grain sizes because they can become compacted causing less space between them. Soils with larger grain sizes at the site are gravel and sand; whereas, soils with smaller grain sizes include clayey silt. As such, the movement of groundwater based on the geology of the site will be analyzed in this section.

Regionally, the site is located within the Skykomish Valley, a relatively steep-sided, rock-walled valley that has been partially filled with glaciofluvial sediments. These glaciofluvial sediments consist mainly of sand and gravel. The direction of regional groundwater flow along the Skykomish Valley is westerly, in a downslope direction coincident with the slope of the floor of the valley.

Shallow groundwater is present in the sand and gravel aquifer underlying the site. The aquifer materials vary greatly in the size and proportion of the sand and gravel; however, in general, little silt or clay is dispersed throughout. The concentration of total organic carbon in the sand and gravel generally ranges between approximately 0.1 and 0.5 percent. Where silts and clays are present, they typically occur as thin discontinuous lenses that will not affect the overall horizontal groundwater flow rate or direction throughout the aquifer; however, they may serve as aquitards to vertical groundwater flow, as described below.

Depth to Groundwater

The depth to groundwater ranges approximately from 3 to 17 feet below ground surface throughout most of the site. In low-lying areas immediately adjacent to the Skykomish River, drainage ditches, and the former channel of Maloney Creek the groundwater may intersect the ground surface and therefore the depth to groundwater in those limited areas may be zero feet below the ground surface. It is generally shallowest close to the Skykomish River and increases in depth to the south. The shallow groundwater is hydraulically connected with surface water in the Skykomish River and former Maloney Creek channel. The bank is composed of sand and gravel, and is similar to the sand and gravel underlying the site, except that the bank is armored in places with coarse riprap. Groundwater flow out of the bank is unlikely to be reduced or enhanced by the riprap.

The groundwater levels throughout the site are influenced by the river level, precipitation, temperature, and local drainage. These factors cause the groundwater levels to vary seasonally. Figure 2-10 shows hydrographs with monthly groundwater levels during 2002 and 2003 in 1A-W-3 and 2A-W-1. These hydrographs show that the measured groundwater levels have varied by 4 to 7 feet since January 2002. They were high during winter and spring and low during summer and fall. Precipitation patterns affect the exact duration and periods of the high and low water levels, as well as the magnitude of the groundwater level changes.

Groundwater elevations are the highest at the southeast corner of the Former Maintenance and Fueling Facility and decrease to the northwest towards the Skykomish River. Groundwater elevations are generally higher during late fall, winter, and spring (November to April) and lower in the summer and early fall (June to early November) (RETEC, 2001).

A 600-foot long subsurface barrier wall was installed in 2001 to intercept the migration of free product towards the river. This barrier wall was designed so that the groundwater levels would not increase by more than 5 inches behind the wall. Monthly fluid levels have been collected from selected wells behind the wall; these levels indicate that groundwater does not appear to be mounding behind the wall, and that groundwater passes under the wall without hindrance.

The former Maloney Creek channel is an intermittent wetland fed primarily by runoff but also occasionally by groundwater influx. The water table is located well below the bed of the channel during seasonal low groundwater levels. During measured seasonal high water levels the groundwater rises to a foot or less below the channel, and it is likely that at times groundwater surfaces in the former creek bed and feeds the channel. The former Maloney Creek channel is discussed further in the surface water section (above) and in Section 2.2.4.

Hydraulic Conductivity

Hydraulic conductivity values, a measure of the permeability of the sand and gravel, have been calculated using laboratory and field tests; these tests have provided hydraulic conductivities between 41 and 84 feet per day (RETEC, 1996). These values are representative of sand and gravels (Todd, 1980).

A clayey silt bed, which is 4 to more than 10 feet thick, underlies the entire site. The top of this silt is present at depths between 10 and 27 feet below the ground surface. The hydraulic conductivity of this unit has not been tested. However, the hydraulic conductivity of a similar clayey silt was measured to be 0.4 feet per day in the RI (RETEC, 1996); this is a representative value for silt (Todd, 1980). Because of the significantly lower hydraulic conductivity, this silt bed impedes vertical groundwater flow within the sand and gravel aquifer and acts as an aquitard.

Groundwater Flow Direction and Gradient

The groundwater flow in the shallow, unconfined sand and gravel aquifer varies throughout the site; however, most groundwater flow throughout the site is horizontal. There is no evidence that preferential channels are present within the site that may affect groundwater flow direction, although silt and clay lenses within the gravelly sand unit can potentially change groundwater flow direction due to the difference in hydraulic conductivity between the silt and the sand and gravel. Groundwater usually has some vertical component to flow; however, the vertical flow is restricted by the silt aquitard.

Groundwater levels collected during several gauging events indicate that the overall flow directions within the site are relatively consistent with time. Figure 2-11 presents a groundwater surface elevation map that was prepared using groundwater levels collected during January and February 2002. East of 4th Street, the groundwater generally flows from south to north, towards the Skykomish River with an average gradient of 0.14 feet per foot (that is 0.14 vertical feet per one horizontal foot). To the west of 4th Street, the groundwater flows from the southeast to the northwest with an average gradient of 0.01 feet per foot (RETEC, 2002a). The hydraulic gradient indicates that groundwater flows at an average rate of 2.5 feet per day (ft/day) (RETEC, 2002a). Groundwater contour maps and additional details on groundwater flow are contained in the Supplemental RI (RETEC, 2002a).

Vertical gradients within the site have been measured using several pairs of wells co-located, but screened at different depths (RETEC, 1996). The measurements show that the gradients are low and do not indicate a strong vertical flow component. The downward vertical gradients are greatest during periods of high groundwater (heavy rainfall) and the lowest gradients have occurred during periods of low rainfall, when groundwater levels are low. This downward gradient is due to rainfall infiltration recharging the groundwater and the effect of the aquitard impeding flow from the overlying sand and gravel to the underlying sand and gravel.

Groundwater Quality

Additional information is provided in Section 3.2.3, which summarizes groundwater quality data collected as part of the Supplemental RI (RETEC, 2002a).

2.2.2.5 Water Supply

No water supply wells are located in the Town of Skykomish. The people of Skykomish are served by two public water supply wells that are located about 1,100 feet east (upgradient) of Skykomish. The primary well is completed to a depth of 216 feet below ground surface (bgs) and is screened across three intervals between 181 and 216 feet bgs. A backup well is located adjacent to the primary well and is completed to a depth of 219 feet bgs. In 1993, the water system pumped an average of 70,000 gallons per day and 2,100,000 gallons per month. Storage capacity was provided by one water tank with a capacity of 220,000 gallons.

2.2.3 Air

2.2.3.1 Climate

The climate of the project region is predominately maritime with cool and relatively dry summers and mild, wet, and cloudy winters. Total annual precipitation is approximately 110 inches per year with an annual average snowfall of 55 inches. Mean average temperature in Skykomish is 49.3 °F. Daily mean high and low temperatures for January are 49.3 °F and 35.8 °F, respectively. Daily mean high and low temperatures for August are 79.6 °F and 68.7 °F, respectively (National Climatic Data Center, Washington State Narrative Summary, 2003).

The influence of semi-permanent high- and low-pressure areas over the North Pacific Ocean dominates winds in the area. Air circulates in a clockwise direction around the semi-permanent high-pressure cell and in a counter-clockwise direction around the semi-permanent low-pressure cell. During the summer, the low-pressure cell becomes weak and moves north of the Aleutian Islands and the high-pressure cell brings a prevailing westerly and northwesterly flow of comparatively dry, cool, and stable air into the Pacific Northwest. Winds in the area are predominately southwesterly to westerly during most of the year. Northeasterly to easterly winds dominate from November to February. Annual average wind speeds are 5.6 knots with peaks of up to 32 knots in the winter months.

2.2.3.2 Air Quality

Air quality is generally assessed in terms of whether concentrations of air pollutants are higher or lower than ambient air quality standards set at levels protective of human health. Based on an ambient monitoring data collected from a network of monitoring stations throughout the region, areas are designated as being in "attainment" or "nonattainment" for particular pollutants.

Skykomish is currently in attainment of ambient air quality standards for all criteria pollutants. This status indicates that the region meets the National Ambient Air Quality Standards (NAAQS) for all pollutants. However, the site is located on the boundary of an area that was designated as nonattainment for ozone until 1996. This area, which incorporates all but the extreme northwest portion of King County, is currently subject to a maintenance plan for ozone approved by the United States Environmental Protection Agency (EPA). The maintenance plan for ozone addresses fuel specifications for mobile sources, inspection and maintenance programs for automobiles, and industry-specific rules. The only significant sources of ozone precursors in the Skykomish area are automobile and train traffic. This project will not be directly affected by the current ozone maintenance plan. The Puget Sound Clean Air Agency (PSCAA) is currently in the process of updating the maintenance plan for the region.

No stationary industrial sources of air pollution have been identified in the proximity of the site. Automobiles travel in the town and on the busier Northeast Stevens Pass Highway (U.S. 2) at the north end of town. Approximately 24 trains pass through Skykomish on a daily basis (Yates, 2003a) and are responsible for diesel exhaust emissions, but they do not routinely stop and idle in town.

Additional information is contained in Section 3.2.6, which summarizes air quality data collected as part of the RI, Supplemental RI and other investigations.

2.2.3.3 Odor

No industrial odor sources are present in Skykomish. Emissions resulting from diesel exhaust from daily trains passing through Skykomish may be a source of odors. Seepages of hydrocarbons have been noted at a number of locations along the Skykomish riverbank. These seepages are the source of hydrocarbon odors along the levee, particularly during low flow conditions and calm winds.

2.2.4 Plants

This section describes the plant life in the Town of Skykomish and at the site. It includes information on the habitats of plants, special plant status, and noxious weeds.

2.2.4.1 Plant Habitat Diversity

The site is located in the western hemlock (*Tsuga heterophylla*) vegetation zone, the most widespread vegetation zone in western Washington (Franklin and Dyrness, 1973). The mild climate of this zone supports growth of productive coniferous forests dominated by Douglas fir (*Pseudotsuga menziesii*), western hemlock, and western red cedar (*Thuja plicata*). Common understory plants include swordfern (*Polystichum munitum*), salal (*Gaultheria shallon*), red osier dogwood (*cornus sericea*) and huckleberry (*Vaccinium spp.*).

The majority of the site is within the developed portions of the Town of Skykomish, consisting of BNSF railyards, and residential and commercial properties. Two small parcels of undeveloped, forested land are adjacent to the site, north of Maloney Creek and at the Maloney Creek outlet. Figure 2-12 shows the habitat types present in the site vicinity. The botanical resources of each of the mapped habitat areas at the site are described below.

Railyard

The railroad yard is an open habitat mostly covered in gravel and sparsely vegetated with grasses and weedy forbs. The area is subjected to high levels of soil and vegetation disturbance, including heavy railroad traffic. It provides low quality habitat for plants.

Residential and Commercial

Habitat in these areas includes buildings, paved roads and sidewalks, paved and graveled driveways, turf grass lawns, home gardens, and a variety of trees and shrubs. Small shrub thickets and young to mature second-growth trees are scattered throughout the area. Weedy non-native species are present along disturbed roadsides.

Skykomish River Flood Control Levee and Shoreline

The south bank of the South Fork of the Skykomish River, which borders the Town of Skykomish, is developed and disturbed to the water's edge along most of its length. Young and mid-successional-aged deciduous trees and scattered patches of shrubs are present along portions of the shoreline. Riparian habitat is poorly developed along the shoreline, as shown on Figure 2-12.

The riprap flood control levee occupies less than 1 acre along the south side of the river (Figure 2-1). Adequate soil is present to support understory vegetation and low density of trees and shrubs along the top and sides of the levee. The northern side of the levee, extending to the ordinary high water line of the river, is dominated by young big-leaf maple (*Acer macrophyllum*) and red alder averaging about 5 inches diameter at breast height (dbh).

Swordfern, Himalayan blackberry (*Rubus discolor*), and giant knotweed (*Polygonum sachalinense*) are present in the understory. The top and southern side of the levee are dominated by grasses and shrubs with a few scattered small trees. Grand fir (*Abies grandis*), black hawthorn (*Crataegus douglasii*), tall Oregon grape (*Mahonia aquifolia*), and snowberry (*Symphoricarpos albus*) are present. Orchardgrass (*Dactylis glomerata*), English plantain (*Plantago lanceolata*), common tansy (*Tanacetum vulgare*), and mullein (*Verbascum thapsis*) are among the common non-native species present at the levee.

Upstream and downstream of the levee, the bank of the Skykomish River is occupied by residences with associated lawns and outbuildings. A few scattered trees and shrubs are present along the riverbank.

Former Maloney Creek Channel

The former Maloney Creek channel is dominated by early to mid-seral deciduous trees and shrubs, with the exception of the culvert inlet site, which is dominated by herbaceous species (see Appendix C). Black cottonwood, red alder and big-leaf maple are the dominant tree species. Red-osier dogwood (*Cornus sericea*) and salmonberry are the dominant shrub species. Native herbaceous species present in the wetland include large-leaf avens (*Geum macrophyllum*), small-fruited bulrush (*Scirpus microcarpus*), piggy-back plant, and common horsetail (*Equisetum arvense*). Non-native species observed at the site include giant knotweed, Himalayan blackberry, and Scot's broom (*Cytisus scoparius*).

The boundaries of the wetland area of the former Maloney Creek Channel are generally discernable, as it is bounded by the railyard area to the north and the Old Cascade Highway and residential development to the south, which have distinct slope breaks. The formal delineation and functional assessment is contained in Appendix C.

The following describes the plant species in the three segments of the former Maloney Creek channel introduced in Section 2.2.2.

- **Upstream Segment**. At the upstream end, the former Maloney Creek channel is confined to a narrow ditch vegetated with grasses, swordfern, salmonberry, and weedy forbs (Figures 2-13 and 2-14). Overstory trees are scattered along the south side of the ditch and include red alder, big-leaf maple, and a few young western red cedar (Figure 2-15). This reach functions as a roadside stormwater drainage ditch.

- **Middle Segment**. The middle section of the historic channel passes through a wetland (see Section 2.2.2, Surface Water Movement, Quantity and Quality). The wetland habitat is dominated by second-growth deciduous trees including red alder, big-leaf maple, and black cottonwood. The understory is dense in places and consists primarily of salmonberry, willow, and weedy species such as giant knotweed and Himalayan blackberry.

- **Downstream Segment**. At the downstream end, the channel is well-defined for a distance of about 400 feet, between the Old Cascade Highway culvert and the confluence with Maloney Creek. Vegetation along the lower section of the historic creek channel is disturbed second growth forest of big-leaf maple and red alder. The sparse understory is composed of salmonberry, vine maple, and sword fern. Residential yards and storage areas impinge in this area.

2.2.4.2 Special Status Plant Species and Habitats

All of the habitats at the site have been disturbed by human activity, such as industrial, residential or commercial development and timber harvest. Native, forested habitat is limited to a small second growth area along the former Maloney Creek channel. This area is disturbed, with a high number of non-native understory species. The site habitats provide low potential for rare plant species, based on the level of current and historical disturbance. No populations of rare, threatened or endangered plant species are known or expected to occur on the site and none have been observed or reported.

The following list the results of research on the special status plant species and habitats for the site:

- A search of the Washington State Department of Natural Resources Natural Heritage Program Database was requested for the site and surrounding areas. No data records for rare plants or high quality ecosystems are present in the database (WDNR, 2002).

- The Washington Department of Fish and Wildlife (WDFW) Priority Species and Habitats database was queried for the presence of priority habitats in the vicinity of the site. Priority habitats are those habitat types or elements with unique or significant value to a diverse assemblage of species. No priority habitats were noted in the database (WDFW, 2003a). Riparian areas along the South Fork of the Skykomish River and Maloney Creek would qualify as priority habitats under the state guidelines. Wetland habitats, such as the wetland within the former Maloney Creek Channel, would also be classified as a state priority habitat.

- The United States Fish and Wildlife Service (USFWS) noted that white-top aster (*Aster curtus*), a federal plant species of concern, has been reported from King County (USFWS, 2003). This species is restricted to grassland habitats in the Puget lowlands; suitable habitat for the species does not occur in the Skykomish area.

- The Town of Skykomish Critical Area Ordinance (CAO) lists the Skykomish River and Maloney Creek shorelines as Primary Fish and Wildlife Habitats. For purposes of this evaluation, the former Maloney Creek channel and associated wetland are ranked as secondary fish and wildlife habitats, based on the lack of documented presence of species listed by the federal government or state of Washington as endangered, threatened, or sensitive (see Section 2.2.6, Fish and Aquatic Resources).

2.2.4.3 Noxious Weeds

Weed control activities on private and state lands in the Skykomish area are managed through the King County Noxious Weed Control Board. Management goals for noxious weeds vary based on weed class: eradication of Class A weeds is required by state law; Class B designated weeds must be prevented from producing seed; and Class B non-designates and Class C weeds may be designated for control at the option of the local weed control board. On National Forest System lands near Skykomish, the United States Forest Service (USFS) administers weed management programs.

No Washington State Class A weeds are known or suspected to occur in the site vicinity. Six species of Class B designate weeds are known to occur in and near the Town of Skykomish (King County 2003a and 2003b):

- Orange hawkweed (*Hieracium aurantiacum*)
- Diffuse knapweed (*Centaurea diffusa*)
- Spotted knapweed (*Centaurea biebersteinii*)
- Dalmatian toadflax (*Linaria dalmatica ssp. dalmatica*)
- Sulfur cinquefoil (*Potentilla recta*)
- Policeman's helmet (*Impatiens glandulifera*)

One species of Class C weed, yellow toadflax (*Linaria vulgaris*), has been recorded in the area.

Orange hawkweed is common along roadsides throughout the Town of Skykomish and in the railyard area. Policeman's helmet is found in moist areas in the southwest side of town between Helen and Thelma Streets. BNSF currently implements management activities for orange hawkweed, diffuse knapweed, spotted knapweed, dalmatian toadflax, yellow toadflax, and sulfur cinquefoil along the rail line in the vicinity of Skykomish.

The USFS weed management program targets three weed species in the Town of Skykomish (USFS, 1999). Japanese knotweed and giant knotweed are present along the Skykomish River corridor and Maloney Creek corridor, and are prescribed for control efforts on National Forest System lands. Scot's broom is present on National Forest System lands along a transmission line corridor that passes through Skykomish. These species are listed as noxious weeds of concern by King County; control of these species is recommended (King County, 2003a).

2.2.5 Wildlife

This section describes the animal life in the Town of Skykomish and at the site. It includes information on the habitats of animals, special status species, and threatened and endangered species.

2.2.5.1 Wildlife Habitat Diversity

Wildlife habitats at the site are affected by ground disturbance, high human activity levels, and urban conditions, and are suitable primarily for wildlife species that are tolerant of these conditions. The wildlife on each of the mapped habitat areas at the site is described below (as illustrated on Figure 2-12).

Railyard

The railyard area receives high levels of human, vehicle, and train activity, and provides low value to wildlife. The grass and weed-dominated site is used primarily by birds and small mammals. Generalist species of disturbed habitats, such as coyote and raccoon, may also use the railyard area on occasion.

Residential and Commercial

Residential back yards in the Town of Skykomish support wildlife habitat for birds and small mammals that use inhabited sites and are tolerant of human activity. Bird species that are expected to be present in the area include, but are not limited to, American robin, house sparrow, Stellar's jay, and starling.

Skykomish River Flood Control Levee and Shoreline

The riparian zone along the south bank of the Skykomish River is of low quality due to the extent of development close to the shoreline. Animals that may use the shoreline habitat include, but are not limited to, common crow, coyote, raccoon, and mink.

Former Maloney Creek Channel and Wetland

The patches of forested and wetland habitat along the former Maloney Creek channel are expected to be used by various birds and mammals, including, but not limited to, towhee, dark-eyed junco, common bushtit, common crow, coyote, and raccoon.

2.2.5.2 Special Status Wildlife

The WDFW, USFS, and USFWS were contacted to determine the presence of special status wildlife species in the vicinity of the Site (Township 26 North, Range 11 East, Sections 26, 27, 33, 34, and 35), the results of the data requests are summarized below:

- **Cascades Frog.** The Cascades frog is a federal species of concern and a state monitor species. In Washington, the Cascades frog occurs at mid-to high elevations in the Cascades and the Olympic mountains (Leonard *et al*., 1993). It is rarely found below elevations of 2,000 feet. The species is most commonly found in small pools in sub-alpine meadows and also inhabits sphagnum bogs, forested swamps, small lakes, ponds, and marshes near streams

  No suitable habitat for Cascades frog is expected to occur in or near the Town of Skykomish at an elevation of 950 feet. No occurrences of Cascades frog were documented in state or federal databases (USFWS, 2003; WDFW, 2003a).

- **Northern Red-Legged Frog.** The northern red-legged frog is a federal species of concern that occurs at low to moderately high elevations in western Washington. It typically uses small ponds, pools, and swamps within forest stands (Leonard et al,. 1993). During the breeding season, the species is most abundant in ponds and pools that are seasonally, rather than permanently, flooded. Red-legged frogs breed in winter, attaching the egg masses weakly to emergent vegetation or underwater branches. Newly metamorphosed frogs, as well as mature adults, are more terrestrial than aquatic, inhabiting shrub and forested areas near permanent water.

  Red-legged frogs were not detected during wetland surveys of the former Maloney Creek Channel in July 2003. This species may occur in the vicinity of the site.

- **Oregon Spotted Frog.** Oregon spotted frog is a candidate for federal listing and a Washington State endangered species. Historically, Oregon spotted frog was present in the Puget trough lowlands from southern British Columbia to northern California and east into the Cascade Mountains in southern Washington and Oregon (Leonard et al,. 1993). Habitat loss, through modification of riparian and wetland habitat, is thought to be a major factor in the population decline. Currently, three populations of Oregon spotted frog are known in Washington State: one in the south Puget Sound, and two in the Cascade Mountains of south-Central Washington (McAllister and Leonard, 1997). One population is known from British Columbia and another 20 populations are documented in Oregon.

  Suitable habitat for Oregon spotted frogs is shallow, emergent wetlands, typically in forested settings (Leonard et al,. 1993). Oregon spotted frogs rarely leave the aquatic environment and are usually found in standing, shallow water with abundant emergent or floating vegetation. No suitable habitat for Oregon spotted frog occurs at the project site or vicinity of the Town of Skykomish. No observations of Oregon spotted frog have been reported in the vicinity of Skykomish (USFWS, 2003; WDFW, 2003a).

- **Tailed Frog.** The tailed frog is a federal species of concern and a state monitor species that occurs in cold, rocky streams from British Columbia to northern California (Leonard et al., 1993). Tailed frogs inhabit cold, rocky streams from low to high elevation, spending several years as tadpoles. Adults are nocturnal and infrequently seen, emerging at night to feed on insects near the stream and in the adjacent forest. Adults can be found in summer, and tadpoles year-round, by turning over rocks in the stream. Tailed frogs do not inhabit ponds or wetlands.

Suitable habitat for tailed frog is not present at the site. The higher gradient reaches of Maloney Creek to the south of the site may support tailed frog. The population status is unknown.

- **Harlequin Duck.** The harlequin duck is a federal species of concern that has been documented to breed upstream of Skykomish along the Beckler River and downstream near the Miller River confluence (WDFW, 2003a). No records of breeding harlequin ducks have been reported along the section of the Skykomish River that borders the Town of Skykomish, or along Maloney Creek. Suitable breeding habitat occurs along fast-flowing streams and rivers with a well-developed, forested riparian zone. The site does not provide this type of habitat. Harlequin ducks may forage and loaf along the section of the Skykomish River that borders the Town of Skykomish.

- **Northern Goshawk.** The northern goshawk is a federal species of concern and a state candidate for listing. Northern goshawk has been documented within 1 mile of the site (USFWS, 2003; USFS, 2003); however, nesting status is unknown (USFS, 2003). Goshawks inhabit mature- to old-growth coniferous and mixed forests, and open woodlands. No mature or old-growth forests are present within the Habitat Assessment Area. Goshawks may occasionally pass through or forage in the Town of Skykomish.

- **Peregrine falcon.** Formerly classified as federally endangered, the American peregrine falcon was delisted in August 1999. The Washington State Status Report for the Peregrine Falcon (Hayes and Buchanan, 2002) notes the falcon is still listed as state endangered, but will likely be reclassified as sensitive in the future. No peregrine falcon nest sites are known to exist in the vicinity of the Town of Skykomish (USFS, 2003; USFWS, 2003; WDFW, 2003a).

- **Pileated woodpecker.** Pileated woodpecker is a Washington State candidate species and a USFS management indicator species. These woodpeckers are closely associated with mature and old-growth forests, using large diameter snags for nesting and roosting. Late- and old-successional forests on the Mount Baker-Snoqualmie National forests provide high-quality habitat for pileated woodpecker. Because of the extent of timber harvest activity near the Town of Skykomish, and the lack of mature forested habitats at the site, use of the site by pileated woodpeckers is expected to be low. Occasional foraging may occur in snag in and around the Town of Skykomish.

- **Pacific Townsend's big-eared bat.** The Pacific subspecies of Townsend's big-eared bat is a federal species of concern, a USFS sensitive species, and a Washington State candidate for listing. The species is an insectivore that inhabits forested regions primarily west of the Cascade Mountains. Townsend's big-eared bats are primarily cavity-dwellers, typically selecting roost sites in caves or abandoned mines; they also use human-made structures such as barns, attics, and bridges, as long as human disturbance is very low (Pierson and Rainey, 1998). They require different sites with specific microclimatic conditions for roosting, hibernation, and reproduction. Caves have reportedly been used as maternal roost sites and hibernacula; bridges have also been documented as maternal sites (Fellers and Pierson , 2002).

  The status of Pacific Townsend's big-eared bat in the Skykomish vicinity is unknown; no occurrences have been reported (USFWS, 2003; WDFW, 2003a).

2.2.5.3 Threatened and Endangered Wildlife Species

The USFWS, USFS, and the WDFW provided information on federally listed, proposed, and candidate wildlife species and Washington State threatened and endangered species that may occur in the vicinity of the site. Three listed species of birds are known to occur in the general vicinity of the site. These species, bald eagle, marbled murrelet, and northern spotted owl, are discussed below. Three listed mammal species, Canada lynx, gray wolf, and grizzly bear, could potentially occur in the site vicinity; however, no suitable habitat for these three mammals is present in the site vicinity and no sightings of the species have been documented (USFS, 2003). These species are not expected to occur in the site vicinity (USFS, 2003; Stinson, 2001) and are not discussed further in this document. A summary of threatened and endangered species is given in Table 2-2.

- **Bald Eagle.** The bald eagle is a federal and state threatened species. Recovery efforts for the bald eagle have been successful in the lower 48 states, including the Pacific region. In 1999, the bald eagle was proposed for removal from the list of threatened and endangered species, as recovery goals had generally been met or exceeded (64 FR36543).

The Skykomish River basin is used by bald eagles primarily during the winter months when spawning salmon are available as a food resource. A winter concentration area is located approximately two miles west of the Town of Skykomish along a tributary to the Skykomish River (USFWS, 2003). Another area of regular winter use by foraging bald eagles is located about a mile northeast of the Site along a tributary river (USFS, 2003).

Bald eagles may roost communally near feeding areas during the winter months. Roost sites are often located in mature or old-growth forest stands in close proximity to feeding areas. A communal night roost is located about one mile west of the Town of Skykomish (USFWS, 2003; WDFW, 2003a).

Bald eagles occasionally use of the South Fork Skykomish River in the vicinity of the Town of Skykomish (USFS, 2003). However, few suitable perch trees are present along this reach of the river, and use of the shoreline is limited. The majority of trees along the riverbank and the flood control levee are red alder and big-leaf maple of about 5 inches in diameter (maximum). These trees are not of suitable diameter and height to support bald eagles or to provide good visibility of the river.

There are no bald eagle nest sites within the Site vicinity (WDFW, 2003a; USFS, 2003).

- **Marbled Murrelet.** The marbled murrelet is a federal and state threatened seabird that nests in old-growth coniferous forests. Suitable habitat for marbled murrelet is present in the Skykomish River basin, primarily within unlogged stands of Douglas fir and western hemlock. In the Project vicinity, critical habitat for marbled murrelet has been designated within Late Successional Reserves (LSRs) designated under the Northwest Forest Plan (USFWS and USDI, 1994 as amended) for the management of northern spotted owl and other old-growth species including marbled murrelets. The LSRs occur exclusively on National Forest System lands.

  No records of marbled murrelet detections were present in the WDFW or Forest Service databases. Few, if any, surveys have been conducted in the Skykomish vicinity (USFS, 2003; WDFW, 2003a). Suitable murrelet habitat is not present within one-half mile of the Town of Skykomish (USFS, 2003).

- **Northern Spotted Owl.** The northern spotted owl was federally listed as threatened in Washington, Oregon, and California in July

1990 (55 FR 26114); it is a Washington State endangered species. Factors that contributed to the federal listing were the declining population trends, the loss of suitable forested habitats throughout the species range, and the lack of adequate regulatory mechanisms to protect existing habitat for the species.

Competition with barred owls may be a factor in the population decline of spotted owls; barred owls have become common in some parts of the Washington Cascades and may outcompete spotted owls for nest-sites and prey in areas where mature and old-growth forests have been fragmented by timber harvest (Dark *et al*., 1998, Herter and Hickes, 2000). Fragmented forest stands with openings in the forest canopy, such as result from clear-cutting and thinning, promote use by great horned owls, a major predator of spotted owls (Johnson, 1993).

Spotted owls are strongly associated with mature and old-growth forests for nesting, foraging, and roosting. Nesting and roosting occur in coniferous forests characterized by moderate to high levels of canopy closure, high density of standing snags, large diameter overstory trees with deformities such as broken tops and witches' brooms, and abundant coarse woody debris on the forest floor (USDI Fish and Wildlife Service, 1987). Foraging occurs in nesting and roosting habitat, and in coniferous forest of younger age and less structural diversity, where key prey species are present. Important forage species of spotted owls in mesic Douglas-fir forests include northern flying squirrel and woodrat species; these species occur at relatively low density and the spotted owl has a correspondingly large home range (USDI Fish and Wildlife Service, 1992).

Critical habitat was designated for the northern spotted owl in 1992 (57 FR 1796). In the project site vicinity, spotted owl critical habitat coincides with Forest Service Late Successional Reserves, all of which are located on National Forest System lands.

The WDFW database shows three spotted owl activity centers representing established territories in the vicinity of the Town of Skykomish (WDFW, 2003a). The site centers of all three territories are over two miles from the edge of town; none of the sites have been surveyed in recent years and the status of the sites is unknown (USFS, 2003). Suitable habitat for spotted owl does not occur closer than one-half mile from the edge of town (USFS, 2003).

It is possible that spotted owls, if present in the basin, could use forested habitats to the north of the South Fork Skykomish River or to the south of Maloney Creek. No habitats within the site are suitable for use by spotted owl.

2.2.6 Fish and Aquatic Biota

This section describes the fish and aquatic life in the water bodies in Skykomish. It includes information on the habitat diversity and threatened and endangered species of fish and aquatic biota.

2.2.6.1 Habitat Diversity

The obvious habitats for fish and aquatic biota at the site are the Skykomish River and the former Maloney Creek channel, which are described below. It should be noted that aquatic habitat and fish populations in the Snohomish Basin (including the South Fork of the Skykomish River) may be limited by natural low-flow conditions. These conditions typically occur in the summer months.

South Fork of the Skykomish River

The Skykomish River channel immediately below the Skykomish River Bridge ranges from approximately 150 to 250 feet wide. The channel gradient in this area averages approximately 27 feet per mile. The channel contains mostly glide habitat, with occasional riffles at lower flows. Larger sections of riffle are present approximately 2,900 feet downstream of the existing levee. Substrate within the channel varies in size from large boulders and cobbles to smaller gravels and sands. Larger boulder substrates are more frequent along the northern portions of the channel, with smaller cobbles, gravels, and sands occurring on a gravel bar adjacent to the southern shore.

Low-velocity shoreline habitat, which provides refuge for migrating juvenile salmonids, is present along the base of the existing levee throughout much of the site. The larger riprap and boulders present along this shoreline reduce flow velocities near the bank by creating eddies where water flows around these larger substrates. Low-velocity areas are also present within the interstices of the larger boulders and riprap.

However, natural low flows within the Snohomish River basin, particularly during the summer months, may limit fish access to low-velocity shoreline habitat areas. These natural low flows may also limit access to pockets of spawning gravels, while also potentially dewatering redds.

Overhanging vegetation present along the shoreline offers refuge from predators for juvenile fish, while helping to reduce water temperatures and increase water quality. In addition, overhanging vegetation provides a food source for juveniles through the deposition of detritus, which is a primary food source for aquatic insect larvae.

Aquatic habitat features present near the site include boulder substrates that provide refuge from high flows, large woody debris that provides refuge from predators, and large holding pools for migrating fish. The Biological Assessment being prepared for the project will describe the aquatic habitat present in the South Fork of the Skykomish River in greater detail.

Former Maloney Creek Channel

The culvert that connects to the downstream segment of the former Maloney Creek channel (wetland) is passable to adult salmonids during flowing periods, as they have been observed at various locations upstream of the culvert (Ecology, 2002b). The channel within the wetland is undefined throughout most of its length, with surface sediment layers dominated by sands and silts overlain with varying amounts of organic debris. Ponding occurs throughout this area. The wetland contains several aquatic habitat features including an invertebrate food source and shading provided by dense canopy cover. Canopy vegetation is dominated by second-growth deciduous trees.

As mentioned above, the Biological Assessment being prepared for the project will discuss the aquatic habitat near the site in more detail.

2.2.6.2 Threatened and Endangered Species

Historically, Sunset Falls presented a barrier to the upstream migration of anadromous fish in the South Fork of the Skykomish River. Anadromous fish access to the upper South Fork has only been possible since 1952, when a trap and haul operation was commenced by the Washington Department of Fisheries at Sunset Falls (DEA, 1999).

Two threatened or endangered species of fish occur in the South Fork of the Skykomish River: Puget Sound chinook salmon (*Oncorhynchus tshawytscha*) and bull trout (*Salvelinus confluentus*). Juvenile chinook would be expected to be present within the South Fork of the Skykomish River near the Town of Skykomish from mid to late February through May. Juvenile bull trout rear in their natal headwater streams, and are not expected to be present within the South Fork. As mentioned above, water levels within the South Fork at this time are such that the shoreline edge habitat is available to juvenile salmonids.

This section only describes Threatened and Endangered species. Coho, a federal candidate species, is discussed below in the section entitled Other Fish.

Chinook

Puget Sound chinook salmon are listed as threatened by the National Marine Fisheries Service (NMFS). They utilize the South Fork of the Skykomish River for spawning, migration, and rearing from the confluence with the North Fork Skykomish River, up to Sunset Falls (WDFW and WWTIT, 1994). Spawning in the upper South Fork basin occurs in suitable mainstem reaches, as well as the lower reaches of larger tributaries, including the Miller, Beckler, Tye, and Foss Rivers (Pentec and NW GIS, 1999).

Chinook life history, presence, and habitat use in the South Fork of the Skykomish River will be discussed in more detail in the Biological Assessment being prepared for the project.

The chinook stock present within the South Fork of the Skykomish River basin is the Bridal Veil Creek fall chinook, which typically spawn from late September through October (USFS, 1999). Juvenile emergence occurs from February to mid-March (Pentec and NW GIS, 1999). Chinook rear in freshwater habitats from several months to a year before emigration.

As described in Section 2.2.2, the substrates within the South Fork of the Skykomish River near the site are dominated by cobbles, with larger cobbles and boulders also present; therefore, large areas of suitable chinook spawning habitat is not likely to be present. However, small pockets of spawning gravels may be present near the site. The nearest large spawning riffle for Chinook is located approximately 2,900 feet downstream of the site. Overhanging riparian vegetation, which is present along the existing levee, provides many important habitat functions for juvenile salmonids (Meehan et al., 1977). Particularly, it increases the quality of the low-velocity shoreline edge habitat for juvenile salmonids by providing refuge from predators, decreasing water temperatures, and increasing production of food resources.

As mentioned in Section 2.2.2, low-velocity river margin areas are present along the base of the levee, containing areas of deeper water adjacent to the shoreline. Flows within the South Fork are typically high enough for juvenile salmonids to utilize this habitat from September to July. In July, the flows decrease to the point where the shoreline edge habitat is dewatered. However, at that time it would be expected that any juvenile salmonids still present would be large enough to occupy areas within the mainstem with higher velocities.

Shoreline edge habitat consisting of larger riprap and boulders offers rearing and refuge habitat to juvenile salmonids, including chinook (Pentec and NW GIS, 1999). The larger substrates slow water velocities near the margins of the streams, allowing juveniles to use these areas for refuge from both high flows and predation, as well as sources of food (Pentec and NW GIS, 1999).

Bull Trout

Bull trout are also listed as threatened by the NMFS. Bull trout in the upper South Fork of the Skykomish River basin exhibit three life history strategies: anadromous (migratory between saltwater and freshwater), fluvial (migratory within river systems), and resident (non-migratory). Bull trout present near the Town of Skykomish are predominantly anadromous, and utilize the South Fork as a migratory corridor, traveling upstream to spawning grounds on the lower East Fork Foss River. However, fluvial and resident bull trout may also be present near the site. Bull trout are opportunistic feeders that prey on a wide variety of organisms. Juveniles utilize terrestrial and aquatic insect larvae, zooplankton, amphipods, and various other invertebrates as a food source. Adults and sub-adults typically feed on juvenile salmonids, sculpin, and whitefish.

Bull trout require cold, clear water and loose, clean gravels for spawning, and prefer habitat with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (WDFW, 1997b). Spawning reaches must contain clean gravels over larger cobbles, with a very low quantity of fines. Bull trout spawning typically occurs from late August through early November, commencing when water temperatures drop below 46 ^{o}F (WDFW, 1998). Preferred bull trout spawning habitat is not likely to be present in the South Fork of the Skykomish River or the former Maloney Creek channel.

Fry typically emerge from the gravel from January through March and April, with juveniles remaining close to their natal headwater areas while rearing (Pentec and NW GIS, 1999). Anadromous bull trout generally leave headwater areas as 2-year olds and migrate to estuarine waters during the spring. During this migration, bull trout are large enough that they do not depend on the low-velocity river margins present within the South Fork.

In addition to bull trout, Dolly Varden (*Salvelinus malma*), a closely related species, may also be present near the site. Dolly Varden exhibit the same life history strategies and habitat requirements as bull trout (WDFW, 1998).

As mentioned above, bull trout life history, presence and habitat use in the South Fork of the Skykomish River will be discussed in more detail in the Biological Assessment being prepared for the project.

Other Fish

There are several other species of fish that may occur in the upper South Fork of the Skykomish River, including coho (*O. kisutch*), pink (*O. gorbuscha*), and chum (*O. keta*) salmon, steelhead (*O. mykiss*) and coastal cutthroat trout (*O. clarki clarki*), pacific lamprey (*Entosphenus tridentatus*), river lamprey (*Lampetra ayresi*), and mountain whitefish (*Prosopium williamsoni*). These species are not listed as threatened or endangered.

The juveniles of the salmonid species would be expected to utilize the shoreline edge habitat of the South Fork of the Skykomish River upon emergence. Juvenile coho, pink, and chum salmon typically emerge from the gravel from late February and early March through April and May. The low-velocity shoreline edge habitat of the South Fork would be used by these species. However, pink and chum generally migrate to estuarine waters immediately after emergence, and would likely only be present for a very short period.

The following describe these other salmonids. Table 2-3 summarizes salmonid presence and timing within the South Fork of the Skykomish River near Skykomish, as well as the former Maloney Creek channel.

- **Coho Salmon**. Coho utilize the South Fork as migratory, rearing, and spawning habitat, generally spawning from late October through January (Pentec and NW GIS, 1999). Coho spawning grounds include appropriate areas of the mainstem South Fork, as well as the lower reaches of Miller, Beckler, Foss, and Tye Rivers. Coho have also been observed in Maloney Creek (White, 2003). They typically prefer spawning habitat similar to chinook; as such, coho spawning habitat is unlikely to be present within the South Fork near Skykomish.

  Coho generally emerge from the gravel from March through May (Pentec and NW GIS, 1999). As with chinook, they would likely utilize the low-velocity shoreline habitat in the South Fork of the Skykomish River from March until June and July while migrating downstream in search of appropriate off-channel rearing habitat.

  The former Maloney Creek channel area contains small, quiet pools with large amounts of organic detritus, which likely offer quality rearing habitat for coho. Coho have been observed in the former Maloney Creek channel, as well as in the main channel of Maloney Creek (Ecology, 2002b).

- **Pink Salmon**. Pink salmon spawn in the upper South Fork basin from mid-September through October in odd-numbered years only, utilizing the mainstem South Fork as well as the Beckler River (Pentec and NW GIS, 1999). Pink salmon have also been documented in Maloney Creek (White, 2003). Pink salmon generally prefer smaller cobbles and gravels for spawning, and therefore would not likely spawn near the site.

  Pink salmon fry emerge from the gravel in March through April, and immediately begin their migration to estuarine waters. Pinks generally only reside in fresh water for 1 to 2 weeks, depending on the length of their seaward migration (Pentec and NW GIS, 1999). However, they may occasionally utilize river shoreline edge habitat for rearing during their migration.

- **Chum Salmon**. Chum salmon are known to spawn in the mainstem Skykomish River as far upstream as Gold Bar (Pentec and NW GIS, 1999). Chum salmon in this area generally spawn from mid-November through mid-January. Spawning information for the upper South Fork of the Skykomish River is scarce, but adult chum have been recorded in the lower reaches of Maloney Creek (Ecology, 2002b). Chum likely spawn in appropriate mainstem reaches along the South Fork of the Skykomish, as well as the lower reaches of larger tributaries. Because of their larger size, chum have similar spawning habitat requirements as chinook. As such, suitable spawning habitat for chum is not likely to be present in the vicinity of the site area.

  Chum fry emerge from the gravel in the spring, usually from February and March into May (Pentec and NW GIS, 1999). As with pink salmon, chum typically do not rear in freshwater, usually residing in freshwater for only a couple of weeks. Limited use of South Fork mainstem rearing habitat may occur during their estuarine migration.

- **Steelhead**. Steelhead use the upper South Fork basin and its tributaries for spawning, rearing, and migration. Summer steelhead spawn from February to April in the lower reaches of Miller, Foss, and Tye Rivers, while winter steelhead spawn from early March to early to mid-June in the lower reaches of Miller, Beckler, and Foss Rivers (Pentec and NW GIS, 1999). Steelhead prefer fast-moving, higher gradient reaches with larger substrates for spawning (WDFW, 1997a). Therefore, the habitat present within the South Fork near Skykomish likely does not contain suitable spawning habitat for steelhead.

  Juvenile steelhead typically emerge from the gravel from June through August. Juvenile steelhead primarily utilize mainstem habitat for rearing, typically overwintering for 2 or more years before emigrating to saltwater (Pentec and NW GIS, 1999). They prefer fast-moving water with larger substrates for rearing, utilizing the areas behind larger cobbles and boulders (WDFW, 1997a). As their emergence time generally corresponds with lower flows and dewatering of the shoreline edge within the South Fork, steelhead likely utilize this habitat for only a short period of time before moving to faster waters.

- **Coastal Cutthroat Trout**. Anadromous coastal cutthroat trout are generally not found above the town of Gold Bar in the Skykomish River (WDFW, 2000). Coastal cutthroat typically prefer slower-moving, lower-gradient streams, and therefore would not likely be found in the mainstem South Fork Skykomish River near the site (Pentec and NW GIS, 1999).

  Fluvial cutthroat trout may be present in limited numbers within the mainstem South Fork and Maloney Creek (WDFW, 2000). Fluvial cutthroat present in mainstem rivers generally migrate upstream to spawn in smaller tributaries and side channels. Fluvial cutthroat in the Snohomish Basin spawn from January through mid-June. Juveniles emerge from the gravel within eight to nine weeks, and generally seek out slow-moving side channels and tributaries (WDFW, 2000).

In addition to the salmonids described above, several other species of fish may be present near the site. Pacific lamprey and river lamprey are both listed as Federal Species of Concern, with river lamprey also listed as a State Candidate species by WDFW (WDFW, 2003c). Both species spawn in gravel in clear streams, with ammocoetes developing in mud, silt, and sand substrates at the bottoms of pools and backwater eddies. In addition, mountain whitefish (*Prosopium williamsoni*), which is listed as a State Species of Concern, may also be present near the site (WDFW, 2003c). Mountain whitefish prefer fast, clear or silty streams, feeding primarily on aquatic insect larvae, mollusks, fish, and fish eggs (Froese and Pauly, 2003).

2.3 Built Environment

This section describes land use plans, public services, environmental health considerations, and transportation. The town and site are described in Section 2.1.

2.3.1 Land and Shoreline Use Plans

This section describes how the Town of Skykomish is zoned in the subsection called Zoning Ordinances. It also describes the CAO, which includes information on shoreline use. Finally, this section describes the housing and demographics of the Town of Skykomish and the aesthetic and historical structures.

2.3.1.1 Zoning Ordinance

The Town of Skykomish is a rural town and is surrounded on all sides by the Mt. Baker-Snoqualmie National Forest. It is divided into five zoning districts: residential, commercial, industrial, historic commercial, and public (Ordinance 235, 1995). The industrial zone of Skykomish consists of the railyard. The historic commercial zone lies north of the railyard along Railroad Avenue between 4th and 6th Streets. There are commercial zones on the north bank of the South Fork of the Skykomish River and south of the railyard.

The remainder of the town is residential with the exception of the public buildings, such as the school, community center, and town hall. There is a public park outside of the city limits on the north side of the South Fork of the Skykomish River, as described below.

The majority of businesses in Skykomish are small retail but also include gas stations, motels, and hotels that cater to local residents and tourists (Town of Skykomish, 1993). Besides the BNSF railroad maintenance activities, there is no other industry in Skykomish. The National Forest Service maintains a depot in Skykomish (Figure 2-16).

The site includes land in each of the five zoning areas, as shown on Figure 2-17. The site includes the historic commercial zone in the downtown area, most of the industrial zone, and most of the public zone. The site covers approximately 230,000 square feet of residential land.

2.3.1.2 Critical Areas Ordinance

A CAO (Ordinance 269, 1998) for the town was adopted by the town council in 1999. The CAO was adopted to designate and classify environmentally sensitive and hazardous areas, including wetlands, fish and wildlife habitats, flood hazard areas, geologic hazard areas, and aquifer recharge areas. The CAO regulates alterations in and adjacent to critical areas to protect natural resource values, public resources and facilities, and public safety. The CAO also meets the requirements of the Washington Growth Management Act (RCW 36.70A) with regard to the protection of critical areas and the Shoreline Management Act (RCW 90.58) with regard to protecting shorelines. The CAO is used to coordinate environmental review and permitting of proposed actions affecting critical areas.

Areas protected under the CAO include the former Maloney Creek channel and wetland, Maloney Creek, and the South Fork of the Skykomish River. The South Fork of the Skykomish River and Maloney Creek meet the definition of Primary Fish and Wildlife Habitat. The former Maloney Creek channel and wetland are ranked for this evaluation as secondary fish and wildlife habitats, based on the absence of documented federal and/or state-listed species. The former Maloney Creek channel and wetland are shown on Figure 2-1. The site of the Skykomish River is considered a "shoreline of statewide significance" with the receipt of water from Beckler Creek, just upstream of the town (WAC 173-18-20).

Areas within the 100-year floodplain are defined as Flood Hazard areas under the CAO. The 100-year floodplain associated with the Skykomish River and Maloney Creek may be seen on Figure 2-9, and is discussed in more detail on Section 2.2.2 under the title "Floods."

The CAO is also the primary regulation applicable to management of activity in and around shorelines. The requirements of the CAO must be met in order to receive a Shoreline Conditional Use permit, a Shoreline Substantial Development permit, or a Shoreline Variance.

2.3.1.3 Housing and Demographics

The majority of housing units in Skykomish are single-family residences (U.S. Census Bureau, 2001). Twenty-six residences lie within the footprint of the site. Some of the residences in Skykomish are mobile homes and approximately one-third of these are used as seasonal residences. The commercial buildings are predominantly small retail but also include gas stations, a church, motels, and hotels that cater to local residents and tourists (Town of Skykomish, 1993). There are 10 commercial buildings on the site.

The most recent census (U.S. Census Bureau, 2001) reports 214 people living in Skykomish of which 29 (13 percent) are under the age of 19. It is estimated that up to 30 seasonal residents live in Skykomish at any time of the year (Dohran, pers. comm., 2003). The decline of the railroad as a primary form of transportation resulted in the loss of railroad-related jobs in Skykomish. Now the USFS is the major employer in Skykomish. Since automotive use has increased, residents of Skykomish have been able to commute to major employment centers and Skykomish has become more accessible to seasonal residents and visitors. The economy of Skykomish is now dependent on tourism and the USFS (Town of Skykomish, 1993).

2.3.1.4 Aesthetics and Historical Structures

Scenic resources in Skykomish include the historic commercial district and the Mt. Baker-Snoqualmie National Forest near the town. The Skykomish School and Teacherage, Maloney's General Store, the Masonic Lodge, and the Skykomish Depot are defined as landmarks of significance of Skykomish and King County. Both Maloney's General Store and the Skykomish depot are listed on the National Register of Historic Places (Skykomish Historical Society). Several of these historic structures are located within the site.

2.3.2 Public Services

This section describes the public services that the Town of Skykomish provides to its citizens. These include schools, parks and recreation, and utilities. In addition, Skykomish provides the following services:

- Fire fighting services through a contract with King County Fire District No. 50. The location of the fire station is provided on Figure 2-16.

- Police protection through a contract with the King County Sheriff (Yates, 2003b).

- Road maintenance including snow plowing and repairing of road surfaces (Yates, 2003b).

The nearest hospital to Skykomish is approximately 40 miles away in Monroe, Washington.

2.3.2.1 Schools

There are no private or charter schools in Skykomish. The Skykomish Elementary and High Schools of School District 404 are located at 105 Sixth Street (Figure 2-16). There are 70 students enrolled in grades K-12 for the 2002–2003 school year. In general, the enrollments of the Skykomish Schools are decreasing. The School District stretches from Index in Snohomish County to the eastern side of Stevens Pass. School buses bringing students to school enter the Town of Skykomish on 5th Street, take a right on Railroad Avenue, and then a right onto 6th Street. The buses turn left at the three-way intersection at the end of the block and turn around (Moore, 2003).

2.3.2.2 Parks and Recreation

Skykomish has one small community park that is south of U.S. Highway 2 and north of the South Fork of the Skykomish River. Access to the park, which includes a baseball diamond, lies approximately half a mile east of the 5th Street Bridge over the Skykomish River. Other nearby recreational facilities include the South Fork of the Skykomish River and neighboring National Forest lands. There are no trailheads or camping grounds within the Town of Skykomish limits nor is there public access to the river on or near the site, although the public can access the river using a path just north of the Skykomish River Bridge across the Skykomish River.

2.3.2.3 Utilities

There are no municipal storm or sanitary sewer systems or wastewater treatment plants in Skykomish. Residents use septic systems consisting of tanks and leach fields to treat and dispose of sanitary waste. The people of Skykomish are served by two public water supply wells that are located about 1,100 feet east (upgradient) of Skykomish, as discussed in Section 2.2.2.

2.3.3 Environmental Health

In this section describes how the built environment of the Town of Skykomish could affect environmental health. Noise, vibrations, and hazardous substances are all factors that could affect environmental health.

2.3.3.1 Noise

Noise can be defined as unwanted sound that is disturbing or annoying. Sound can be objectionable due to pitch or loudness. Pitch depends on the frequency of vibrations that produce the sound. Loudness is the intensity of sound waves. Decibels (dB) measure the relative amplitude of sound. The decibel scale is logarithmic, meaning that an increase of 10 decibels is a ten-fold increase in acoustic energy. The A-weighted sound level (or dBA) gives greater weight to sound frequencies to which the human is ear is more sensitive, as shown on Figure 2-18. Table 2-4 gives descriptions of different levels of sound. Since environmental sounds are often made up of time-varying events, most environmental sounds are described using an average level that has the equivalent acoustical energy as the summation of all the time-varying events.

Noise attenuates in the atmosphere as a function of distance between the receiver and the source. Typically noise is reduced 6 dB for every doubling in distance. Additionally noise is attenuated by intervening structures.

The two main sources of noise in Skykomish are the BNSF railroad that passes through town and traffic along U.S. Highway 2. Stationary idling locomotives exceed 85 dB (the occupational limit) at 30 feet (Union Pacific Railroad, 1999) while a train traveling 30 to 40 miles per hour produces 88.7 dB of noise at a distance of 100 feet (RETEC, 2003c). Approximately 24 trains pass through Skykomish on average each day, but do not regularly stop and idle in town.

2.3.3.2 Vibrations

Train traffic passing through Skykomish is the only significant source of vibrations on a regular basis.

2.3.3.3 Hazardous Substances

The most significant risk of explosion or new releases to the environment on the site is an accident on the railroad or highway. There is an existing potential of exposure to hazardous substances from the subsurface contamination that is being addressed in this FS/EIS. In addition, heating oil is used throughout the town and is stored in underground storage tanks throughout the town. The school also has a diesel boiler.

2.3.4 Transportation

This section describes roads, transportation systems, and traffic through Skykomish.

2.3.4.1 Roads and Transportation Systems

There is no public transportation within Skykomish or to Skykomish now that the railroad no longer stops at the depot in town. U.S. Highway 2 is a federal highway. U.S. Highway 2 goes west from Skykomish to Everett, Washington, and east from Skykomish to Chelan, Washington. Figure 1-1 shows U.S. Highway 2 and Figure 2-16 shows roads in the town.

The Washington State Department of Transportation (WSDOT) maintains the steel truss bridge into town from U.S. Highway 2. The bridge is 102 feet long with 10 feet of clearance (Department of Highways, 1938). There are no posted load restrictions on the bridge.

There are about 3.3 miles of local predominantly asphaltic concrete roads in Skykomish (Town of Skykomish, 1993).

2.3.4.2 Traffic

The average annual daily traffic count for U.S. Highway 2 north of town is approximately 4,750 vehicles (Taylor, 2003). There is limited traffic within Skykomish itself and there are no traffic lights.

2.4 Interim Cleanup Actions and Ongoing Site Maintenance

This section describes the interim cleanup actions and ongoing maintenance of them at the site.

2.4.1 Barrier System

In August 2001, a barrier system was constructed along the West River Road at the site. The barrier system consists of a 600-foot cement-bentonite slurry wall constructed to a depth of 15 feet bgs, and recovery wells. The purpose of the barrier system is to contain and recover free product migrating to the Skykomish River. Free product was present within the levee downgradient of the wall when the barrier system was installed and is being recovered to extent feasible with booms and pads, as described in Section 2.4.2. The barrier wall and booms are not designed to contain all hydrocarbons dissolved in groundwater.

The wall is positioned along West River Road adjacent to the levee. This location was selected to intercept oily seeps and thereby minimize risk to human health and the environment. The length and configuration of the wall is based on the location of product seeps and the free product plume. Because the wall alignment is not perpendicular to the groundwater flow direction, wing walls were constructed for extra protection against free product flow around the downgradient end of the wall and to enhance product recovery throughout the recovery zone (area immediately upgradient of the wall). The barrier wall extends deeper than historical low water levels of about 10 feet bgs. This ensures containment of free products but is not designed to capture petroleum dissolved in groundwater that may migrate beneath and around the wall.

Recovery wells have been installed upgradient from the barrier wall. These wells are screened across the water table and are 6- or 8-inch diameter, stainless steel wells with a 20 slot wire-wound screen. These have been gauged on a monthly basis and skimmer pumps have been installed and are operational in those wells in which free product has been accumulating. The free product is pumped from the wells into subsurface vaults. These vaults are evacuated, as necessary. Figure 2-19 shows the configuration of the recovery wells and barrier wall. The free product between the river and the barrier wall was there prior to the barrier wall construction. This is an ongoing source of free product to the river and is being recovered to extent feasible with booms and pads, as described in Section 2.4.2. Further details are provided in the *Interim Action Completion Report* (RETEC, 2001) and *Phase 2 Interim Action Completion Report* (RETEC, 2003d).

2.4.2 Oil Recovery Booms

Seeps of free product have been observed on the southern bank of the South Fork of the Skykomish River downstream of the Skykomish Bridge. The source of these seeps is free product that was present downgradient of the barrier wall when the barrier system was installed. The oil seeps consist of a dense, thick, heavyweight product with a viscosity similar to bunker C fuel oil. The specific gravity is slightly less than one, thus the product floats to the water surface. Product has been observed in the form of sheens or occasional globules up to 0.5 inch in diameter seeping out of the riverbank with groundwater. To mitigate such seeps while completing the RI/FS, BNSF implemented the boom deployment and mitigation program, described in the Interim Action Plan (RETEC, 1995) and *Boom Maintenance Technical Memorandum* (RETEC, 2002b). Boom deployment and maintenance supplements the oil recovery system and subsurface barrier wall. The current boom maintenance program entails placing oil-absorbent booms along the riverbank year round at the seep locations. These booms are inspected regularly and are replaced, as needed. Single or multiple rows of boom have been used for the free product recovery. Further details are provided in the *Boom Maintenance Technical Memorandum* (RETEC, 2002b).

2.4.3 Dust Suppression Application

Currently, the dust suppressant Soil Sement® is being used at the site to control dust and erosion. Soil Sement® is an environmentally safe non-hazardous polymer emulsion that bonds surface dust and aggregate together into a hard, dust-free, and water-resistant surface. The sealant is applied to reduce dust generation from areas of the railyard that contain elevated concentrations of lead and arsenic. The purpose of the interim action of applying the sealant is to minimize human environmental exposure to the contaminants (lead, arsenic) through direct contact and windblown dust.

3 Nature and Extent of Contamination

In this section, we describe the type of contaminants at the site (nature) and the distribution of these contaminants across the site (extent). The nature and extent of contamination was determined based on data collected for the RI.

Petroleum hydrocarbons are the most widespread and significant group of contaminants in the site. They are present throughout much of the site in soil, groundwater, and sediment. These have been tested for as TPH in the diesel and motor oil range throughout the site. In addition, the hydrocarbon composition and hydrocarbon constituent compounds have been tested from selected samples as polynuclear aromatic hydrocarbons (PAHs); benzene, toluene, ethylbenzene and xylenes (BTEX); and extractable and volatile hydrocarbon fractions (EPH/VPH).

Plumes of free product extend from the railyard northwest to the Skykomish River (Figure 3-1). The free product plumes act as sources for soil contamination and for dissolved hydrocarbons in groundwater. The highest concentrations of TPH within all impacted media typically coincide with the locations of free product. The extent of free product has been more extensive in the past than at present; the areas that typically formerly contained free product, now contain high concentrations of residual TPH and the soil is heavily stained with hydrocarbons. These areas still contain high concentrations of TPH in the soil and groundwater.

Metals, specifically lead and arsenic, are also contaminants within the site. The metals impacts are generally restricted to shallow soil on the railyard, although there are some isolated elevated concentrations of lead in shallow soil in the residential and commercial area north of the railyard

Polychlorinated biphenyls (PCBs) have also been detected in soil at the site in a limited area. These are related to a former substation and transformers on the railyard. They are restricted to the shallow soil on the railyard.

The contamination across the site is present within similar lithologies; however, the methods that may be used to clean it up vary in different parts of the site because of surface constraints and differing cleanup requirements. Figures 6-2 through 6-6 in the Supplemental RI (RETEC, 2002) show the affected lithologies. These cross sections indicate that contamination is predominant within sand and gravel and does not extend far into the underlying silt. Site cleanup zones (Figure 3-2) have been developed for the site to facilitate development and description of remedial alternatives, and designate areas of the site that may be amenable to common treatment technologies. The site has been divided into zones based on land use (railyard, commercial, residential), land type (wetland, levee, upland) and

TPH composition. Based on the above assessment, the following zones were created:

- **Aquatic Resource Zones** – Includes the Skykomish River, the levee and the former Maloney Creek channel

- **Northeast Developed Zone** – Includes land that has been or will likely be developed for commercial or residential use and is affected by petroleum plume primarily composed of diesel fuel

- **Northwest and South Developed Zones** –This includes land that has been or will be developed for commercial or residential use. The smear zone soil and groundwater have been impacted by plumes consisting of a mixture of diesel and bunker C, and isolated elevated concentrations of lead in surface soil.

- **Railyard** Zone – Includes land historically used for industrial purposes and portions of two immediately adjacent residential properties. The soil in this zone has been impacted by petroleum hydrocarbons (diesel and bunker C) in the surface, vadose and smear zone, and by lead and arsenic in the surface soil. Some groundwater within the zone contains dissolved petroleum hydrocarbons and there are some small areas with free product. This land is all owned by BNSF, except for the two residential properties that are owned by James W. Hawkins and Lorna M. Goebel.

The zones are described in more detail in Section 6 and are referred to in the remainder of this section.

3.1 Soil Quality

Soil samples have been collected from locations throughout the site and have been analyzed for petroleum hydrocarbons (TPH-Dx, EPH/VPH, PAHs, and BTEX), lead, arsenic, PCBs and dioxins. The soil samples have been collected to support several site investigations; the most extensive of these was reported in the RI (RETEC, 1996) and in the Supplemental RI (RETEC, 2002a). Details of the other investigations are provided in Section 2 of the Supplemental RI Report (RETEC, 2002a). The soil samples have been collected from several depth intervals ranging from the ground surface to approximately 20 feet below the ground surface. These depth intervals have been defined as the surface, vadose, smear and saturated zones, and are described below.

- **Surface Zone.** The surface zone has been defined as the upper 6 inches outside the railyard and the upper 2 feet in the railyard.

This is the uppermost soil within the vadose zone, however this uppermost interval has been designated as the surface zone to distinguish those impacts that do not extend far below the ground surface. The soil in this zone is unsaturated with groundwater at all times.

- **Vadose Zone.** The vadose zone is located between the surface zone and the smear zone. This zone is located above the water table under normal conditions and consists of unsaturated soil. Contaminants within this zone will migrate vertically downwards under the influence of gravity and will not be transported by groundwater flow. This zone varies in depth and thickness throughout the area. The top of the vadose zone always underlies the base of the surface zone. The base of the vadose zone corresponds to the maximum groundwater levels and the top of the smear zone. This depth averages approximately 4 feet north of the railyard and is approximately 10 feet in the vicinity of the railyard; as a result, the thickness of the vadose zone varies between 2 and 8 feet. In a few low-lying areas and close to the barrier wall, the base of the vadose zone may be as shallow as 2 feet below the ground surface or may even be absent because of high water levels that may intersect the ground surface.

- **Smear Zone.** The smear zone is defined as the range of depths within which the groundwater will fluctuate under normal seasonal conditions, and therefore, in which free product would move and "smear" the soil in response to these seasonal changes in the water level elevation. The smear zone soils may therefore be saturated or unsaturated with groundwater at any given time. In addition to groundwater fluctuations influencing contaminant migration, the contaminants may be transported laterally through the aquifer in the direction of groundwater flow by the movement of groundwater.

  The top of the smear zone varies from a minimum depth of 2 feet near the barrier wall to a maximum depth of approximately 10 feet in the railyard. The base of the smear zone ranges from an approximate depth of 10 feet near the barrier wall and north of the railyard to a maximum depth of approximately 18 feet on the railyard. The thickness of the smear zone varies according to the groundwater elevation and the depth to groundwater; typically, it is 5 to 10 feet thick. In areas where the ground surface is much lower than the surrounding area, the smear zone is closer to the ground surface. The former Maloney Creek channel is an example of this. In the former channel, the depth to groundwater is typically very shallow and may actually be at the ground surface when the groundwater levels are high. Therefore, in the Maloney Creek area, the smear zone may extend to the ground surface

- **Saturated Zone.** The saturated zone is defined as the depths where groundwater is always present regardless of groundwater elevation fluctuations. The top of the saturated zone is the base of the smear zone. Since free product floats on and near the water table, it does not enter the saturated zone. The base of the smear zone is the top of the saturated zone and occurs generally between 10 and 18 feet below the ground surface.

3.1.1 Petroleum Hydrocarbons in Soil

Petroleum hydrocarbons are present within the surface zone, vadose zone and smear zone in parts of the site. Soil samples have been analyzed for TPH (as diesel and motor oil) using methods WTPH-D, NWTPH-Dx, NWTPH-D and EPA Method 418.1. In addition, fractionation data on specific carbon chain-length hydrocarbons were collected from samples at depth using EPH/VPH and selected soil samples have been analyzed for BTEX and PAHs.

3.1.1.1 Total Petroleum Hydrocarbons in Soil

The analyses show that TPH is present in the surface, vadose and smear zones within the railyard. The concentrations of TPH (diesel and oil) in vadose and smear zone soil are presented in Figures 7-2 though 7-6 of the Supplemental RI. In general, the surface and vadose zone impacts coincide with historical railroad operational areas that acted as sources of contamination, although some surface zone impacts were also caused by road asphalt. These operational areas included the fueling station and diesel tank, and areas topographically downgradient from the oil unloader pits, timber oil sump and soil pump house.

TPH is more widespread in the smear zone. Figures 3-3 and 3-4, which show the extent of contamination in the vadose zone and smear zone, respectively, have been revised since the data were presented in the Supplemental RI (RETEC, 2002a) to ensure that the extent of contamination in the soil is consistent with the extent of TPH in groundwater and location of free product. In addition, Figure 3-4 has been revised to provide a conservative estimate of contamination for designing the remediation systems for the site.

In the smear zone, TPH is generally located in areas coincident with the vadose zone impacts and is hydraulically downgradient from those impacted areas. This reflects free product migration with groundwater downgradient (to the northwest) from the former operational areas. The maximum TPH concentrations are 13,400 mg/kg, 30,700 mg/kg and 40,000 mg/kg in the surface zone, vadose zone and smear zone, respectively (RETEC, 2002a –

Table 7-2). No free product was present in the surface or vadose zone during the field sampling. The residual saturation in the vadose zone varies with differences in the lithology throughout the site. These data indicate that the residual saturation on the railyard may be as high as 30,700 mg/kg.

The saturated zone samples indicate that contamination has not been detected in soil more than 25 feet below ground surface. In addition, groundwater samples collected from wells (DW-1 through DW-5) completed below the silt have not contained detectable concentrations of hydrocarbons (RETEC, 1996). This indicates that the silt bed that underlies the site at approximately 15 to 25 feet is an effective barrier to vertical migration of contaminants.

3.1.1.2 Composition of Hydrocarbons in Soil

Diesel fuel and bunker C were historically used on the railyard. As such, the petroleum hydrocarbons present throughout the site consist of these two fuels in varying proportions. Soil was analyzed for diesel and bunker C using the NWTPH-Dx method. The NWTPH-Dx method reports TPH as diesel (C9 to C24) and oil (C20 to C32). Diesel fuel generally includes hydrocarbon ranges C9 to C20 whereas bunker C is a fuel mixture that generally contains both diesel range and oil range hydrocarbons (C9 to C32). Therefore, TPH-diesel analysis will provide the concentration of diesel fuel and/or the lighter hydrocarbons in bunker C within a sample, whereas TPH-oil will only provide concentrations of the heavier hydrocarbons present in bunker C. As a result the relative extents can be determined from the concentrations of TPH-diesel and TPH-oil; TPH-oil is used to assess the extent of bunker C only. Furthermore the ratio of TPH-diesel to TPH-oil indicates the relative proportions of diesel to bunker C within the samples. The diesel: oil ratio varies considerably throughout the site, indicating that the composition is not uniform; this is consistent with visual observations made during collection of the soil samples. These observations showed the product to be an emulsion (or immiscible combination) of bunker C and diesel. The geometric mean of the diesel: oil ratio for all soil samples is 1:1.3; however this ratio varies from a maximum of 10:1 to a minimum of 1:10. The ratio of diesel to oil also varies depending upon the depth from which the soil sample was collected. The geometric mean of ratios from the surface and vadose zones is 0.5, whereas the geometric mean of samples from the smear zone equals one. This indicates that there is relatively more diesel in samples below the high groundwater table than in the vadose zone. Diesel constitutes the lighter weight, more mobile hydrocarbons, and therefore this observation is not surprising.

3.1.1.3 Extractable and Volatile Petroleum Hydrocarbons in Soil

EPH/VPH samples have been collected from soil samples in the vadose, smear and saturated zones both inside and outside the railyard (RETEC, 2002a). These analyses indicate that the petroleum hydrocarbons consist mainly of C12 to C34 carbon ranges for aromatics and aliphatics; this is consistent with the diesel and motor oil range hydrocarbons present at the site, and indicates that both diesel and bunker C are present in these samples. Further details of the hydrocarbon ranges detected in the soil samples are provided in Section 7.1 of the Supplemental RI (RETEC, 2002).

3.1.1.4 Polynuclear Aromatic Hydrocarbons in Soil

PAHs have been reported in soil samples from the site; these are generally reported in the soil samples that contain the highest concentrations of TPH. These samples are in former source areas or in areas within the smear zone with free product or high concentrations of residual petroleum hydrocarbons. All PAHs that have been tested for have been detected in soil samples; the most widespread include acenaphthene, fluoranthene, fluorene and pyrene. Further details, including a more complete discussion of the results, are presented in Section 7.5 of the Supplemental RI.

Benzene, Toluene, Ethylbenzene, and Xylenes in Soil

BTEX compounds are not common constituents of the petroleum hydrocarbons, though low concentrations have been detected. The low BTEX concentrations are not surprising considering that the petroleum hydrocarbons used at the railyard are primarily composed of the heavier-end hydrocarbons, and that the releases occurred at least 30 years ago.

3.1.2 Metals in Soil

During initial investigations, arsenic and lead were identified as the primary metals of concern and are, therefore, the only metals that were subsequently investigated. Samples were collected primarily from surface zone soils; however, several samples were also collected from shallow subsurface soils.

3.1.2.1 Arsenic in Soil

Arsenic (Figure 3-5) is present at concentrations above MTCA Method A concentrations (20 mg/kg) on the railyard. The majority of samples with levels above 20 mg/kg were collected near current and former railyard facilities. The sources of arsenic in soil are not completely understood; arsenic is commonly associated with treated railroad ties and therefore the distribution may be associated with areas in which the ties were stockpiled. Arsenic is also frequently present in sandblasting grit, and therefore the arsenic may be associated with some historic sandblasting operations. Elevated arsenic concentrations have also only generally been detected within samples from the upper 2 feet of soil collected from the railyard. Only one deeper sample (MW-31 at 4 feet bgs) contained arsenic greater than 20 mg/kg; this sample contained arsenic at a concentration of 27 mg/kg.

3.1.2.2 Lead in Soil

Lead (Figure 3-6) is elevated above the site-specific background concentration of 24 mg/kg (as calculated in Appendix D) within some areas of the railyard that coincide with historical railyard operations. On the railyard, elevated lead concentrations coincide with historical operations. The potential sources of lead include sandblast grit, leaded-fuel train exhaust and paint. The maximum lead concentration (3,600 mg/kg) was detected in a surface sample (B-9) from the railyard. Within the railyard, lead concentrations are elevated in the surface soil only. Elevated lead concentrations are present in sporadic surface soil samples from outside the railyard; the sources of this lead are unknown. See Section 4.2.1 for additional details.

3.1.2.3 Polychlorinated Biphenyls in Soil

Low concentrations of PCBs are present near the former transformer pads on the railyard (Figure 3-7). The PCBs are localized in extent and have not been detected anywhere other than close to the site of the historic transformer pads on the railyard. Further details are provided in the *Supplemental RI Report* (RETEC, 2002a).

3.2 Free Product

This section describes the nature and extent of free product. The movement of free product via groundwater through soil is described in Section 4.2.3.

3.2.1 Location and Extent of Free Product

Several discrete areas of free product are present within the site. A site-wide fluid gauging event was conducted in January and February 2002 for the *Supplemental RI*. Figure 3-1 shows the estimated extent of free product throughout the site based on the 2002 measurements. The areas of free product are discontinuous and are present both on and off the railyard. The "apparent" thickness of the free product within the plumes has been as great as 4 feet (in well MW-36); however, it tends to have an average thickness of approximately 0.5 foot (RETEC, 2002a). Between many of these areas of free product are areas of residual product. The lateral extent and location of free product probably changes as a result of water table fluctuations in the smear zone, expanding and contracting within a relatively constant overall area of residual product. This fluctuation also affects the product thickness measured in wells as LNAPL moves slowly with respect to water table changes.

Figure 3-1 also shows areas of suspected free product. No data are available to confirm or refute the presence of free product in these areas; however they have not been included in the areas of known free product based on area soil quality data, groundwater quality data and migration characteristics of the free product.

The largest two free product plumes are present in the northwest part of the site, underlying residential and commercial properties. These two plumes have migrated downgradient from the source areas on the railyard since the original releases, and extend to the northwest and towards the Skykomish River. The migration of free product in the plumes has been curtailed by the installation of the hanging barrier wall in 2001 along West River Road. The rate of migration is slow, as in evidence that the plume is still present within the site, many years after the original releases. The actual rate of migration is not known. Oil was observed seeping into the Skykomish River as early as the 1950s. The data collected by BNSF indicate that some of the product has migrated downgradient from several wells on the railyard since 1993. Further details are provided in Section 8.1.1 of the Supplemental RI (RETEC, 2002a).

Downgradient from the barrier wall, the extent of free product in the levee has not been determined from examination of soils in the levee or soil sample data. However, the locations of seeps in the river bank approximately line up with the plume locations south of the barrier wall; therefore, it is assumed that the plumes extend to the river.

The extent of free product, presented on Figure 3-1, is slightly different from the extent of free product presented in the Supplemental RI. This is based on a more extensive comparison between the fluid-level measurements and the soil and groundwater data, and because fluid levels have been measured from some additional wells (most notably 5-W-5) since the Supplemental RI was completed.

The extent of free product throughout the site appears to have changed with time (RETEC, 2002a). Within the last ten years, free product has been measured in several wells, in the railyard, which no longer contain free product. This suggests that free product has migrated downgradient from an area within the railyard that recently contained free product. The downgradient boundary is largely unchanged; therefore the plume boundaries appear to be shrinking with time (RETEC, 2002a). Conversely, free product has made an appearance in wells (e.g., R-8) close to the barrier wall that previously did not contain free product. However, these wells are relatively close to wells containing product and the overall plume expansion caused by the barrier wall is localized and relatively small.

It should be noted that the rate of migration is relatively slow, and that plume boundaries can fluctuate over time due to changes in the water table, therefore only general assumptions can be made from the product thickness data. The occurrence and thickness of free product has been measured from selected wells on a monthly basis. Table 3-1 presents fluid gauging results from selected wells for 2002 and 2003. These measurements indicate that the thickness of free product in a well may fluctuate over time. Figure 3-8 presents a graph of product thicknesses in MW-36. This shows that the product thickness can vary significantly without showing discernable trends on a monthly basis. Figure 3-8 also presents a hydrograph for the same time period. Comparison of the hydrograph with the product thickness indicates that there does not appear to be a strong correlation between product thickness and fluid levels. With respect to product migration, the rate of change can be measured in years; therefore, the extent of free product can be considered relatively constant for purposes of estimating cleanup requirements.

3.2.2 Physical Properties of Free Product

The predominant types of product used or stored at the railyard were historically bunker C and diesel. Fortnite oil (a kerosene-like product) was reportedly used as a cleaning solution during repair activities that occurred at the maintenance yard from the 1890s to the mid-1940s. In addition, gasoline, and waste oil have been used and stored on the railyard. Free product samples collected at the site are characterized as a mix of diesel and bunker C fuel, consistent with the predominant product types used on the site.

Bunker C is usually blended with lower-molecular-weight fractions, such as diesel, to decrease viscosity and improve flow characteristics. The groundwater contains 43 to 49 percent petroleum hydrocarbons in the diesel range, with the exception of MW-39, which contains approximately 21 percent petroleum hydrocarbons in the diesel range. The free product in well MW-39 consists primarily of bunker C fuel with little, if any, diesel.

Product characteristics have been determined by laboratory analysis of four product samples collected at the site (RETEC, 1996 – Table 6-11). These samples comprise a mixture of diesel and bunker C. The nature of the hydrocarbons in the samples was evaluated using Washington Method WTPH-HCID. Samples were obtained from the river seep near SED-4/SED-5 and from wells MW-22, MW-27 and MW-39, and analyzed for physical parameters including specific gravity, viscosity, surface tension and interfacial tension. The test results are summarized below:

- Specific gravity ranges between 0.9676 (MW-27) and 0.9922 (MW-39). This indicates that the specific gravity is relatively consistent, and that the specific gravity is slightly less than water (Specific Gravity = 1). Therefore, the product will float on water.

- Viscosity at 7.5 ºC (45 ºF) ranges between 1,035 centipoise (cP) (MW-27) to 95,350 cP (MW-39). This indicates that the viscosity varies greatly. This is probably due to the different product composition of the samples. The viscosity of lighter hydrocarbons present in diesel is much lower than the heavier hydrocarbons that are present in bunker C, and the chemical analyses demonstrate that sample MW-39 contains mainly heavier hydrocarbons. The lower viscosities are more typical of the free product present throughout most of the plume area and seeping into the river.

- Surface tension ranges from 33 dynes/cm (MW-22) to 39 dynes/cm (the river seep). Surface tension describes the force required to break the surface of the liquid. The surface tensions of the product samples are relatively consistent and lower than water (72.8 dynes/cm at 20ºC).

- Interfacial tension ranges from 25 dynes/cm (MW-39) to 81 dynes/cm (MW-27). The other two samples contained interfacial tensions of 27 and 49 dynes/cm; this indicates that the value of 81 dynes/cm may be an overestimation since this number exceeds the surface tension of water and is disproportionately higher than the other sample results. Interfacial tension is the force required to rupture the interface between two liquids (in this case, the product sample and water. This varies considerably for the different samples; it indicates that the two liquids will remain fully separate rather than mixing.

3.3 Groundwater Quality

Water has been sampled from shallow screened wells throughout the site to assess the impacts of site contamination on groundwater quality. The most groundwater sampling has been conducted for the Supplemental RI (RETEC, 2002a); this consists of site-wide sampling during January 2002 and January 2003. These groundwater-sampling rounds included samples from approximately 50 monitoring wells, many of which were installed for the Supplemental RI, which have provided the most comprehensive data on groundwater quality for the site. Groundwater samples were submitted for analysis of TPH-Dx. Selected samples were also submitted for analysis of PAHs, BTEX, and/or EPH/VPH. In addition, one sample was submitted for PCB analysis.

3.3.1 Petroleum Hydrocarbons in Groundwater

Groundwater has been contaminated with petroleum hydrocarbons. All groundwater samples have been analyzed for TPH. Groundwater samples have also been collected from selected wells for PAHs, BTEX, and/or EPH/VPH.

3.3.1.1 Total Petroleum Hydrocarbons in Groundwater

TPH in groundwater was analyzed using method NWTPH-Dx. This method reports diesel range (TPH-D) and motor oil range (TPH-MO) organics. TPH-MO is generally not detected in groundwater from the site; therefore, TPH-D represents the extent of TPH contamination in groundwater. Groundwater samples were collected site-wide during January 2002 and January 2003. The January 2002 TPH data are presented in the Supplemental RI (RETEC, 2002a). Figure 3-9 shows the extent of TPH-diesel in groundwater that was measured during January 2003. Table 3-2 presents the TPH data for both sampling events. The TPH-D concentrations from the two sampling events ranged from below detection limit (0.25 mg/L) to 2.6 mg/L in 2002 and 3.33 mg/L in 2003. The highest concentration was present in 2A-W-6 during both sampling events. The highest concentration appears to be in the eastern part of the site. This relates to the eastern free-product plume that contains a higher diesel-to-motor oil ratio.

The TPH-D concentration generally was greatest in or close to the free product plumes in nearby areas that contain high concentrations of residual product. TPH concentrations in the area generally exceed 0.5 mg/L.

3.3.1.2 Polynuclear Aromatic Hydrocarbons in Groundwater

Groundwater samples from selected wells were analyzed for PAHs in January 2002 and in August 2002. The groundwater data (Table 3-3) indicate that concentrations of most PAHs in most groundwater samples were generally below detection levels during both sampling events. Where PAHs were detected, concentrations generally decreased between the two sampling events. The data showed that PAH occurrences are closely related to areas with free product on the railyard. PAHs are not detected in samples collected within 300 feet of the Skykomish River. PAHs may sorb to soil closer to the source and are not as mobile and will not transport as quickly as other chemicals in the plume. This 'partitioning' is another possible reason for the difference in chemical differences across the site.

Fluorene is the most widely distributed PAH, followed by acenaphthene. The data also show a compositional difference between dissolved PAH in the groundwater in the western part of the site and the groundwater in the eastern part of the site. The dissolved hydrocarbons in the western part of the railyard contain elevated concentrations of fluorene and low concentrations of acenaphthene, whereas the dissolved hydrocarbons in the southern and eastern parts of the railyard contain several additional PAHs. The reason for the variations are not fully understood, however the variations are consistent with changes in the hydrocarbon ranges present within the site and probably result from different sources across the railyard.

3.3.1.3 Benzene, Toluene, Ethylbenzene, and Xylenes in Groundwater

BTEX are not significant contaminants associated with the Former Maintenance and Fueling Facility. Groundwater samples from 31 wells were submitted for analysis of BTEX using EPA Method 8020 during the Supplemental RI. The BTEX components were below the detection limits in all samples except for toluene (1.80 µg/L) in MW-11. This is consistent with the BTEX results presented in the Draft RI Report (RETEC, 1996) Groundwater samples were also collected during August 2002 for BTEX analysis (Table 3-4). A comparison of the data collected during the two sampling events indicates that only two groundwater samples have contained BTEX compounds and no consistent trends are evident from the data.

3.3.1.4 Extractable and Volatile Petroleum Hydrocarbons (EPH/VPH) in Groundwater

Groundwater samples collected from 20 wells have been analyzed for EPH/VPH as part of the Supplemental RI. These analysis indicate that they detected fractions are the C10 to C34 aliphatics and C12 to C34 aromatics. EPH/VPH fractions were only detected in groundwater samples from five wells. Only the groundwater sample from MW-39, a well containing free product, contained detectable EPH/VPH in several fractions. EPH/VPH was detected in 2003 but not in 2002 from this well. The discrepancy indicates that free product may have been entrained in the 2003 sample whereas no free product was entrained in the 2002 sample. Furthermore, most of the EPH/VPH results from this well and the others report hydrocarbon fractions greatly above their respective solubility limits. This implies that, where detected, EPH/VPH in groundwater results from the presence of entrained free product in the groundwater samples.

3.3.1.5 Metals in Groundwater

The extent of elevated metals concentrations in groundwater has been evaluated in previous studies (RETEC, 1996; RETEC, 1997). These previous studies concluded that metals are not significant site groundwater contaminants, and that the metals appear to be at background concentrations.

3.3.1.6 Polychlorinated Biphenyls in Groundwater

PCBs were not detected in any wells during the 1996 RI. Thirteen wells located in the vicinity of previous PCB detections in soil or other areas of potential concern were sampled quarterly for PCBs. In 1993, PCBs were detected in well MW-32 at a concentration of 0.11 µg/L (Aroclor 1254). Groundwater samples from MW-32 were tested for PCBs during two quarters of the RI sampling and during the Supplemental RI; PCBs were not detected.

3.3.1.7 Physical Chemistry of Groundwater

For the Supplemental RI (RETEC, 2002a), groundwater samples from selected wells were analyzed for dissolved oxygen (DO), oxidation-reduction potential (ORP), pH, turbidity and temperature. The DO data indicate that dissolved oxygen concentrations from samples from wells within areas of known contamination or hydraulically downgradient from these areas (with the exception of MW-44, located west of the barrier wall) are below the detection limit of the field measurement instrument. Dissolved oxygen concentrations in groundwater samples that are not from areas with petroleum hydrocarbon contamination ranged from 0.2 to 5.4 mg/L, which is within the range of typical concentrations of dissolved oxygen in groundwater.

The lowest ORP values are generally present in wells in the vicinity of the railyard. Low ORP values can indicate anaerobic or anoxic conditions often seen in contaminated groundwater. Higher values are present in the wells in the western portion of the site, with the highest value in MW-44.

The pH, turbidity, conductivity, and temperature of groundwater were measured in the field during the Supplemental RI. A summary of the results is provided below.

- pH was 5.02 to 6.47 standard units
- Turbidity was 1.7 and 20.5 Nephelometric Turbidity Units
- Conductivity was 37 to 268 micromhos per centimeter (µmhos/cm)
- Temperature ranged from 2.8 to 8.6 ºC

Additional details are provided in the Supplemental RI (RETEC, 2002a).

3.4 Sediment Quality

There are two separate areas of sediment within the site, as described in Section 2.2.1. These are along the south bank of the Skykomish River and along the former Maloney Creek channel. The sediment quality in these two areas is summarized below.

3.4.1 Skykomish River Sediment

Sediment has been impacted by free product seeps and dissolved groundwater fractions entering along Skykomish River. This has resulted in high TPH concentrations (maximum TPH of 87,000 mg/kg) at the identified seep locations. The TPH concentrations decrease rapidly away from the actual seep locations and data indicates that impacts extend no more than ten feet into the river, and often considerably less.

Sediment along the bank of the Skykomish River has been sampled for the RI and the Supplemental RI (RETEC, 1996; RETEC 2002a). In addition, sediment samples were collected during 2002 for additional sediment bioassays; these samples were analyzed for TPH, EPH/VPH, BTEX, and PAHs. Figure 3-10 shows the extent of TPH in the sediment along the bank of the Skykomish River. The results from this testing and a more complete discussion of the sediment sampling are presented in Appendix B.

3.4.2 Former Maloney Creek Sediment

As part of the Supplemental RI additional investigations were conducted in the former Maloney Creek channel and in adjacent areas. Figure 3-11 presents a longitudinal transect from sample 3-SD-1 downstream of the culvert to 2B-SD-6 immediately downstream of the upper road culvert and five transverse transects. The profiles show that the fine-grained sediment is limited in vertical extent, and that although TPH is present within the shallow sediment, higher concentrations are present in the underlying sand and gravel. The contamination data is summarized on Figure 3-11 in two ways: (a) impacted (visual, odor, sheens, or product) soil noted during the drilling is indicated by cross-hatching, and (b) TPH-T (diesel and lube oil range) values from collected samples in the intervals indicated next to the boring.

The transects indicate that the following distinct segments can be identified in the former Maloney Creek channel, based on differences in topography and lithology. These areas are described in Section 2.2.2 and are summarized below.

1) An upstream segment with a steep gradient in which the channel is narrower and channelized between steeper banks, and essentially is a drainage ditch for the Old Cascade Highway and surrounding residential areas. This section contains silty sand (possibly older fill material) in the surface layers. The sample 2B-SD-6 is located at the point were the drainage ditch widens into a marshy swale.

2) A middle segment encompassing samples 2B-SD-5, 2B-SD-4 and 2B-SD-3. This area has a gentle gradient and wider profile and one to three feet of silty sediment typically overlays the alluvial sands and gravels typical of the area. This area is wooded and marshy, with slower water flow and presence of side channels and marshy swales. The section narrows just south of 2B-SD-5 by a private residence and adjacent yard. A pool area is present on the western end of this segment containing samples 2B-SD-2 and 2B-SD-1. At 2B-SD2 gravelly alluvial material reaches the surface and may represent an old riffle area with steeper slope. Downstream of 2B-SD-2 a deeper scour or plunge pool is present behind the road culvert. The plunge pool is filled with a foot of silt overlying 5 feet of silty sand. The pool area is marshy and open, lacking tree growth.

4) A segment downstream of the 5th Avenue/Old Cascade Highway culvert. This portion is a steeper, scoured channel, with limited accumulation of fines. This area has the characteristics of a creek. Sample 3-SD-1 was collected here.

Groundwater gauging data indicate that groundwater levels are located well below the bed of the channel during seasonal low groundwater levels. During measured seasonal highs the groundwater typically rises to within a foot of the channel, and at times groundwater may surface in the former creek bed. This is significant because it indicates that hydrocarbons that are typically contained in the sand and gravel that underlies the former channel may in some areas also affect the shallow sediment contained within the channel (i.e. the sediment is within the groundwater smear zone).

Low concentrations of TPH, up to 48 mg/kg, were detected in sediment from the upper segment.

The middle segment of the former Maloney Creek channel is underlain by contaminated sand and gravel in the smear zone below the surface sediment. This contamination in the smear zone is continuous with the affected property, and is similar in concentration, type, and hydrogeological characteristics to that found in the surrounding soils. In general, contamination is greater in the sand and gravel beneath the surface sediment and does not appear to be significantly impacting the sediment near the ground surface. This is illustrated on Figure 2-5, where it can be noted that visibly impacted subsurface soil is generally confined to the deeper gravel layers, as is the situation in the adjacent railyard. Near-surface concentrations of TPH are notably lower than in the visibly impacted deeper layers. This suggests that there appears to be no upwards transport component of contaminants in most of the former Maloney Creek channel.

However, in the area around 2B-SD-5, substantial contamination is present close to the ground surface, particularly immediately adjacent to the private residence at location 2B-B-4. This is the only area where the subsurface smear zone extends into the silty depositional material. This contamination could be due to smearing of underlying contamination in groundwater or possibly from historic drainage into the channel through an oil drain immediately upstream of 2B-SD-5 (Figure 2-2).

The lower segment (pool area) upstream of the culvert contains moderate contamination (500 mg/kg TPH) in the depositional surface layers. This area functions as a sink for contaminated sediment from upstream, as evidenced by the deep layer of sedimentary material at this location. Deeper sediment shows declining concentrations, indicating that older, historical releases, if any, are not resulting in significant deleterious impacts. No high concentrations of TPH indicative of residual contamination remaining from the time when active discharge occurred to the channel are present.

The channel section downstream of the culvert contains some contamination with TPH immediately downstream of the culvert, however the lower section is generally scoured free of fine-grained sediment, and therefore contamination is unlikely to accumulate in this area for extended periods of time.

The hydrocarbon composition provided by EPH/VPH data (RETEC, 2002a) indicates that the TPH is similar to that found elsewhere throughout the site, with heavier aliphatics and aromatics typical of diesel and motor oil range hydrocarbons (TPH-MO) predominant. PAHs were detected in the smear zone of the former channel, where TPH concentrations are highest; however, PAHs are generally absent from the surface sediment and underlying sediment (0 to 2.5 feet). Note that although surface sediment is defined as the top 10 centimeters, sample collection consisted of a composite of the top 2.5 feet, and is here used as an estimate for the surface sediment. BTEX is absent from the sediment, which is consistent with the soil and groundwater quality in this area. Metals (arsenic and lead) were consistent with background concentrations. PCBs were not detected within the sediment at quantitation levels generally in the 0.1 mg/kg range or less (RETEC, 2002a).

3.5 Surface Water Quality

Site groundwater recharges the two surface water bodies in the study area: the South Fork of the Skykomish River and occasionally the former Maloney Creek channel. Free product seeps migrate slowly into the river throughout much of the year, and groundwater with dissolved petroleum hydrocarbons flows into the river. The river level seasonally varies with flow. There are generally two high and low flow periods each year. One of the periods of high flow generally occurs in November through early March, the other high flow period occurs between May and July during runoff from snowmelt.

Seeps have not been observed during high flow conditions. This is probably largely because the seepage face is submerged under several feet of fast flowing river water. The seeps are also likely to be less during times of high water because the hydrostatic pressure from the higher river water would form resistance to seepage, and the water would also lower the temperature of the product and increase the viscosity, resulting in more limited product mobility.

During low water conditions, the riverbank is typically dry and there are either pools of water close to the bank or low flowing water. The seeps are more noticeable during these times and product seeps may lead to sheens on the water close to the bank, or accumulate in pools of low/no flowing water. Booms have been placed and maintained along the riverbank as an interim cleanup action, to contain the product close to the actual seep locations. Absorbent pads are used to clean up seeped petroleum. Surface water samples were collected from seven locations in the Skykomish River, Maloney Creek and the former Maloney Creek channel on four occasions during the RI (RETEC, 1996). Surface water samples show that there are generally no impacts to surface water in the Skykomish River, Maloney Creek, or the former Maloney Creek channel. (Table 11-15, RI Report)

Surface water temperature, pH, DO and conductivity were collected as part of the RI sampling (RETEC, 1996). These data indicate that the water in both the South Fork of the Skykomish River and the former Maloney Creek channel is neutral to basic (6.6 to more than 10 standard units [su]), has relatively low conductivity (22 to 338 µmhos/cm), and is well oxygenated (greater than 9 mg/L DO). No significant differences were noted between the river readings and those from the creek.

3.6 Air Quality

Air monitoring was conducted during drilling and excavations for the RI (RETEC, 1996: RETEC 2002a). This monitoring indicated that vapors from petroleum hydrocarbons have not adversely impacted air quality. This data demonstrates that there is no significant potential for migration of volatile compounds to the air from impacted soil and groundwater. During health and safety monitoring for the Supplemental RI, readings of total volatile organics taken during sampling were consistently non-detect in the breathing zone, with the exception of one reading of 0.5 parts per million (ppm) during sediment sampling. Volatile organics were only detected at appreciable levels during hollow-stem auger drilling of boring B-10, and from the top of the casing during air rotary drilling of boring B-7.

In most cases, detected values correspond to wells with measurable free product accumulations. Only four compounds have estimated air concentrations that total greater than 0.00001 mg/kg, including mercury, 2-methylnaphthalene, butyl benzyl phthalate, and xylenes.

Indoor air sampling was performed under the 1993 Agreed Order with Ecology in six buildings between 1997 and 1999. Samples were analyzed for an extensive suite of VOCs by EPA Method IP-1A and SVOCs by EPA Method IP-7. Indoor air was sampled in response to requests by Skykomish residents. The Washington State Department of Health (WDOH) in its "Health Consultation" dated August 30, 1999 concluded that 'exposure to contaminants detected in indoor air over the seven sampling events are not at concentrations expected to pose a health threat' and that 'there were no apparent public health hazard from exposure to contaminants detected in any of the locations' and communicated this conclusion to the public by issuing an "Environmental Health Update" in June 1999 (WDOH, 1999) and presenting their findings at a public meeting in Skykomish.

3.7 Summary of the Nature and Extent of Contamination

The following summarize the conclusions of the nature and extent of contamination:

- The most common contaminant at the site is petroleum hydrocarbons. These have been measured as TPH, PAH, BTEX and EPH/VPH.

- It is estimated that several plumes of free petroleum product are present at the site. These plumes are present on the railyard, in residential and commercial areas, and along the riverbank as free product seeps through portions of the riverbank west of the Skykomish River Bridge.

- The highest concentrations of petroleum hydrocarbons in soil, groundwater and sediment are typically present in the same location as free product.

- Petroleum hydrocarbons are present in the surface and vadose zone in historical source areas on the railyard and limited areas off the railyard. These areas may contain high TPH concentrations in the surface zone and vadose zone soil, but do not always coincide with the highest concentrations of TPH in smear zone soil.

- TPH is more widespread in the smear zone, and is typically found in both the soil and groundwater. This distribution is due to migration of petroleum hydrocarbons as free product with groundwater downgradient from the original source areas.

- Free product has migrated to the Skykomish River and is seeping through the banks into the river. The impacts to sediment in the Skykomish River appear to be restricted primarily to those seep locations.

- Shallow sediment in the former Maloney Creek channel, adjacent to the railyard, has been impacted. The shallow sediment in the creek is underlain by sand and gravel with high TPH concentrations similar to the condition observed in surrounding smear zone soils. The sediment contamination may result from smearing from the underlying soil at times of high groundwater levels.

- Elevated concentrations of lead and arsenic are present in some soil on the railyard. These concentrations are restricted to the surface zone soil.

- Lead and arsenic are not elevated in groundwater.

- There are some isolated areas with lead in surface soil in the residential/commercial area north of the railyard. The source(s) of this lead are unknown.

- PCBs have been detected in surface soil from portions of the railyard. The PCBs are generally present in the vicinity of the former substation and old transformer pads.

- PCBs have not been detected in smear zone soil or in groundwater anywhere throughout the site.

3.8 Indicator Hazardous Substances

This section selects indicator hazardous substances for purposes of defining site cleanup requirements. Indicator hazardous substances are the compounds found at the site that are most prevalent and comprise the greatest risk to human health and the environment at the site. Also, by focusing site cleanup on these compounds, the majority of the risk at the site is eliminated.

MTCA allows for the elimination "from consideration those hazardous substances that contribute a small percentage of the overall threat to human health and the environment. The remaining hazardous substances, or indicator hazardous substances (IHSs) can be implemented at sites that are contaminated with a large number of hazardous substances" for monitoring during "any phase of remedial action for the purpose of characterizing the site or establishing cleanup requirements for the site" (WAC 173-340-703). The use of IHSs in development of a final remedy for this site is appropriate, because from the large number of chemicals, only a few have been detected commonly and only a few contribute to a significant overall threat. The RI (RETEC, 1996; RETEC, 2002a) was designed to investigate the presence and distribution of all hazardous substances at the site.

The data collected for the RI has been subjected to a rigorous screening process to develop the list of IHSs for the Skykomish site. Note that TPH is considered an IHS for all media, and was not subjected to the screening process. Details of the analysis are presented in Appendix D. This information is summarized below by medium and in Table 3-5:

- In addition to TPH, soil at the site has eight IHSs: arsenic, lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene and indeno(1,2,3-cd)pyrene.

- In addition to TPH, the sediment has the following four IHSs: lead, benzo(a)anthracene, benzo(b)fluoranthene and chrysene.

- The groundwater IHSs consist of TPH, benzo(a)anthracene, chrysene and fluoranthene.

- Surface water does not contain any IHSs as such, other than TPH; however, since groundwater discharges to surface water and groundwater must be protective of surface water, the IHSs for groundwater will also apply to surface water for purposes of developing cleanup levels in Section 5.

The distribution and movement of IHSs is summarized in Section 4, as part of the Conceptual Site Model.

4 Conceptual Site Model

Data collected during the RI, Supplemental RI and interim actions provide information necessary to understand the nature and extent of contamination and potential exposure to human health and the environment at Skykomish. This section of the FS/EIS synthesizes the available data into a conceptual model of contaminant occurrence, movement, and potential exposure. The conceptual site model presented herein is primarily qualitative in nature and serves to translate available physical, chemical, and biological data into an accurate narrative and graphical representation of site conditions. The model serves as a useful aid to the development of cleanup standards and cleanup action alternatives that are the subject of forthcoming sections of the FS/EIS.

4.1 Source Characterization

There are no continuing sources of hazardous substance releases at the site. All existing contamination derives from historical releases that occurred during operation of the Former Fueling and Maintenance Facility (from 1893 to 1974). Historical releases (e.g. spills, leaks, discharges) from storage facilities and former fueling and maintenance activities are the presumed primary sources of contaminant release. A search of historical records revealed no documentation of fuel or other contaminant releases.

Figure 2-2 shows three generally contiguous source areas (Maintenance, Fueling, and Electrical Substation/Sandblasting), defined on the basis of historical records of structures and known operations. The three areas are all located east of 5th Street between the existing rail lines and the former Maloney Creek channel.

4.2 Indicator Hazardous Substances and Impacted Media

The conceptual site model focuses on contamination of soil, groundwater, surface water and sediment arising from releases of metals (primarily arsenic and lead) and petroleum fuels (Table 4-1). The analysis of all hazardous constituents detected at the site (see Section 3.3) demonstrates that risks to human health and the environment are dominated by these contaminants.

In Section 5, cleanup levels are ultimately established for metals, petroleum hydrocarbons, select PAHs and the more updated IHSs detected at the site (e.g., PCBs). However, near-surface metal deposits within the railyard and the magnitude and impact of petroleum fuel releases, are the central driving force behind the development and evaluation of cleanup action alternatives presented in this FS/EIS.

With the exception of near-surface soil, the IHSs at the site are TPH and the PAH associated with the TPH residues. The TPH is relatively free of volatile contaminants (BTEX) that are common to lighter fuels (e.g., gasoline). Surface soil (0 to 2 feet bgs) is considered separately from deeper soil in this analysis because metals are found predominantly only in surface soils.

The following sections demonstrate how the IHSs listed in Table 4-1 have or have not migrated from their source.

4.2.1 Metals

The nature and extent of metals contamination at the site were described extensively in Section 3.1.1. Lead and arsenic are the only metals IHSs at the site. Moreover, soil is the only medium that contains metals above background and IHS screening levels. The distribution of metals is largely confined to the railyard where potential sources resulted from railyard operations such as coal-burning locomotives, sandblasting, use of lead-containing fuels, painting and other metal-producing activities. Consistent with these near-surface source activities, metal impacts are confined to surface and near-surface (less than 5 feet bgs) soil. Further, there are no observable groundwater impacts from these near-surface metal deposits. This suggests that dissolution of metals into surface water and infiltration of surface water to groundwater is not detrimental to groundwater quality.

Soil sampled off the railyard contained occasional and sporadic detections of lead and arsenic above background. The source(s) of this lead and arsenic is unknown.

4.2.2 Total Petroleum and Polynuclear Aromatic Hydrocarbons

The nature and extent of TPH and PAH contamination at the site were described extensively in Section 3. The source(s) of these contaminants were releases of petroleum fuels during operation of the former fueling and maintenance facilities. While these sources no longer exist, the resulting impacts to soil and groundwater quality require an assessment of exposure risks (Section 4-4) and development of cleanup standards (Section 5).

A continuing impact of the historical petroleum releases on soil and groundwater quality results from the presence of free and residual product in the subsurface. Free product (oil) discharges to the river are observed at a number of seep locations opposite the levee and west of 5th Street. The residual product (i.e., that which does not appear as a distinct separate layer or move as a separate phase under the influence of gravity and groundwater flow conditions) serves as a secondary source of petroleum hydrocarbons that dissolve in groundwater, which ultimately discharges to the river. Therefore, knowledge of the characteristics and behavior of free and residual product and its interaction with groundwater and soil is important to understanding current site conditions.

4.2.3 Characteristics and Behavior of Free and Residual Product

LNAPLs or "light nonaqueous phase liquids" can describe both free (mobile) and residual product. MTCA defines LNAPL as a "hazardous substance that is present in the soil, bedrock, groundwater or surface water as a liquid not dissolved in water." LNAPLs derived from petroleum fuels are complex mixtures of organic (carbon-based) molecules with slight solubility in water. The term "light" refers to the density of petroleum liquids as typically being less than that of water. The term "nonaqueous" refers to the fact that petroleum liquids are not miscible with water (i.e., they do not mix with and fully dissolve in water to form a single phase). Instead, LNAPL exists as a separate phase in contact with water and soil particles. LNAPL at the Skykomish site is derived from releases of petroleum fuels (primarily diesel and bunker C fuel oil) used at the Former Fueling and Maintenance Facility.

The general character and behavior of free and residual product in the subsurface environment is illustrated on Figure 4-1. MTCA defines "free product" as LNAPL "present in the soil, bedrock, groundwater or surface water as a distinct separate layer" and "capable of migrating independent of the direction of flow of groundwater or surface water." The figure graphically depicts contaminated and uncontaminated soil conditions. Product releases that reach the water table remain near the groundwater table because the density of the free product is less than that of water. As the water table fluctuates seasonally the free product is "smeared" vertically across the soil in the fluctuation interval. The buoyancy of product in water inhibits LNAPL migration below the seasonal low water table.

Petroleum hydrocarbons and water share soil pore space (Figure 4-1). This sharing limits product mobility and complicates its recovery from the subsurface. Released product migrates downward through the subsurface under the influence of gravity. Above the smear zone, volatile product components, where present, separate into soil gas and form vapor plumes local to the release. This is not a significant concern at the Skykomish site based on empirical data obtained from indoor air sampling during seven sampling events at six residences and structures throughout town (refer to Section 5.2.1.4 for additional discussion). Upon reaching groundwater, the product spreads laterally and begins to dissolve into groundwater, thereby forming the dissolved-phase plume (Figure 4-1(5)). Typically, dissolved-phase plumes attenuate via biological processes over short distances (e.g., a few hundred feet) (Wiedemeier et al., 1999). Over extended periods of time, the most soluble compounds weather out of the product, leaving behind a mixture of low-solubility compounds that collectively have a relatively high viscosity. The viscosity of product samples taken from the site is very high (Table 4-2) compared with values typical of diesel and bunker C fuel oil.

The soil medium within which product exists is physically described as a porous medium consisting of solids (e.g., soil grains) and void space (soil pores). The void spaces in soil contain water (Figure 4-1(1)). Above the water table (vadose zone) air coexists with water in the pore space. Water is preferentially attracted to the solid surfaces, forms a continuous wetting phase about the soil grains, and fills the smaller pore spaces. Thus, water occupies the margins of the pore space, leaving the remaining central portions filled with air (a non-wetting fluid).

Released product flows downward through the vadose zone as a non-wetting phase that partially displaces air between soil particles (Figure 4-1(3)). Water remains on the particles as a continuous wetting phase. If the release is of sufficient volume (as was the case at the Skykomish site), the product will reach the groundwater table. Here, the free product displaces water from the interior regions of the soil void or pore space (Figure 4-1(4)). Selective entry of free product into larger pores reflects the fact that it is physically easier for free product to displace water from large pores than smaller pores.

Initially, product occurs in the smear zone as a continuous network of interconnected pores that contain product (Figure 4-1(4)). The product is surrounded by water that forms a continuous liquid phase about the solids. Product does not float above groundwater as suggested by the analogy of oil floating on water in a tank. Instead, product is largely submerged and its movement is constrained by the pressures needed to displace water from the pores at the margins.

Water and product coexist in the pores under different pressures. The difference in pressure between the product (non-wetting phase) and water (wetting phase) is defined as capillary pressure. Capillary pressure is a result of the two liquids (water and product) having different densities. This property governs the distribution and potential mobility of product in groundwater. The greater the pressure in the non-wetting phase (e.g., LNAPL), the more fully the pore space is filled (saturated) by the non-wetting phase.

The fraction of pore space occupied by product decreases over time as the volume of product is depleted. Depletion occurs from the volumetric movement of free product in the direction of groundwater flow and attenuation processes such as dissolution. With depletion, free product flow paths become smaller and more tortuous. This reduces the ease with which free product can move (mobility). Ultimately, the free product then breaks into isolated blobs and ganglia that are discontinuous and immobile as a separate liquid phase (Figure 4-1(6)). The saturation or concentration at which product is immobile is referred to as residual saturation.

Residual product is present wherever free product has come into contact with soil. Thus, source areas where releases occurred and areas in the path of free product migration contain residual product. Residual product is "trapped" in the soil pores by capillary pressures and will not flow under the influence of gravity or groundwater flow.

Residual product is immobile but may remain a source of dissolved contaminants in groundwater. In the smear zone, soluble fractions of petroleum are dissolved and mobilized from the residual product until an insoluble residue remains. This is different than residual product left in the vadose zone that will not move under the force of gravity. Residual product in the vadose zone is also subject to dissolution, but because the smear zone is below the groundwater table some of the time, the dissolution is likely to be greater within the smear zone.

The threshold at which product becomes mobile (free product) is called the residual saturation concentration. This concentration depends on the physical properties of the product and the soil. A site-specific determination of residual saturation concentration is not available. MTCA provides a default assumption of 2,000 mg/kg for residual saturation of diesel and fuel oils, but the literature and site-specific conditions suggest that the residual saturation for diesel and fuel oil at this site is substantially higher and may exceed 10,000 mg/kg. For example, soil TPH concentrations in excess of 30,000 mg/kg are found adjacent to monitoring wells that contain no free-phase LNAPL (see Section 3). The site-specific MTCA residual saturation value (2,000 mg/Kg) is not appropriate for this site.

4.2.4 Influence of the Barrier Wall on Free Product

The barrier wall constructed parallel to the Skykomish River in August 2001 was part of an interim action to block free product from entering the river. The barrier wall extends from near the ground surface (above the water table) to below the seasonal groundwater table. The free product, which tends to move with groundwater, is thereby prevented from moving further downgradient towards the river and is collected in recovery wells. Seeps observed since the barrier wall construction are attributable to free product that existed between the barrier wall alignment and the river before construction.

The barrier wall was constructed to allow groundwater to flow around and beneath the wall, but prevent downgradient movement of free product. In the absence of product removal, mobile free product is expected to accumulate behind the barrier wall.

Groundwater generally flows in a northwesterly direction along most of the barrier wall. Groundwater elevation and flow direction near the wall have been largely unaffected by the barrier wall. Therefore, mobile free-phase LNAPL should continue to migrate toward the wall and recovery wells.

4.2.5 Dissolved Petroleum Hydrocarbons Groundwater

Both residual and free product are sources of groundwater contamination at the site. Individual chemical constituents of product dissolve into the passing groundwater in accordance with chemical and physical properties of the product and soil at this site. In the absence of natural degradation, these properties control the distribution of TPH constituents dissolved in groundwater. Once released into groundwater, the dissolved TPH constituents are subject to natural attenuation, such as resorption to soil particles, volatilization, dispersion, dissolution and biodegradation.

The data show that dissolved-phase TPH in groundwater is distributed very similarly to TPH in soil. The data also show that dissolved contaminants in groundwater attenuate rapidly with distance from free product and residual LNAPL in soil. This is consistent with the generally accepted understanding of petroleum LNAPL dissolution and attenuation as reported in the literature.

4.3 Conceptual Model Summary

Figure 4-2 provides a physical conceptualization of impacts to the site. The figure summarizes and integrates existing knowledge of site geology, hydrogeology and contaminant distribution as previously discussed in this and previous sections of the FS/EIS. The figure is a cross section of the town from the Old Cascade Highway south of the railyard to the river north of the railyard. The geology is generalized based on information from boring logs. The seasonal high and low groundwater table defines the region labeled as the "smear zone."

Petroleum releases in former maintenance and fueling areas at the site deposited fuel (product) on the ground surface. The product migrated vertically downward into the subsurface under the influence of gravity. While a portion of the product accumulated within soil pores above the groundwater table (vadose zone) and ceased moving (residual), the releases were of sufficient volume to migrate to the water table. Further vertical movement of product through the water table was precluded by the density differential between water and the product. Consequently, the free product spread in the upper horizon of the water table both laterally and in the direction of groundwater flow. Over time and under the influence of the prevailing hydraulic gradient, free product migrated in a north to northwesterly direction beyond the railyard boundary to the Skykomish River where seeps of free product are currently observed. These seeps resulted in sediment impacts near the south embankment of the Skykomish River where groundwater recharges the river.

Residual hydrocarbon contamination in the vadose zone is restricted to the railyard where petroleum fuel was originally released and migrated from the surface vertically to the groundwater table. Free product is mainly found downgradient of the railyard, where it has migrated towards the river under the influence of groundwater flow. Groundwater in contact with free and residual product in soil becomes contaminated by dissolution of hydrocarbon constituents into the dissolved phase. The plume of dissolved-phase hydrocarbon contamination migrates downgradient, eventually entering the river and impacting surface water and sediment quality. Data indicate that the dissolved hydrocarbon plume attenuates rapidly with increasing distance from areas of free and residual product in soil and that removing free product from the soil and groundwater will protect surface water. Subsurface soil underlying the former Maloney Creek channel are composed of sand and gravel, generally overlain by a thin layer of silt. The former Maloney Creek channel area consists of a deeper smear zone continually hydrologically connected to surrounding soils to the north and south of the wetland, and a shallower zone with intermittent hydrologic contact with the surrounding soil. The deeper sand and gravel is contaminated with high concentrations of TPH, however, the biologically active portion of sediments within the wetland (upper 10 cm) is largely unaffected except during very high groundwater conditions. These sporadic, high groundwater events may introduce contaminants from underlying smear zone soil into shallow wetland sediment, but if this does occur it appears to result in concentrations <500 mg/kg in the biologically active zone.

Downstream bedload transport of sediment occurs during periods of heavy surface runoff. At these times, contaminated sediment may be mobilized and trapped upstream of the culvert. This is the likely source of the contamination noted in the surface sediment in this area. Sediment trapped here has filled in an old plunge pool. The decreasing concentrations at depth in older, deeper sediment suggest that the hydrocarbon contamination degrades or dissociates from the sediments over time.. Discharges from the period of railyard operations when oily contamination was evident in the channel are no longer present in the former Maloney Creek channel or its associated wetlands.

4.4 Exposure Assessment

This section identifies potential human and ecological exposures to contaminated media at the site. Consistent with the purpose of the RI/FS (WAC 173-340-350(1)), the goal of this section is to identify exposure scenarios to assist in the selection of a cleanup action. Cleanup actions developed in this FS/EIS must "protect human health and the environment (including, as appropriate, aquatic and terrestrial ecological receptors)" (WAC 173-340-350(8)(c)(i)(A)). In order to evaluate cleanup actions, the cleanup standards must be determined. As outlined in WAC 173-340-700(5), in order to set the cleanup standards applicable to cleanup actions, the following issues must be determined:

- Nature of the contamination
- Potentially contaminated media
- Current and potential land and resource uses
- Current and potential receptors
- Current and potential pathways of exposure

The nature of contamination and impacted media were described previously in Section 3. This section determines current and potential receptors and pathways of exposure, based on current and potential land and resource uses. Figure 4-3 is a conceptual site model illustrating potential exposure pathways present at the site.

4.4.1 Current and Potential Land and Resource Uses

Cleanup levels must derive from reasonable maximum exposures, defined as the "highest exposure that is reasonably expected to occur at a site under current and potential future site use" (WAC 173-340-708(3)(b)). This section identifies the current and future potential uses of resources where contaminated media are known or suspected to be present. The resources under consideration here are land, groundwater, surface water and sediment. The land resource may be divided into railyard and off-railyard areas.

4.4.1.1 Railyard

The railyard property is currently zoned industrial. This zoning designation (King County) is in accordance with land use planning under chapter 36.70A of the RCW (Growth Management Act). The railyard is currently used as industrial property by BNSF, and the most likely future use of the property is industrial. Trespassing is prohibited on the railyard and the general public is only permitted to cross the yard using the public right-of-way (Fifth Avenue). In response to the community's request, BNSF recently installed a fence along the former Maloney Creek to reduce trespassing from the residential areas south of the yard. The BNSF railyard property is "industrial property" fur purposes of GMA and MTCA (RCW 70.105D.030(2)(f) and WAC 173-340-200).

4.4.1.2 Off-Railyard – Developed Property

The current land uses of impacted off-railyard properties are residential, commercial (restaurants, hotels, stores), municipal (town offices and garages), and educational (Skykomish School). Some of the properties (notably the town garages) may meet the requirements for designation as industrial property. However, for the purposes of this exposure assessment, the highest beneficial use of the developed properties off of the railyard is assumed to be residential. In addition to human health, ecological receptors must be protected as part of cleanup actions.

4.4.1.3 Off-Railyard – Undeveloped Property

Undeveloped property exists to the south of the railyard along sections of the former Maloney Creek channel and along the south bank of the Skykomish River. These areas of undeveloped property are generally wooded. The narrow strip along the Skykomish River serves as part of the King County Department of Natural Resources flood-control dike for the Skykomish River. Future development in this area is unlikely.

A portion of the former Maloney Creek channel and surrounding wooded areas exist off railyard property. There are no known development plans for this area, and due to the proximity of this land to the railyard and other residences, no development is foreseen. However, the highest potential land use for these areas remains residential.

As these areas currently are vegetated with non-cultivated plants, and may support animal life, they are potential habitat for ecological receptors as discussed in Section 2.

4.4.1.4 Groundwater

Groundwater contaminated with TPH and PAHs exists under the railyard and both developed and undeveloped off-railyard properties. Generally, the highest beneficial use of groundwater is as a source of drinking water (WAC 173-340-720(1)(a)). However, shallow groundwater in the impacted area of the Skykomish site is not a current source of potable water in Skykomish, nor will it likely be used as a source of potable water in the future.

WAC 173-340-720(2) sets forth criteria for determining whether the highest beneficial use of groundwater is potable water. Of these criteria, two are met at this site.

- ***The groundwater does not serve as a current source of drinking water* – WAC 173-340-720(2)(a).**

  Shallow groundwater is not currently used as a source of potable water in Skykomish. The public water supply wells for the Town of Skykomish are located approximately 0.5 mile upgradient of historic site operations and are screened about 200 feet bgs in fractured rock, presumably at the surface of the bedrock layer underlying the uppermost alluvial aquifer.

- ***The department determines it is unlikely that hazardous substances will be transported from the contaminated groundwater to groundwater that is a current or potential future source of drinking water at concentrations that exceed groundwater quality criteria* WAC 173-340-720(2)(c), WAC 173-200).**

  As stated above, current drinking water wells for Skykomish are located upgradient of the impacted groundwater plume. Based on gauging performed over at least 10 years, groundwater flow in the upper aquifer underlying the site is consistently toward the Skykomish River. Locally reversed gradients along the shoreline were observed during two pre-RI gauging events (October 1990 and December 1991). This is most likely due to transient increases in water levels in the river; the reversed gradient extended only slightly into the residential area near the river – approximately 100 to 150 feet. Further, based upon our knowledge of groundwater flow in river basins, it is correct to assume that groundwater flows toward the river.

  In addition, the drinking water wells are screened to approximately 200 feet bgs. Five deep (35 to 40 feet bgs) monitoring wells have been installed at the site; none of these have ever had detectable levels of TPH. Well DW-5, located near the recovery system and screened below the LNAPL layer, has been sampled 10 times between 1993 and 1997; TPH has never been detected. Based on this data, the plume of dissolved TPH attenuates within a short distance (less than 25 feet) below the LNAPL plume. Therefore, because the drinking water wells are located upgradient of site impacts and are screened much deeper than any known groundwater contamination beneath or downgradient of the site, it is impossible that hazardous substances in groundwater underlying the site would be transported to the vicinity of the public water supply wells.

WAC 173-160-171(3) provides an additional regulatory requirement that makes the use of groundwater in the vicinity of the Skykomish site unlikely. WAC 173-160-171(3) requires that wells shall not be located within certain minimum distances of known or potential sources of contamination, including septic systems. The minimum setback specified in WAC 173-160-171(3)(b) is 50 feet from a septic tank, septic holding tank, septic containment vessel, septic pump chamber, and septic distribution box and 100 feet from the edge of a drain field. It is estimated that the commercial and residential portions of the site all meet this criteria, as the town uses septic systems for wastewater management. These regulatory requirements, along with the availability of public water supply, make use of shallow groundwater in the vicinity of the site as a potential source of drinking water highly improbable.

Other potential users of groundwater are industry, businesses and agriculture. In order to extract groundwater for these uses, groundwater wells are required. There are no known existing groundwater extraction wells for agriculture in Skykomish, nor are there industrial processes with high water demand which may desire groundwater extraction to support these processes. Siting for wells to be used for industrial, commercial, and agricultural is also required to meet the setback requirements in WAC 173-160-171(3). As such, there is no current or reasonable potential future human use of groundwater in Skykomish. However, since the criterion listed in WAC 173-340-720(2)(b) is not applicable to the site, in cannot be determined that groundwater is not a potential future source of drinking water.

Despite the unlikelihood of human use of groundwater in Skykomish, cleanup actions for groundwater in Skykomish must prevent direct or indirect violations of surface water, sediment, soil, or air cleanup standards (WAC 173-340-720(1)(c)). As groundwater discharges to the Skykomish River and, at times, to the former Maloney Creek channel, highest beneficial use of these water bodies must be protected; that is, groundwater must be protected as a potable water source.

4.4.1.5 Surface Water

WAC 173-340-730(1)(a) states that cleanup standards for surface water (Skykomish River and Maloney Creek) are "based on estimates of highest beneficial use and the reasonable maximum exposure expected to occur under both current and potential future site use conditions." WAC 173-201A defines the Skykomish River as a Class AA river. Characteristic uses of Class AA rivers include water supply (domestic, industrial, agricultural), stock watering, fish and shellfish, wildlife habitat, recreation (primary contact recreation, sport fishing, boating, and aesthetic enjoyment), commerce and navigation. As discussed above, the water supply for Skykomish comes from wells upgradient of the town, not from the Skykomish River. However, this does not preclude downstream use of the river for any of these purposes.

4.4.2 Potential Receptors

For the purposes of this exposure assessment, receptors and receptor activities are identified based on the highest beneficial use of each resource, as required in WAC 173-340-708(3)(b). This section discusses receptors that may be present at the site, based on the beneficial uses identified in the previous section, and observed land and water uses in the Skykomish area.

4.4.2.1 Residents

The highest beneficial use of the railyard is industrial. However, trespassers have been observed on the railyard and have the potential to contact surface soil. Trespassers are assumed to reside on the railyard only briefly (in transit across the railyard) and are typically not frequenting areas where access is limited by fencing.

Residential use is the highest beneficial use of property off the railyard. Current and future residents of the Town of Skykomish may garden or landscape in the surface soil (i.e., off railyard property), and may have basements that extend into the impacted subsurface soil. Residents do not typically excavate to subsurface soil.

4.4.2.2 Industrial Railyard Workers

Industrial railyard workers are typically not engaged in construction work that would involve excavation on the railyard. However, these workers may directly contact surface soil during day-to-day maintenance activities.

4.4.2.3 Construction and Utility Workers

Construction and utility workers engaged in excavation work on or off the railyard have the potential for exposure to surface soil, subsurface soil, and groundwater.

4.4.2.4 Recreational Users of the Skykomish River

Humans use the Skykomish River for recreational purposes, such as rafting, kayaking, fishing, and boating. Thus, the potential exists for human receptors to contact contaminated surface water and sediments of the Skykomish River, and to ingest fish from the river.

4.4.2.5 Terrestrial Ecological Receptors

Under WAC 173-340-7490(2), a terrestrial ecological evaluation must be performed unless conditions allowing exclusion of such evaluation are met. Ecology has determined that a site-specific terrestrial ecological evaluation must be performed. A terrestrial ecological evaluation is in progress, and a screening level literature review will be submitted under separate cover. If it is determined that site-specific cleanup levels must be developed to protect terrestrial organisms, it is anticipated that would require 6-8 months. BNSF continues to dispute that a terrestrial ecological evaluation is needed for this site. The existing residential areas of Skykomish are not "contiguous undeveloped land" under WAC 173-340-7490(1)(c)(ii).

4.4.2.6 Ecological Receptors in the Skykomish River

The Skykomish River is habitat for fish, shellfish, and sediment-dwelling organisms, as discussed in Section 2.2.6. These are the most sensitive users of the surface waters near the site. Other potential downstream receptors (e.g., water users) encounter very low contaminant concentrations, due to the dilution that occurs within the river. Downstream receptors typically involve larger organisms (i.e., livestock), which tend to be less sensitive to low-level contaminant exposures. Cleanup actions to protect in-stream organisms will protect downstream water users.

4.4.2.7 Ecological Receptors in Former Maloney Creek Channel/ Wetlands

Ecological receptors in wetlands are present in and around the former Maloney Creek channel. Fish use the wetland and ditches connected to the wetland. The wetland characteristics, habitat and potential ecological receptors are characterized in Section 2.2.6 and Appendix C.

The same assumptions cited above for the Skykomish River apply to the former Maloney Creek channel. The ecological receptors in the creek are considered the most sensitive receptors, and scenarios evaluating these receptors will adequately address potential impacts to other downstream receptors.

4.4.3 Transport Mechanisms

Figure 4-3 depicts the mechanisms (shown with purple arrows) by which contaminants (summarized in Section 4.2) can be transported and thereby lead to a potential exposure to the receptors described in Section 4.4.2. These mechanisms are summarized below.

4.4.3.1 Surface Soil to Water

Contaminants in surface soil may be mobilized (dissolved or sorbed to soil particles) by stormwater. The stormwater may then infiltrate to groundwater, or may travel over the surface, generally to storm drains, which in turn, lead to the Skykomish River.

4.4.3.2 Free Product to Water

Free product moves in the direction of groundwater flow under potentiometric forces (i.e., hydraulic gradient). Contaminants enter the dissolved phase of groundwater after leaching from soil or free product or following infiltration of contaminated stormwater. The dissolved phase contaminants are then transported with the movement of groundwater. Groundwater at the site moves toward, and discharges to, the Skykomish River.

4.4.3.3 Soil, Groundwater, and Free Product to Indoor Air

Contaminants sorbed to surface soil (e.g., on the railyard) can be transported by wind. Wind-blown transport of lead and arsenic from soil to air is a complete exposure pathway, and will be evaluated further in this document. As shown on Figure 4-3 and discussed in Section 3.6, volatilized contaminants may be present in ambient air or may accumulate in confined spaces. See Section 2.4.3 regarding interim actions being taken by BNSF to control dust.

4.4.4 Potential Receptor Exposures

This section discusses the potential for receptors to encounter IHSs via one of the exposure or transport mechanisms identified previously. Figure 4-3 depicts these potential receptor exposures (highlighted in green).

4.4.4.1 Industrial Worker Exposures (on Railyard)

Routine railyard industrial workers are typically engaged in maintenance work and have the potential for contact with contaminated surface soil on the railyard. Direct contact, inhalation and incidental ingestion are the potential means of industrial worker contact with surface soil. Exposure to volatilized contaminants in outdoor air is considered to be insignificant, based on empirical data (Section 5.2.1.4). Railyard industrial workers are unlikely to be involved in excavation work that could lead to contaminated subsurface soil and groundwater exposures. Further, exposure to contaminated storm water flow is considered a negligible exposure pathway.

4.4.4.2 Construction and Utility Worker Exposures (On and Off Railyard)

Construction and utility workers may be exposed to contaminated surface soil, subsurface soil and groundwater while excavating. Direct contact, inhalation and incidental ingestion are the potential means of worker contact with these contaminated media. Exposure to volatilized contaminants in outdoor air is considered to be insignificant, based on empirical data (Section 5.2.1.4). Exposure to contaminated stormwater flow is considered a negligible exposure pathway.

4.4.4.3 Residential Exposures

Residents of the Town of Skykomish may contact contaminated surface soil off the railyard via direct contact or inhalation of soil transported off the railyard by wind. Exposure to volatilized contaminants in indoor air is considered to be insignificant, based on empirical data (Section 5.2.1.4). Residents who enter the railyard (trespassers) and come into contact with surface soil have the potential for occasional and very minor short-term exposures to surface soils. Residents who conduct redevelopment work on their homes may be exposed to contaminated subsurface soils, groundwater, vapors and free petroleum product. However, deep excavation work is typically contracted out to commercial workers.

4.4.4.4 Terrestrial/Ecological Exposures

Terrestrial receptors have the potential for exposure to contaminated groundwater at the riverbank, where groundwater discharges to the Skykomish River. Deep roots of plants or terrestrial receptors drinking water near the potential groundwater discharge locations in the Skykomish River or former Maloney Creek channel may ingest groundwater.

Groundwater may recharge the former Maloney Creek channel during prolonged periods of heavy precipitation coupled with a rise in groundwater table. During these conditions, aquatic organisms have the potential to come into contact with contaminated groundwater.

4.4.4.5 Recreational User Exposures

Recreational users of the Skykomish River have the potential to come into contact with contaminated groundwater and free product at the riverbank (direct contact and incidental ingestion) where groundwater discharges to the Skykomish River. Further, recreational users of the river may contact surface water that has been impacted by contaminated groundwater (and free product LNAPL) discharges to the river. Exposure to contaminated surface water further away from the riverbank is a minor risk as the fast-moving surface water flow quickly dilutes the upland discharges to inconsequential contaminant concentrations.

4.5 Summary

The information presented in this section serves as the foundation for development of cleanup standards and cleanup action alternatives under MTCA. As presented in Section 5, cleanup levels are developed for the IHSs based on their potential for migration to other media and for exposure to various human and ecological receptors.

Figure 4-3 illustrates the complete human and ecological conceptual site model. This figure illustrates how the IHSs can potentially affect human health and ecology by migrating through soil, stormwater, groundwater, and surface water to potential receptors. In summary, complete exposure pathways are summarized in the following sections by media. They are summarized by media because cleanup levels are developed for each receptor by media in Section 5.1. The cleanup actions that will mitigate these exposure pathways are described in the following sections of this report.

4.5.1 Soil

The following human populations have the potential for exposure to soil:

- Industrial Worker (on railyard) to surface soil
- Construction and Utility Workers (on and off the railyard) to surface and subsurface soil
- Residents (on railyard) to surface soil

- Residents to subsurface soils (off the railyard while excavating)
- Residents (on and off railyard) through the soil to outdoor air transport mechanism

In addition,

- Terrestrial receptors have the potential for exposure to soil.
- IHSs in soil can migrate to groundwater; therefore, cleanup levels are developed in Section 5 for concentrations of soil that protect groundwater.

As such, in Section 5, cleanup levels are developed for human health, ecology, and soil concentrations that protect groundwater.

4.5.2 Groundwater

The following summarize potential receptors to IHSs in groundwater:

- Construction and Utility Workers (on and off the railyard to groundwater while excavating)
- Residents (off the railyard to groundwater while excavating)
- Receptors to sediment due to the transport mechanism of groundwater to sediment
- Aquatic receptors to surface water due to the transport mechanism of groundwater to surface water
- Recreational users of the Skykomish River and Maloney Creek due to the transport mechanism of groundwater to surface water

As such, in Section 5, cleanup levels are developed for human health, groundwater concentrations that protect sediment, and groundwater concentrations that protect surface water.

4.5.3 Sediment

The potential receptors to IHSs in sediments are biota that dwell in, and feed on and from, the sediment.

4.5.4 Surface Water

No IHSs other than TPH have been detected in surface water; however, surface water (specifically Skykomish River and Maloney Creek) directly affects recreational, terrestrial, and aquatic receptors. To ensure that the health of these receptors is protected, groundwater IHSs are used to calculate cleanup levels for these receptors.

Cleanup levels are developed for human health and ecological receptors in Section 5.

5 Cleanup Standards

MTCA provides the framework for evaluating and selecting cleanup actions, as described in Section 1.1. Within this framework are threshold requirements that must be met by all cleanup actions. The threshold requirements for cleanup actions, as defined in WAC 173-340-360(2)(a), are to:

- Protect human health and the environment
- Comply with cleanup standards
- Comply with applicable state and federal law
- Provide for compliance monitoring

Other MTCA requirements for cleanup actions, as identified in WAC 173-340-360(2)(b), are to use permanent solutions to the maximum extent practicable, to provide for a reasonable restoration time frame, and to consider public concerns raised on the draft cleanup action plan during the public comment period. WAC 173-340-360(2)(c) through (h) identifies additional minimum requirements for cleanup actions. SEPA requires Ecology to consider the adverse environmental impacts of cleanup alternatives and to incorporate mitigation measures to offset these impacts.

The potential for human health and ecological exposures to the IHSs at the site were evaluated in Section 4. This section develops cleanup standards for the site that protects these human health and environmental receptors. This section also identifies the state and federal laws that are applicable to the site and cleanup actions at the site. Adverse environmental impacts and mitigation measures are described in Section 7.

As described in Section 1.1, under MTCA, cleanup standards consist of the following:

- The concentration of a hazardous substance that protects human health and the environment (cleanup level)

- The location on the site where the cleanup level must be attained (point of compliance)

- Other regulatory requirements that apply to a cleanup action because of the type of action and/or the location of the site

Each of these is discussed below. Subsequent sections of this FS/EIS identify and evaluate alternative means of achieving site cleanup.

5.1 Indicator Hazardous Substances

IHSs in addition to TPH were identified through a detailed screening process, as described in Section 3.8 and Appendix D. The IHSs applicable to different media, in addition to TPH, are also summarized in Section 3.8 and include lead, arsenic, and PAHs. Cleanup standards are developed later in this section for comparison to site concentrations, and in many cases the cleanup levels will be the same as the screening levels used to select the IHSs in Appendix D.

5.2 Cleanup Levels

Cleanup levels under MTCA are defined as the concentrations of hazardous substances that are protective of human health and the environment under exposure conditions (e.g., the exposure scenarios developed in Section 4). Cleanup levels are developed for IHSs in media that pose a threat to human and ecological receptors, as summarized in Section 4.4. The relevant IHSs were identified in Section 3.8 and Appendix D for soil, groundwater, sediment, and surface water.

MTCA provides three methods for developing cleanup levels for soil, groundwater and surface water:

1) Method A defines cleanup levels for 25 common site chemicals and is generally designated for routine cleanups

2) Method B determines cleanup levels at sites using a site-specific risk assessment with cancer risk levels established at 10^{-6} for individual carcinogens and 10^{-5} for total site risk, and non-cancer risk at or below a hazard index of 1

3) Method C determines cleanup levels for specific site uses (i.e., industrial) using site-specific risk assessment when Method A and B levels are technically impossible to achieve

Since the cleanup for the site is not considered routine, Method A values will not be used for this site. Method B cleanup levels are applicable to all sites and will be used at this site. Although the railyard is zoned for industrial use, the off-railyard areas are zoned residential, commercial, municipal, and educational; therefore, Method C will not be used for off-railyard areas. Method B will be used to develop cleanup levels for soil at off-railyard areas and for groundwater and surface water for all areas of the site, and Method C will be used for soil at railyard areas.[1]

[1] Method C criteria will be developed for the railyard and incorporated in the Cleanup Action Plan.

MTCA also requires that cleanup levels for each media be at least as stringent as the concentrations established under applicable state and federal law. The applicable state and federal standards for each media will be identified in the following subsections. Figure 5-1 illustrates the general approach to setting Method B cleanup levels at the site.

Sediment cleanup standards are defined under MTCA in WAC 173-340-760, which requires compliance with WAC 173-204 (Sediment Management Standards [SMS]). Under WAC 173-204-520(1)(d), freshwater sediment cleanup screening levels and minimum cleanup levels are determined on a case-by-case basis consistent with the intent of the SMS, which is to "eliminate adverse effects on biological resources and significant health threats to humans" (WAC 173-204-100(2)).

Cleanup levels are set for soil, groundwater, sediment, and surface water. For each of the environmental media, potential exposures to human health and the environment were evaluated in Section 4. Those exposures include the potential migration of IHSs from one media to another. For example, soil cleanup levels must not only protect the people who may come into direct contact with the soil, but also ensure that the ground water cleanup levels are not exceeded. For each of those potential exposure pathways, including the exposure to other media, protective concentrations must be developed (refer to Figure 5-1 for the relationship between cleanup levels in the various media). The cleanup level is the most stringent of those concentrations.

5.2.1 Soil

As summarized in Section 4.4, cleanup levels are developed for human and ecological (terrestrial) receptors in this section. In addition, cleanup levels are developed for soil for two transport mechanisms: soil to groundwater and soil to air. The soil cleanup levels are established in accordance with WAC 173-340-740.

Under Method B, soil cleanup levels must be at least as stringent as each of the following concentrations:

- Concentrations established under applicable state and federal laws
- Concentrations that protect human health
- Concentrations that protect the environment (terrestrial ecological receptors)
- Concentrations that protect ground water quality
- Concentrations that protect air quality

5.2.1.1 Concentrations that Protect Human Health

The establishment of soil cleanup levels that are protective of human health depends on the reasonable maximum exposure expected to occur under both current and future site use conditions. MTCA defines "reasonable maximum exposure" as the highest exposure that can be reasonably expected to occur for a human or other living organisms at a site under current and potential future site use [WAC 173-340-200]. As described in Section 4.4.1, land use across the site varies. The rail yard is currently used as industrial property by BNSF, and the most likely future use of the property is industrial. The highest beneficial use of off rail yard properties is residential. The regulation allows for the establishment of soil cleanup levels based on two types of land use: unrestricted land use and industrial land use. Unless a site qualifies as an industrial property, soil cleanup levels must be based on unrestricted land use. See WAC 173-340-745(1).

At the site, although the rail yard is an industrial land use, the surrounding areas are residential, commercial, and recreational. Consequently, soil cleanup levels will be based on unrestricted land use.

Soil cleanup levels protective of human health were determined using Equations 740-1, 740-2 and 740-3 (WAC 173-340-740) based on a soil direct contact exposure pathway.

Carcinogenic PAHs

Values for the cPAHs that have been identified as IHS for soil were obtained from the CLARC v3.1 (Ecology, 2001a).

Metals

For arsenic, the MTCA Method B cleanup level is the Ecology background concentration of 20 mg/kg. The Method C arsenic cleanup level is 87.5 mg/kg.

The MTCA Method B value for lead will be the cleanup level that is based upon preventing unacceptable blood lead levels and calculated by the IEUBK model (250 mg/kg). The Method C cleanup level for lead is 1,000 mg/kg based on direct contact.

Total Petroleum Hydrocarbons

Finally, Ecology evaluated Method B soil TPH cleanup levels for unrestricted land use in their April 11, 2003 memorandum. The *Worksheet for Calculating Soil Cleanup Level for Direct Contact Pathway: Method B – Unrestricted Land Use (MTCATPH10.xls)* spreadsheet tool provided on Ecology's website was used to perform the calculations required by Equation 740-3 for petroleum mixtures. Petroleum hydrocarbon fractionation data obtained from EPH/VPH analysis of soil samples was used to perform the calculations. A technical memorandum documenting the procedures used for establishing the EPH/VPH dataset is included as Appendix E. See Appendix G for information regarding other site-specific input parameters for the four-phase model.

Iterations of the model were made for each sample to ensure that the back-calculated TPH concentration satisfied four sub-criteria:

1) Hazard index = 1
2) Total cancer risk =1 x 10^{-5}
3) Cancer risk due to benzene = 1 x 10^{-6}
4) Cancer risk due to cPAHs = 1 x 10^{-6}

The median TPH concentration was selected as the cleanup level for a specific soil zone. Cleanup levels developed by Ecology for the vadose and smear zone soil are 2,130 and 2,765 mg/kg TPH (by EPH/VPH method), respectively. Ecology assumed TPH was present at half the detection limit for TPH fractions that were not detected. Ecology also assumed direct contact by a child ingesting 200 mg of soil per day for 6 years, and an acceptable cancer risk of 1 in 100,000.

BNSF believes the assumptions could be modified to develop cleanup levels protective for construction workers, city workers maintaining water lines or other subsurface structures, or residents performing excavation work in their yards. Using these assumptions, soil concentrations well above residual saturation values (i.e., >100,000 mg/kg TPH) are protective for a soil ingestion or direct contact pathway. This calculation is performed by substituting the body weight of an adult for a child (70 kg instead of 16 kg), decreasing the soil ingestion rate from 200 mg/day to 100 mg/day (note this is still twice the soil ingestion rate of an industrial worker) and decreasing the exposure frequency to approximately one-tenth of the year, or 36.5 days per year rather than year-round. This may also be an appropriate methodology for developing TPH remediation levels for soil where a cleanup action that relies, in part, on containment and institutional controls because TPH residual saturation levels protect groundwater, surface water and sediments.

The Method C TPH cleanup level will be developed for Ecology consideration during development of the Cleanup Action Plan.

5.2.1.2 Concentrations that Protect the Environment

The establishment of soil cleanup levels that are protective of the environment requires a terrestrial ecological evaluation (TEE) under certain circumstances. The regulation establishes a tiered process for evaluating potential risks to terrestrial ecological receptors. This process is set forth in WAC 173-340-7490 through 173-340-7494. WAC 173-340-7491 provides for specific exclusions from the TEE requirements. Certain site circumstances provide an exclusion from any further ecological evaluation at a site because the contaminants either have no pathway to harm the plants or animals, e.g., they are under buildings or deep in the ground; or there is no habitat where plants or animals live or forage near the contamination; or finally, the contamination does not occur at concentrations higher than what is found naturally occurring in the area. Ecology has determined that residential areas around the railyard are "contiguous undeveloped property" such that the site does not qualify for an exclusion. See Sec. 4.4.2.5. A site-specific TEE must be performed per WAC 173-340-7493. This evaluation is in process and the results will be available before a Draft Cleanup Action Plan is circulated for further public and agency review and comment.

5.2.1.3 Soil Concentrations that Protect Groundwater

Because hazardous substances in the soil could leach into the ground water, soil cleanup levels must also be protective of ground water quality. To protect ground water quality, soil cleanup levels must be sufficiently stringent to ensure that the potential leaching of residual IHSs from the soil into the ground water will not cause an exceedance of ground water cleanup levels. Section 5.2.2 identifies the ground water cleanup levels for this Site.

As described in Section 4.2.1, the metals IHSs, arsenic and lead, have not impacted groundwater (neither compound is an IHS in groundwater). Therefore, in this section, cleanup levels are only calculated for TPH and its constituents.

WAC 173-340-747 describes various methods for deriving soil concentrations for groundwater protection. Certain methods are tailored for particular types of hazardous substances or sites. Some methods are more complex than others and some require the use of site-specific data. Per WAC 173-340-747(3)(c), the four-phase partitioning model may be used to derive soil concentrations for any site where hazardous substances are present in the soil as a nonaqueous phase liquid (NAPL). Ecology evaluated TPH soil concentrations protective of groundwater, which in turn protects sediments and surface water, using the four-phase model in their technical memorandum dated April 11, 2003 and derived the following cleanup levels:

Basis	Vadose Zone Soil Concentration (mg/kg)	Smear Zone Soil Concentration (mg/kg)
Protection of Potable Groundwater (Hazard Index = 1)	Site-specific residual saturation limit	76.9
Protection of Surface Water to Site-Specific Value of 700 µg/L[2]	Site-specific residual saturation limit	160.3

[2] The derivation of the site-specific surface water criteria of 700 µg/l is discussed in Section 5.2.4.

Therefore, for vadose zone soils, concentrations below site-specific residual saturation limits are protective of underlying groundwater and surface water at the site. Note that the residual saturation limit is the soil TPH concentration, above which free product may accumulate and flow due to gravity. Ecology's default residual saturation is 2,000 mg/kg TPH as diesel or heavy oil. At Skykomish, empirical data indicates that site-specific residual saturation values are in the range of 30,000 mg/kg.

According to the four-phase model results, a smear zone soil concentration of 77 mg/kg TPH is required to protect groundwater and the surface water and sediments into which groundwater flows (selected cleanup level is the more stringent of the calculated values for a particular soil zone). Therefore, a soil cleanup level to protect groundwater would be 77 mg/kg or alternatively, this cleanup standard could be satisfied by attainment of appropriate groundwater criteria (see Section 5.2.2 for derivation of groundwater cleanup levels).

BNSF does not agree that the four-phase model is appropriate for developing soil cleanup levels protective of groundwater at this site. While the model itself is scientifically sound and based on well accepted equilibrium partitioning theory, Ecology's requirement that VPH analytical data serve as the basis for estimating the concentrations of light aromatic fractions (C8-C10 and C10-C12 aromatics) in soil is fundamentally flawed, particularly at Skykomish. The VPH analysis has a high bias for aromatics (i.e., it consistently overestimates the concentration of light aromatics in soil). This phenomenon is acknowledged by Ecology in the VPH analytical method. This bias is compounded several fold in the four-phase model because of the very high solubility limits these fractions possess. As a result, the model predicts that the light aromatic fractions present the greatest risk at this site and that the soil cleanup level must be 2,130 and 2,765 mg/kg TPH for vadose and smear zone soil, respectively, to protect groundwater. The data, however, do not support this conclusion. The light aromatic fractions (C8-C10 and C10-C12) have not been detected above reporting limits (50 µg/L) in any groundwater samples from the site, including groundwater from wells that contain or previously contained free product, and wells near heavily-contaminated soil (>10,000 ppm) in direct contact with the groundwater.

Leaching Tests

As discussed above, WAC 173-340-747 acknowledges that the four-phase model may not be appropriate for all sites and provides various alternatives methods for developing soil concentrations protective of groundwater. WAC 173-340-747(3)(d) states that leaching tests may be used to establish soil concentrations for petroleum hydrocarbons provided sufficient information is available to demonstrate that the leaching tests can accurately predict groundwater impacts. BNSF chose to conduct leaching tests to determine of leaching tests could accurately predict soil TPH concentrations protective of groundwater.

The leaching tests provide site-specific data that conservatively predict the impacts of hydrocarbon- contaminated soil on groundwater. The leaching test results are consistent with the groundwater data and demonstrate that TPH in the soil at the site does not present an unacceptable carcinogenic or non-carcinogenic risk from drinking groundwater, except where free product (defined in MTCA as "a distinct separate layer" of oil) is present. Leaching test results are presented in Appendix F-1.

Leaching Tests vs. the Four-Phase Model

The leaching tests provided site-specific results that predict soil impacts to groundwater more accurately than the four-phase model. For example, the four-phase model calculates a non-carcinogenic risk to groundwater that is dominated by contributions from the C8 -C10 and C10 -C12 aromatic fractions These fractions were not observed above analytical reporting limits (50 µg/L) in the leach testing samples or in groundwater at the site. As noted above, the groundwater samples were obtained from wells that contained free product or historically contained free product or are located near heavily contaminated soil (>10,000 ppm). Similarly, soil used for leach testing contained high concentrations of TPH (>10,000 ppm).

In order to better satisfy the requirements of WAC 173-340-747(3)(d) that "sufficient information is available to demonstrate that the leaching test can accurately predict ground water impacts," BNSF plans to conduct further groundwater analysis at the site The objectives of this ongoing analysis is, in part, to better define the relationship between EPH/VPH concentrations in groundwater. This on-going groundwater analysis will also help explain the presence of aliphatic EC fractions in groundwater well in excess of solubility limits. BNSF believes that free-phase hydrocarbons are causing this phenomenon. This information will be available well before the currently scheduled publication date for public and agency review and comment in May 2004 of the draft CAP.

Table 5-1 lists the soil TPH concentration that BNSF believes is protective of groundwater as "res satr" for residual saturation. BNSF developed these cleanup levels based on the results of the four-phase model, the leaching tests and the soil and groundwater data from the site. Note that TPH is a surrogate for all other organic IHSs because the carcinogenic and non-carcinogenic risk associated with PAHs and benzene are included in the development of this value.

5.2.1.4 Soil Concentrations that Protect Air

Metals

Constituents in soil that could impact air include wind-blown arsenic and lead to outdoor air. Arsenic and lead are identified as IHSs for soil. As discussed in Section 4, a potential exposure pathway that must be addressed is particulate dispersion and subsequent inhalation of these compounds. However, the MTCA Method A cleanup levels shown in Table 5-1 based on direct contact are also protective of this exposure pathway. Therefore, the most stringent soil cleanup levels for lead and arsenic are 250 and 20 mg/kg, respectively.

TPH

Because hazardous substances in the soil could volatilize into the air, soil concentrations must also be protective of air quality. To protect air quality, soil cleanup levels must be sufficiently stringent to ensure that the volatilization of residual hazardous substances in the soil will not cause an exceedance of air cleanup levels. This section evaluates the soil to vapor pathway per WAC 173-340-740(3)(b)(iii)(C) and (3)(c)(iv)(B).

According to WAC 173-340-740(3)(b)(iii)(C), the soil to vapor pathway must be evaluated under the following conditions:

- For gasoline range organics, whenever the TPH concentration is significantly higher than a concentration derived for protection of groundwater for drinking water beneficial use under WAC 173-340-747(6) (four-phase partitioning model) using the default assumptions

- For diesel range organics, whenever the TPH concentration is greater than 10,000 mg/kg

- For other volatile organic compounds, including petroleum components, whenever the concentration is significantly higher than a concentration derived for protection of groundwater from drinking water beneficial use under WAC 173-340-747(4) (fixed parameter three-phase model)

Since soil TPH concentrations exceeding 10,000 mg/kg are present at the site, the second condition listed above is applicable to the site. WAC 173-340-740(3)(c)(iv)(B) states that soil cleanup levels that are protective of indoor and ambient air shall be determined on a site-specific basis. Soil cleanup levels may be evaluated as being protective of air pathways using any of the following methods:

- Measurements of the soil vapor concentrations
- Measurements of ambient air concentrations and/or indoor air vapor concentrations throughout buildings. Such measurements must be representative of current and future site conditions when vapors are likely to enter and accumulate in structures. Measurement of ambient air may be excluded if it can be shown that indoor air is the most protective point of exposure.
- Use of modeling methods. Soil vapor and/or air monitoring may be required to verify calculations and compliance with air cleanup standards.
- Other methods approved by Ecology

BNSF previously performed product headspace analysis and indoor air sampling work at the site that clearly qualify as appropriate evaluation methods per the second and fourth bullets (indoor air sampling and other methods approved by Ecology). Since main septic lines extend from septic tanks to toilets, sinks, etc. in residences, the school and other structures, these lines could serve as a preferential pathway for vapor migration from the subsurface to indoor air. Under these circumstances, an evaluation of indoor air is appropriate, as the potential preferential pathway would lead directly into residences, not to outdoor air. In other words, the most protective point of exposure at the site is indoor air per the second bullet. The indoor air monitoring program coupled with the heated product flux chamber test provides evaluation of "the most protective point of exposure" at the site – and during seven discrete indoor air sampling events.

Indoor Air Sampling

Indoor air sampling (required by Ecology) was completed and evaluated from 1997 to 1999 through a cooperative effort between BNSF, Ecology, the State of Washington and King County Departments of Health, and the Agency for Toxic Substances and Disease Registry (ATSDR). This indoor air sampling program included 6 residences and buildings (including one control) over 7 separate sampling events. BNSF and RETEC believe that the existing primary documents from the indoor air sampling, which summarize the product headspace analysis and indoor air sampling work, more than adequately fulfill MTCA indoor and outdoor air pathway requirements:

1) *Scope of Work and Sampling and Analysis Plan* (SOW and SAP) submitted to Ecology on July 1, 1997, with addendums issued on July 14, 1997 and January 8, 1998. This SOW and SAP, approved by Ecology on July 15, 1997, clearly state the purpose and objectives of the sampling program and were developed over a

period of several months with multi-party involvement including Ecology, the state and county Departments of Health, and ATSDR.

2) *Final Report on Indoor Air Sampling* by ThermoRetec dated April 28, 1999. The indoor air sampling program included seven periodic indoor air sampling events during falling barometric pressure conditions in six residences and public buildings (including one control). The sampling was performed over the period August 1997 to February 1999. As stated in the SOW, comparison of air quality data from indoor air sampling with MTCA Method B cleanup levels for ambient air (WAC 173-340-750) and other screening levels was performed to determine whether vapor evolution from the subsurface to indoor air is a potential exposure pathway of concern at the site. Although the indoor air sampling program was initiated in response to community concern, the SOW was designed and intended to assess the vapor pathway in general.

The results of the extensive indoor air sampling program (seven quarterly events, during falling barometric pressure conditions in public and residential buildings) determined that concentrations of compounds found in the indoor air samples collected in Skykomish are generally typical of indoor air in locations not overlying petroleum plumes. Although background chemical concentrations were detected, many of the compounds were not detected in product headspace samples, so are not associated with migration from the subsurface. Finally, contaminants detected in indoor air were not at concentrations that would result in adverse health effects. Therefore, further evaluation of this exposure pathway is not warranted.

The indoor air sampling described above was performed during falling barometric pressure. This feature of the sampling program was intended to detect any flux of soil vapor from the subsurface into indoor air resulting from a drop in ambient air pressure and subsequent upward movement of soil vapors during equalization of air pressure. This feature of the program addresses specifically the outdoor air pathway as well as the indoor air pathway. Another feature of the indoor air sampling program that makes it particularly well suited to evaluate the outdoor air pathway as well as indoor air is the fact that several of the structures that were sampled have cinder-block, and not continuous concrete, foundations, including the Mackner residence (the site of a single odor complaint by the seller during sale of the home). Cinder block foundations are assumed to be more porous than concrete foundations.

Flux Chamber Evaluation

In addition to the indoor air sampling described above, the SOW included the extreme case of product headspace analysis using a modification of EPA's flux chamber procedure. The product headspace analysis was designed to evaluate, in a worst-case scenario, what constituents could potentially volatilize from petroleum in the subsurface and evolve to indoor or outdoor air. In summary, product samples from various locations of the plume were collected and subjected to a laboratory test similar in concept to EPA's emission flux chamber method. The flux chamber procedure is the same procedure under consideration by Ecology for the proposed ambient air sampling.

For this analysis, a laboratory set-up was used in which the flux chamber was placed directly above the product, rather than on the ground surface in the field. The product was heated to 50 ºC (122 ºF). Note that this is more than double the year-round average groundwater temperature at Skykomish of 51.8 ºF, and therefore an unrealistically conservative estimate of the potential for volatilization of the product. The results of this analysis are presented in the Final Report on Indoor Air Sampling. Comparison of volatile organic compound (VOC) and semi-volatile organic compound (SVOC) analytical results to the Method B standard air cleanup levels for the site in Table 5-2, attached, shows that for most compounds detected in product headspace for which screening levels were proposed, the concentrations are less than the proposed ambient air screening levels.[3] In addition, a TPH air cleanup level of 1,350 µg/m3 was calculated using the four-phase model (MTCATPH.xls), A.4-Worksheet for Calculating Soil Cleanup Level for the Protection of Method B-Air Cleanup Level as presented in Figure 6 of Ecology's February 24, 2003 Memo, *Evaluation of Method B Soil TPH Cleanup Levels for Unrestricted Land Use at BNSF Site* (Ecology, 2003). This value exceeds the cumulative product headspace concentrations (775.12 µg/m3), indicating no potential for adverse risk from indoor air VOCs.

Soil Screening Levels Protective of Air Pathway

USEPA does not recommend using soil concentrations to identify whether or not the vapor intrusion pathway is complete or to model resulting indoor air concentrations, due to uncertainties in the assumptions underlying the standard modeling approach (USEPA, 2002). However, Ecology has proposed a soil cleanup level of 2,900 mg/kg for the protection of indoor air

[3] Naphthalene was detected above MTCA Method B levels in one of three product headspace samples where product was heated to 50^{o}C, however it was also detected in the blank. Indoor air collected from 6 locations during 4 sampling events detected a variety of petroleum constituents, many of which are not found in the petroleum at the site. Naphthalene was measured at concentrations ranging from 0.13 to 0.95 $\mu g/m^3$ in indoor air. The MTCA Method B air cleanup level for naphthalene of 1.37 $\mu g/m^3$.

quality (Ecology, 2003). Ecology used the four-phase model to develop this soil cleanup level.

Air Pathway Summary

The previous indoor air sampling and product headspace analysis satisfies MTCA's requirement to evaluate the soil to vapor pathway. The data demonstrate that current site conditions and soil concentrations of TPH and its constituents do not pose an indoor or ambient air risk to human health.

Furthermore, Ecology evaluated the soil to vapor pathway in their four-phase model report and determined that this pathway is "not likely to be considered as critical as other exposure pathways" for deriving a Method B soil TPH cleanup level (Ecology, 2003). Ecology calculated a Method B soil TPH cleanup level protective of air quality (2,900 mg/kg), which RETEC believes is overly conservative in light of the empirical data and uncertainties surrounding the model input assumptions. Ecology's proposed cleanup level for soil to protect indoor air is included for reference in Table 5-1.

Nonetheless, it may be necessary to develop air cleanup levels for purposes of protection monitoring construction and operation of the cleanup action, consistent with WAC 173-410(1)(a). For example, if a remedy were selected that would result in an increase in subsurface temperatures, it may be necessary to monitor ambient and/or indoor air, or otherwise evaluate and mitigate any potential increases in volatilization of TPH from the subsurface.

5.2.2 Groundwater

As summarized in Section 4.4, cleanup levels are developed for human receptors in this section. In addition, cleanup levels are developed for two transport mechanisms: groundwater to sediment and groundwater to surface water. The groundwater cleanup levels are established in accordance with WAC 173-340-720.

Under Method B, groundwater cleanup levels must be at least as stringent as each of the following concentrations:

- Concentrations established under applicable state and federal laws
- Concentrations that protect human health
- Concentrations that protect sediment quality
- Concentrations that protect surface water quality

5.2.2.1 Concentrations that Protect Human Health

The establishment of groundwater cleanup levels that are protective of human health depends on the classification of groundwater as either potable (a current or potential source of drinking water) or non-potable. The classification of groundwater depends on the highest beneficial use expected to occur under both current and future site use conditions. Although site groundwater is not considered a source of potable water, the highest beneficial use of water must be protected as a potable source, as groundwater recharges to the Skykomish River and potentially to the former Maloney Creek channel.

Groundwater cleanup levels that protect human health through the groundwater ingestion pathway can be calculated by using MTCA Method B and also by considering drinking water standards established under applicable state and federal laws. These include:

- MCLs established under the Safe Drinking Water Act (SDWA)
- Maximum contaminant level goals (MCLGs) for noncarcinogens established under the SDWA
- Secondary MCLs established under the SDWA
- MCLs established by the state board of health

The MTCA Method B criteria for PAH constituents were obtained from the CLARC v3.1 table (Ecology, 2001a).

Per WAC 173-340-720(4)(b)(iii)(C), Ecology's *Worksheet for Calculating Method B Potable Ground Water Cleanup Levels (MTCATPH10.xls)* was used to perform the calculations required by Equation 720-3 for petroleum mixtures. Ecology performed model runs using the entire EPH/VPH groundwater dataset. Iterations of the model were made to ensure that the back-calculated TPH concentration satisfied four sub-criteria:

5) Hazard index = 1
6) Total cancer risk =1 x 10^{-5}
7) Cancer risk due to benzene = 1 x 10^{-6}
8) Cancer risk due to cPAHs = 1 x 10^{-6}

Ecology derived a TPH cleanup level of 477 µg/L (by EPH/VPH) in groundwater that would be protective of human health.

5.2.2.2 Concentrations that Protect Organisms in Sediment

Because groundwater discharges to the Skykomish River and former Maloney Creek channel, groundwater cleanup levels must also be sufficiently stringent to ensure that groundwater does not cause sediments to exceed cleanup levels established for sediments. Section 5.2.3 identifies the cleanup levels for sediment. Ecology derived a groundwater cleanup level of 64 µg/L TPH to protect aquatic organisms in sediment. This value is based on the results of sediment bioassays and modeling of groundwater to sediment interactions using an equilibrium partitioning approach. BNSF disagrees with the approach used to develop this value since the available bioassay data corresponds to samples with product seeps. BNSF believes that evaluation of this pathway should be performed at a later date, when product seeps are eliminated and representative sediment samples can be collected to assess the impact of dissolved contaminants to benthic organisms. Thus, BNSF proposes a performance based cleanup level for protection of aquatic organisms in sediment. Rather than measuring groundwater in an effort to predict whether these organisms are adversely affected by groundwater, BNSF proposes confirmational monitoring in the form of sediment bioassays following removal of product seeps and impacted sediments. In this case, TPH or confirmational bioassays are used as surrogates for other IHSs.

5.2.2.3 Concentrations that Protect Beneficial Uses of Surface Water

Because groundwater discharges to the Skykomish River and the former Maloney Creek channel, groundwater cleanup levels must also be sufficiently stringent to ensure that groundwater does not cause surface water to exceed cleanup levels established for surface water. As presented in Section 5.2.4, 500 µg/L of TPH (by NWTPH-Dx) is protective of surface water.

The most stringent criteria for groundwater are based on protection of surface water for all IHSs considered (refer to Table 5-1). However, since some of the levels are lower than practical quantitation limits (PQLs), cleanup levels for groundwater and surface water are compared to the PQLs, and the higher of the two values is listed as the cleanup level per WAC 173-340-700(6)(d). All cleanup levels based on PQLs are flagged on Table 5-1. WAC 173-340-707(4) requires that Ecology review cleanup levels based on PQLs every five years and, if necessary and appropriate, Ecology may at that time require the use of improved analytical techniques with lower PQLs.

5.2.3 Sediment

As summarized in Section 4.4, cleanup levels are developed for ecological receptors including fish, shellfish and sediment-dwelling organisms in this section. The IHSs in sediments at the site include lead, PAHs and TPH.

Sediment cleanup standards are defined under MTCA in WAC 173-340-760, which requires compliance with WAC 173-204 (Sediment Management Standards [SMS]). Under WAC 173-204-520(1)(d), freshwater sediment cleanup screening levels and minimum cleanup levels are determined on a case-by-case basis consistent with the intent of the SMS, which is to "eliminate adverse effects on biological resources and significant health threats to humans" (WAC 173-204-100(2)). Sediment quality standards are determined within the range set by the sediment cleanup objective of no adverse effects at the minimum cleanup levels (WAC 173-204(4)).

No chemical specific cleanup criteria have been defined for freshwater sediments (WAC 173-204-520(1)(d)). Procedures for setting cleanup levels in Puget Sound marine sediments using sediment toxicity bioassays are defined in WAC 173-204-570. An approach similar to the procedures defined for marine sediment was applied at this site, using site-specific acute and chronic sediment toxicity bioassays on a suite of three species (Microtox®, *Hyalella azteca*, and *Chironomus tentans*) analogous to the marine sediment procedures. The bioassay results are presented in Appendix B and can be used to define the area of impacted sediments requiring cleanup.

Based on the bioassay results in Appendix B, we propose a minimum sediment cleanup level of 91 mg/kg of TPH, representing the maximum acceptable concentration threshold (MACT) for sediment not impacted by free product. This is the concentration threshold for minor adverse effects to benthic biota.

Ecology is not specifying a sediment cleanup level per se, and Ecology and BNSF are in agreement about the Skykomish River sediment impacted zone. However, Ecology has a different interpretation of the sediment bioassay results, and has derived a sediment TPH value of 23.7 mg/kg for use in back-calculating acceptable groundwater cleanup levels protective of sediment dwelling organisms (see Section 5.2.2.2). BNSF believes this value is overly conservative in that it is below TPH values measured in Skykomish River sediments at upstream, reference stations. Furthermore, this value was derived based on bioassays conducted on sediment samples containing product.

5.2.4 Surface Water

The surface water cleanup levels are established in accordance with WAC 173-340-730.

Under Method B, surface water cleanup levels must be at least as stringent as each of the following concentrations:

- Concentrations established under applicable state and federal laws
- Concentrations that protect human health
- Concentrations that protect the environment (aquatic ecological receptors)

5.2.4.1 Concentrations that Protect Human Health

The establishment of surface water cleanup levels that are protective of human health depends on the reasonable maximum exposure expected to occur under both current and potential future site use conditions. The reasonable maximum exposure for surface water at the site is discussed in Section 4.4 and is based on classification of the Skykomish River as a Class AA River. Therefore, the highest beneficial use of surface water at the site may include water supply, fish and shellfish, wildlife habitat, and recreation.

No IHSs were identified for surface water at the site except for TPH; however, as discussed in Section 4.4, groundwater at the site recharges to surface water. Therefore, it is necessary to establish groundwater cleanup levels protective of surface water, and to consider all groundwater IHSs in doing so. Thus, surface water criteria are developed for the groundwater IHSs in Table 5-1.

Surface water cleanup levels protective of human health are based on ingestion of aquatic organisms and water and are selected from the following:

- National Recommended Water Quality Criteria (2002; NRWQC)
- MTCA Method B surface water criteria for human health protection per WAC 173-340-730(3)(b)(iii)
- MTCA Method B drinking water criteria

MTCA Method B surface water criteria were obtained for all IHSs from CLARC v3.1 (Ecology, 2001a). For petroleum mixtures, Equation 730-1 was used along with bioaccumulation factors for various TPH fractions provided in a technical memorandum prepared by SAIC (SAIC, 2002) for Ecology. These calculations are provided in Appendix H and resulted in an overly conservative value. WAC 173-340-730(3)(b)(iii)(C) allows use of Method A TPH cleanup levels for groundwater as an alternative to this calculation. The MTCA Method A groundwater cleanup level of 500 µg/L of TPH-D or TPH-MO by NWTPH-Dx is included in Table 5-1.

5.2.4.2 Concentrations that Protect the Environment

The requirements and procedures for establishing surface water cleanup levels that are protective of the environment depend on whether environmental effects-based concentrations have been established under applicable state and federal laws. The most stringent concentrations are used for hazardous substances for which environmental effects-based concentrations have been established under applicable state and federal laws. For hazardous substances for which environmental effects-based concentrations have not been established under applicable state and federal laws, a protective concentration must be established. Protective concentrations are defined as concentrations that do not result in adverse effects on the protection and propagation of fish, aquatic life, and wildlife. Whole effluent toxicity (WET) testing may be used to demonstrate that a concentration is protective of fish and aquatic life. In this context, "aquatic life" refers to organisms residing in the water column.

Environmental effects-based concentrations have not been established for the surface and groundwater IHSs at the site. Therefore, WET testing of groundwater obtained from the site was conducted to determine TPH concentrations that are protective of aquatic organisms. WET-testing results are presented in Appendix I. The results concluded that a TPH concentration of 700 µg/L (by NWTPH-Dx) is protective of fresh water organisms. Because the WET-testing measures toxicity associated with all constituents present in groundwater, TPH concentrations are used as a surrogate for all of the IHSs.

The most stringent of the human health and environmental effects-based criteria are selected as the cleanup level for each IHS (Table 5-1). For TPH, the most stringent criteria were human health-based criteria for carcinogenic and non-carcinogenic PAHs, based on fish consumption. However, since some of the levels are lower than PQLs, cleanup levels for surface water are compared to PQLs and the higher of the two values is selected as the cleanup level per WAC 173-340-700(6)(d). All cleanup levels based on PQLs are flagged on Table 5-1.

5.3 Points of Compliance

The points of compliance define the locations where the cleanup levels must be attained. The term includes both standard and conditional points of compliance. Points of compliance are established for each environmental medium in accordance with the requirements and procedures set forth in WAC 173-340-720 through 173-340-760. A conditional point of compliance is only available under certain conditions.

For the site, points of compliance for soil, groundwater, sediments, and surface water must be established and evaluated. The requirements pertinent to the establishment of those points of compliance are summarized below. The standard and conditional points of compliance considered in this FS are also summarized below.

5.3.1 Soil

The point of compliance for soil depends on the exposure pathway that the soil cleanup level is based on.

- **Direct Contact.** For soil cleanup levels based on direct contact, the point of compliance is defined as throughout the site from the ground surface to 15 feet below the ground surface.

- **Soil to Groundwater.** For soil cleanup levels based on protection of ground water, the point of compliance is defined as throughout the site. This means that the point of compliance extends throughout the soil profile and may extend below the water table.

- **Protection of the Environment.** For soil cleanup levels based on protection of the environment, the standard point of compliance is defined as throughout the site from the ground surface to 15 feet below the ground surface. For sites with institutional controls to prevent excavation of deeper soil, a conditional point of compliance may be set at the biologically active soil zone. This zone is assumed to extend to 6 feet. A different depth may be established based on site-specific information. Where a cleanup action involves containment of hazardous substances that exceed cleanup levels at the point of compliance, the cleanup action still complies with cleanup standards, provided the requirements specified in WAC 173-340-740(6)(f) are met.

5.3.2 Groundwater

Below, we discuss the standard point of compliance and the conditional point of compliance.

5.3.2.1 Standard Point of Compliance

The standard point of compliance for ground water is throughout the site, from the uppermost level of the saturated zone, taking into consideration the seasonal groundwater fluctuations, and extending vertically to the lowest-most depth that could potentially be affected by the site (WAC 173-340-720(8)(b)).

For the site, a standard point of compliance is evaluated in Alternative "STD" of this FS/EIS.

5.3.2.2 Conditional Point of Compliance

A conditional point of compliance may also be set for groundwater where it can be demonstrated that it is not practicable to meet the cleanup levels throughout the site within a reasonable restoration timeframe (WAC 173-340-720(8)(c)). Conditional points of compliance may either be set on the property or off the property that is the source of the contamination, subject to several conditions. Off-property points of compliance may be set off property in three specific situations, subject to several conditions specified in WAC 173-340-720(8)(d).

In this FS/EIS, an on-property conditional point of compliance is evaluated in Alternatives PB1 to 5 and an off-property conditional point of compliance is evaluated in Alternatives SW1 to 4. These conditional points of compliance are summarized below.

On-Property Conditional Point of Compliance

The on-property conditional point of compliance must be set as close as practicable to the source of the hazardous substances, but may not exceed the property boundary. The use of an on-property point of compliance is conditioned on the use of all practicable methods of treatment at the site (WAC 173-340-720(8)(c)). Alternatives PB1 to 5 consider an on-property conditional point of compliance. Each of those alternatives sets the point of compliance at the BNSF property boundary (the railyard).

Off-Property Conditional Point of Compliance

The definition of and the requirements for the off-property conditional point of compliance depend on the location of the BNSF property, which is the source of the contamination to the adjacent surface water. In this case, the BNSF property is located near, but does not abut, surface water. Consequently, the off-property conditional point of compliance must be set as close as practicable to the source of the releases that occurred on BNSF's property, but may not exceed the point where groundwater flows into the Skykomish River (WAC 173-340-720(8)(d)]).

The establishment of such an off-property conditional point of compliance is conditioned on meeting several requirements, including, but not limited to the following (WAC 173-340-720(8)(d)(ii)):

- Groundwater discharges must be provided with all known available and reasonable treatment methods before being released into the Skykomish River.
- Groundwater discharges must not result in violations of sediment quality values.
- The affected property owners between BNSF's property boundary and the Skykomish River must agree in writing to setting such a conditional point of compliance.

Alternatives SW1 to 4 consider an off-property point of compliance located at the point of groundwater discharge to the Skykomish River and the former Maloney Creek channel.

5.3.3 Sediment

The point of compliance is the biologically active zone consistent with WAC 173-760 and 173-204. Given that supplemental, site-specific information has not been obtained, the default point of compliance is the top 10 centimeters. Site-specific conditions, such as recontamination potential from subsurface sediments and/or groundwater, must also be considered in determining points of compliance.

5.3.4 Surface Water

The standard point of compliance for surface water is the point at which hazardous substances are released to the surface waters of the state.

At the site, hazardous substances are released to the surface water as a result of groundwater flows. Therefore, the point of compliance must be established at the point at which hazardous substances are released to the surface waters. At the site, this point is where groundwater emanates from the sediment.

5.4 Other Potentially Applicable Requirements

MTCA requires that all cleanup actions comply with applicable state and federal laws (WAC 173-340-360(2)). MTCA defines applicable state and federal laws to include "legally applicable requirements" and "relevant and appropriate requirements." The information is presented in three tables (Table 5-3, Table 5-4, and Table 5-5) categorized as follows:

- Laws pertaining to establishment of cleanup levels
- Laws pertaining to treatment and disposal activities
- Laws that could affect planning or place restrictions on how cleanup actions may be performed.

The laws and regulations cited in this section pertain to non-hazardous wastes only as no "hazardous waste" exists at the site nor is the generation of any hazardous waste anticipated as part of cleanup. Tables 5-3 through 5-5 do not refer to State Dangerous Waste Regulations (WAC 173-304) or Federal Resource Conservation and Recovery Act Subtitle C regulations (40 CFR 260-268) that regulate the management and disposal of "hazardous waste."

6 Development of Remedial Alternatives

This section describes the remedial alternatives that can meet the cleanup standards presented in Section 5. To develop remedial alternatives, individual cleanup technologies were first screened to identify technologies that are implementable and effective at the site. This screening is described in detail in Appendix J and summarized in Section 6.1.

Some of the individual cleanup technologies that are implementable will need further testing to determine their effectiveness at the site. Section 6.2 describes the bench-scale testing that is taking place to determine their effectiveness.

Using the results of the technology screening, technologies that are implementable and effective at the site were grouped into remedial alternatives. Section 6.3 describes the approach that was used to group individual cleanup technologies and develop the resulting remedial alternatives presented in Section 6.4.

In Section 6.4, the remedial alternatives for the site are described. Section 6.4.1 summarizes how each technology (regardless of alternative) would be implemented at the site. Section 6.4.2 summarizes each alternative.

6.1 Technology Screening

This section summarizes the results of the screening process for individual cleanup technologies that should be suitable for cleaning up contaminated soil, groundwater, sediment and surface water at the site. Surface water cleanup was not considered separately in this screening evaluation because cleanup actions designed for sediments, soil and groundwater must also protect surface water. A detailed description of the screening process is presented in Appendix J.

Table 6-1 identifies the cleanup technologies screened and determined to be effective and implementable or to hold promise of being effective and implementable in the context of physical and chemical conditions at the site. In Section 6.4, these technologies are grouped into remedial alternatives that address all of the contamination at the site.

6.2 Bench-Scale Testing of Cleanup Technologies

Few *in situ* cleanup technologies are considered potentially effective for contaminants identified at the site and limited performance data are available

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6.2 Bench-Scale Testing of Cleanup Technologies

Few *in situ* cleanup technologies are considered potentially effective for contaminants identified at the site and limited performance data are available for these technologies and contaminants. To determine the effectiveness of these technologies, bench-scale testing is being performed. The scope of this testing is described in the *Bench Testing Work Plan* (RETEC, 2003e). Bench-scale testing is being performed for the following cleanup technologies:

- *In situ* flushing using hot water mixed with surfactant and polymer
- *In situ* biological treatment
- *In situ* chemical oxidation using ozone

This testing commenced in May 2003 and complete results should be available in the fourth quarter of 2003. The tests are designed to measure the effectiveness of these three technologies at this site. The test results will be incorporated into the Final FS/EIS, the Cleanup Action Plan and/or the Engineering Design Report, as they are available. *Ex situ* technologies (e.g., excavation) do not require bench scale testing to determine their potential effectiveness.

6.3 Approach to Developing Remedial Alternatives

This section describes the approach used to develop site-wide remedial alternatives, using the individual cleanup technologies discussed in Section 6.1 and the cleanup levels discussed in Section 5. The remedial alternatives are described in Section 6.4.3 and evaluated in detail in Section 7. The approach to developing the suite of remedial alternatives presented herein was performed in phases, as described below:

1) Subdivide the site into “cleanup zones” based on exposure pathways, land use, and distribution and chemical composition of hazardous substances (Section 6.3.1).

2) Consider standard and conditional POCs for each affected media (Section 6.3.2).

3) Consider soil remediation levels based on exposure pathways (Section 6.3.3).

4) Combine individual cleanup technologies from Section 6.1 into a suite of remedial alternatives that meets cleanup standards (i.e., cleanup levels at various POCs) and remediation levels.

Each of these phases is described in more detail below. The resulting remedial alternatives are presented in Section 6.4.

6.3.1 Site Cleanup Zones

The concept of site cleanup zones was developed to facilitate the evaluation of remedial alternatives. The zones are based on exposure pathways, land use, and distribution and chemical composition of hazardous substances at different parts of the site. The zones are defined as follows:

3) **Aquatic Resource Zones –** The Skykomish River and Levee and the former Maloney Creek channel (and associated wetland) are considered Aquatic Resource Zones due to the potential for ecological and recreational exposures, the presence of contaminated groundwater that affects sediment and surface water, and the lack of potential future development, such as housing. The Aquatic Resource Zones are noted in the orange hatching on Figure 6-1.

4) **Developed Zones –** The Developed Zones have been or are likely to be developed for residences, commercial buildings, streets, and public institutions, such as the school, city hall, and community center. These zones are primarily affected by petroleum contaminants in the groundwater and surrounding subsurface soil.

   Three Developed Zones were defined based on location and the different types of petroleum affecting the zones: the Northwest (NW) Developed Zone, the South Developed Zone, and the NE (NE) Developed Zone (Figure 6-1). The NW Developed Zone and the South Developed Zone are affected by petroleum plumes that consist of a mixture of diesel and bunker C and are separated by the Railyard Zone. These two developed zones are noted in the pink hatching pattern on Figure 6-1. The NE Developed Zone is affected by a petroleum plume primarily composed of diesel fuel. Smear zone soil data from 1B-W-1, 1C-W-1, and 2A-W-6 indicate that 85% to 90% of the petroleum present in this Zone is in the diesel range. The greater diesel content in the NE Developed Zone indicates that petroleum in this Zone is more soluble and more biodegradable than the petroleum present in the NW and South Developed Zones. Therefore, different cleanup technologies may be applied to the NE Developed Zone than the NW and South Developed Zones. The NE Developed Zone is noted in purple hatching on Figure 6-1.

5) **Railyard Zone –** The Railyard Zone has historically been used for industrial purposes and should continue as an industrial site for the foreseeable future. It includes BNSF property with surface and subsurface soil impacts. It also includes small areas immediately adjacent to the BNSF property: two with surface soil metal

impacts, and one with surface and subsurface soil TPH impacts. The Railyard Zone is noted in blue hatching on Figure 6-1.

Figure 6-1 provides a clear representation of the locations of these zones. Figure 6-2 illustrates the basis for the areal extent of these zones by overlaying all known and suspected areas of soil, groundwater, and sediment impacts. The extent of TPH soil impacts illustrated on Figure 6-2 is based on the 2,000 mg/kg TPH-diesel contour for surface, vadose, and smear zone soil impacts. This contour was used to represent the maximum extent of impacts exceeding cleanup levels for purposes of the FS/EIS as it closely approximates the areas that exceed the direct contact cleanup level for all TPH.

6.3.2 Points of Compliance

Section 5.3 presents the standard and conditional POCs used to develop and evaluate the remedial alternatives. The POCs are the locations where cleanup levels would be achieved and are considered part of the cleanup standards and are summarized in Table 6-2. Site-wide remedial alternatives were developed to meet cleanup standards for the following three POCs: (1) off-property, conditional groundwater POC at the points of discharge to surface water (SW1 to SW4); (2) on-property, conditional groundwater POC at the property boundary (PB1 to PB4); and (3) the standard POCs (STD).

6.3.3 Remediation Levels

Remediation levels were developed that incorporate physical properties (e.g., free product), chemical concentrations, and exposure pathways. Remediation levels are not cleanup standards, but are used to define where and when individual cleanup technologies will be applied as part of the overall remedial alternative. Specifically, the following remediation levels were integrated into the analysis of remedial alternatives:

1) Provide additional protectiveness to people by achieving direct contact cleanup levels for soil (described in Section 5.2.1) in the upper 2 feet in the Railyard Zone, minimizing contaminated dust and incidental ingestion or inhalation.

2) Provide additional protectiveness to people by achieving direct contact cleanup levels for soil (described in Section 5.2.1) in the upper 4 feet in the NW Developed Zone, preventing incidental ingestion or inhalation at residences and on public property (i.e., the school or community center).

3) Protect people and environmental receptors by achieving cleanup levels in sediment (described in Section 5.2.3) in the former

Maloney Creek channel and the Skykomish River in a manner that will not significantly impact habitat in the wetlands or along the shoreline.

4) Restore groundwater and protect the Skykomish River and former Maloney Creek channel by removing free product.

5) Restore groundwater and protect the Skykomish River and former Maloney Creek channel by removing soil necessary to restore groundwater to drinking water quality (empirical data indicate that only free product in off-railyard areas exceeds 477 µg/L TPH as a sum of EPH/VPH; see Figure 3-9).

6.4 Description of Remedial Alternatives

The approach outlined in Section 6.3 is used in this section to develop a suite of remedial alternatives. Individual cleanup technologies were first selected for each cleanup zone based on the nature and extent of contamination, land use and exposure pathways. The technologies selected for each cleanup zone are described in Section 6.4.1.6. Institutional controls are applicable to some extent in all cleanup zones; therefore, they are discussed in context of all cleanup zones in Section 6.4.1.7.

After grouping technologies by cleanup zone, they were grouped based on their ability to comply with cleanup standards and attain remediation levels. As described in Section 5, compliance with cleanup standards includes attaining the cleanup levels at specific POCs. Soil, sediment and surface water POCs are the same for all alternatives. However, the standard and two conditional POCs for groundwater (defined in Section 5.3) were used to develop the remedial alternatives. The groundwater POCs were used to name the alternatives in Section 6.4.2.

In addition to meeting cleanup levels at the POCs, alternatives were selected based on achieving remediation levels (Table 6-3). Remediation levels mostly apply to soil and sediment cleanup; however, a remediation level for free product removal from groundwater is also included. All alternatives meet the remediation levels, as explained in Section 6.4.2, in addition to meeting the cleanup levels at the POCs.

6.4.1 Detailed Description of Remedial Approaches by Cleanup Zone

The site-wide remedial alternatives presented in Section 6.4.2 use different combinations of cleanup technologies within each cleanup zone, as illustrated in Table 6-4. To limit repetitious text, all cleanup technologies applicable to each cleanup zone are described separately, by cleanup zone, in the following six subsections (as listed on Table 6.4).

For example, the technologies for cleaning up the South Developed Zone include natural attenuation and excavating free product and TPH in the surface soil and the smear zone. Some site-wide remedial alternatives use all of these technologies; whereas, others use only a few of the technologies (Table 6-4). The following six subsections demonstrate how each cleanup technology would be implemented in each cleanup zone and describe all remedial approaches. Section 6.4.2 describes how the remedial alternatives combine these different cleanup technologies in a way that meets site-wide cleanup standards and remediation levels.

6.4.1.1 Levee and Skykomish River Aquatic Resource Zone

This zone incorporates the area downgradient of the existing barrier wall and the locations of petroleum impacts to the bank and sediment of the Skykomish River. The majority of this zone includes the floodwater control levee that was designed by the USACE in 1951 and is currently managed by the King County Department of Natural Resources, Rivers Section.

The cleanup technologies for this zone include:

- Removing surface sediment
- Enhanced bioremediation
- Permeation grouting
- Ozone sparging
- *In situ* flushing
- Excavation

These technologies are described in the following subsections. All activities on the levee would be coordinated with King County, which manages the levee for purposes of local water control.

Remove Surface Sediment

This technology involves the excavation of the upper 4 inches (10 centimeters) of sediment to achieve cleanup levels in the biologically active zone. It is estimated that an area about 440 feet long and 20 feet wide exceeds the cleanup level (Figure 6-3). Including overexcavation to a depth of 1 foot, 330 cubic yards (cy) of sediment is expected to be removed. Surface sediment removal would not occur until soil and groundwater impacts within the levee have been addressed. Sediment removal activities would be designed to comply with ARARs, such as Ecology's water quality standards (including anti-degradation) and the Federal Clean Water Act and Engendered Species Act.

Two of the site-wide remedial alternatives (SW3 and PB2) include excavation of free product from within the levee. For these alternatives, removal of surface sediment would be limited to the free product seep areas since this is where bioassay failures occurred. These alternatives minimize disruption to the shoreline habitat. This sediment removal area is about half the area that exceeds cleanup levels for an excavation volume of 165 cy.

A temporary cofferdam or deflector will be placed in the river to keep surface water away from the sediment excavation. An access ramp to allow dam placement and excavation will be created by removing about 6 feet of clean fill from the top of the levee in a 50-foot-wide area near the east end of the levee. Excavation would be performed using a track-mounted excavator. Difficulties are to be expected due to the presence of cobbles and boulders. Excavated sediment will be immediately removed from the river channel via an off-road dump truck to a stockpile area on the railyard. The excavation will be backfilled with coarse-grained soil, similar to what was excavated. This work would be performed in late summer during low water conditions to minimize impacts on water and protected fish species. The construction window for the South Fork of the Skykomish River and its tributaries between Sunset Falls and Alpine Falls would allow in-water cleanup activities to occur between July 1st and August 31st (WDFW, pers. comm., 2003c). This construction window may be extended based on site-specific permitting.

Enhanced Bioremediation

Enhanced bioremediation is not an effective cleanup technology by itself in the Levee Zone due to the presence of bunker C/diesel free product and significant soil impacts. The purpose of this technology is to address dissolved-phase groundwater impacts that could continue to migrate through the levee under some of the site-wide alternatives due to the presence of free product or significant soil impacts in the Levee Zone or the NW Developed Zone.

Enhanced bioremediation will be implemented using air-sparging techniques. A single row of air sparging wells will be installed across the area that exceeds the groundwater cleanup level of 0.5 mg/L. These wells will be installed through the top of the levee and, as a result, will require that the levee be cleared of brush and trees (Figure 6-4). Aboveground power lines along West River Road will be shielded, as necessary, during drilling and trenching activities. Where this technique is used following ozone sparging (described below), some existing wells might be converted from ozone to air sparging. Wells will be installed at 25-foot spacing, with the top of the well screen 10 feet below the low water table elevation, and air will be injected at a rate of 2 to 3 standard cubic feet per minute (scfm) per well. Compressed air will be supplied using positive displacement blowers located in the vicinity of the levee. These blowers will be contained in insulated sound enclosures to reduce noise impacts. Compressed air piping will be placed in a trench on top of the levee.

Permeation Grouting

This technology would be used to solidify free product in the Levee Zone. The technology involves installing wells on 3- to 20-foot centers and injecting Portland cement to turn the free product and associated soil into a solidified mass. This technology would eliminate seeps to the Skykomish River and prevent leaching of contaminants to groundwater.

The installation of grouting wells will require angle boring from the top of the levee at angles of up to 40 degrees from vertical using a track-mounted ODEX drill rig. Some drilling may also have to occur on West River Road or along the bank of the Skykomish River to get full coverage. Aboveground power lines along West River Road will be shielded, as necessary, during drilling and trenching activities. A 1- to 3-inch PVC grout injection tube with radial drilled holes is used to inject the grout under pressure. This work would be performed during low waters so that grout seeps to the River can be controlled. No aboveground structures or activities remain after permeation grouting.

Ozone Sparging

Ozone sparging is intended to chemically oxidize organic compounds in soil and groundwater. This technology is more typically used to address chlorinated solvents and PAHs because bioremediation is more cost-effective for TPH than ozonation. However, due to the proximity of the levee to ecological receptors, the TPH concentration in the levee, and the heavy petroleum composition, it is believed that ozone sparging might be effective in the Levee Zone. Bench-scale testing is being performed to verify the effectiveness of ozone at degrading the bunker C/diesel impacts identified at the site. At full-scale, this technology requires three rows of ozone sparging wells installed parallel to the river in the levee to provide complete coverage where free product is present, where significant residual soil impacts are present, and where groundwater concentrations exceed 1 mg/L (Figure 6-5). The installation of three rows of wells will require angle boring from the top of the levee at angles of up to 40 degrees from vertical using a track-mounted ODEX drill rig (Figure 6-6). One row of ozone wells will be installed parallel to the river where lower residual soil concentrations are present and where groundwater concentrations are between 0.5 and 1 mg/L. Wells will be installed at 25-foot spacing in each row with the top of the well screen located 10 feet below the low water table elevation. Aboveground power lines along West River Road will be shielded, as necessary, during drilling and trenching activities.

Ozone must be generated near the injection site as it naturally degrades rapidly. Ozone and oxygen generators will be installed at the levee to allow ozone production at concentrations of up to 12 percent in air. This equipment will be contained in insulated sound enclosures to reduce noise impacts. Compressed air piping will be placed in a trench on top of the levee.

In Situ Flushing

In situ flushing is an enhanced groundwater extraction and treatment system that uses a combination of heat, polymers, and surfactants to remove free product and residual soil impacts. Due to the proximity of the levee to surface water, this technology has to be carefully designed to prevent discharges to the river. As a result, injection and extraction will occur in the center of the levee to maximize the likelihood of full containment (Figure 6-7). Injection will occur in the vadose zone using a shallow trench (approximately 560 feet long) at a total rate of 44 gallons per minute (gpm). Because injection will occur in the vadose zone, only surfactants will be used because polymer will increase the injection solution viscosity and hinder infiltration. Extraction will occur to provide capture throughout the levee from a single row of wells. These wells will be screened to 15 feet below the low water elevation, will be spaced evenly every 40 feet, and will extract 4 gpm per well for a total extraction rate of 60 gpm. Aboveground power lines along West River Road will be shielded, as necessary, during drilling and trenching activities.

Unlike other site locations, flushing will be performed in the levee during low rather than high water conditions to minimize the potential for discharges to the river. The water conditioning (heating and mixing) system will be located on the railyard as will the water treatment system. Extracted and treated water will be recycled to the maximum extent possible. These systems will be connected to the levee wells by piping and trenches placed in public rights-of-way. Injection pipes will be insulated to minimize heat loss.

Excavation

Excavation includes the removal of all free product or all contaminated soil from between the existing barrier wall and surface sediment in the Skykomish River (Figure 6-8). All brush on the levee will be removed prior to excavation. A temporary cofferdam or deflector will be placed in the river to keep soil and contamination away from surface water. Power poles and lines along West River Road and the levee will be temporarily relocated during construction activities. Access for dam construction and clearing will be created by cutting an entry in the east side of the levee, as described for surface sediment excavation and by creating a ramp on the west end of the levee. A temporary road will have to be constructed west of the schoolyard to allow traffic to circulate and to provide emergency access to residences on the west end of West River Road. The abandoned residence on West River Road (the second residence east of the school yard) could be demolished so that a road might be constructed to connect Railroad Avenue to West River Road. If this is not possible, an alternate means of access to the west end of West River Road will need to be established, or the residents may need to be vacated during excavation activities.

The excavation will start on the east end of the levee, closest to the bridge. Clean soil will be excavated from the top of the levee and placed in trucks for temporary stockpiling on the railyard. Impacted soil will then be loaded into trucks for temporary stockpiling prior to treatment or disposal. As the excavation proceeds to the west, clean overburden soil might be immediately placed as backfill in previously excavated areas.

The free product excavation is estimated to be 3,730 cy, with 2,490 cy requiring treatment or disposal. Excavation to cleanup levels would generate 18,920 cy of soil, with 12,190 cy requiring treatment or disposal (2,000 mg/kg TPH-diesel).

Alternatives SW3, SW4, PB2 and PB3 assume a sloped excavation sidewall that protects the existing barrier wall, leaving some residual TPH impacts immediately downgradient of the barrier wall. For site-wide alternatives PB4 and STD, the barrier would be excavated since excavation of free and residual product would occur in both the Levee and NW Developed Zones.

Excavation would be performed in late summer during low water conditions to prevent discharges to surface water and to satisfy the “fish window” that is intended to protect threatened species. The “fish window” for the South Fork of the Skykomish River and its tributaries between Sunset Falls and Alpine Falls is July 1st through September 15th. It is assumed that some water in the excavation will be managed to remove any free product that accumulates and to allow collection of excavation verification samples from the bottom of the excavation. Soil confirmation sample analysis will be performed with an on-site laboratory or using 48-hour turnaround at a fixed facility.

6.4.1.2 Former Maloney Creek Aquatic Resource Zone

This zone includes the ditch and wetland areas located north of the Old Cascade Highway and is associated with storm drainage through the former Maloney Creek channel. The zone also includes any surface sediment impacted areas between the culvert and Maloney Creek on the south side of the Old Cascade Highway. This zone is considered separately due to the potential for groundwater discharge to surface water during high water events and due to the presence of a wetland. In addition, coho salmon, a threatened species, have been noted in this storm water drainage. Cleanup in this zone will be closely coordinated with cleanup in the South Developed Zone and on the southern edge of the Railyard Zone.

The cleanup technologies for this zone include:

- Remove surface sediment
- Natural attenuation
- Enhanced bioremediation
- Excavation

These technologies are described in the following subsections.

Remove Surface Sediment

The technology involves the excavation of the upper 4 inches (10 centimeters) of sediment to achieve cleanup levels in the biologically active zone. It is estimated that the full wetland area exceeds the sediment cleanup level including a small area on the downgradient side of the culvert (Figure 6-9). Assuming an excavation depth of 1 foot with over excavation, a total of 1,740 cy of sediment will be removed if excavation is to cleanup levels. A temporary cofferdam or deflector will be placed in the channel to keep soil and contamination away from surface water. Work will be performed in the summer to minimize the likelihood of precipitation. A bypass pump and hose will be used to pump any collected surface water around the excavation area.

Due to the high value of forested wetland, including the presence of mature trees, excavation of all impacted surface sediment would cause significant damage to the habitat. As a result, several alternatives have been developed that include removal of some surface sediment in strategic locations. For these alternatives, the excavation volume is assumed to be one half of the total removal volume or approximately 870 cy. For other alternatives, no excavation of surface sediment is proposed in this zone to avoid impacting the habitat.

Natural Attenuation

Natural attenuation might be used as the primary petroleum treatment method in the Former Maloney Creek Aquatic Zone due to the presence of the wetland habitat and petroleum constituents at moderate concentrations (per Figure 3-11, only boring 2B-SD-5 has NWTPH-Dx concentrations above 3,200 mg/kg). Free product present on the adjacent South Developed Zone at MW-39 would be removed to accelerate natural attenuation. Natural attenuation will be monitored using compliance monitoring data. Dissolved oxygen data will also be collected because aerobic degradation is anticipated to be the primary method of petroleum degradation.

Enhanced Bioremediation

Enhanced bioremediation is a viable *in situ* cleanup alternative for the Former Maloney Creek Aquatic Zone, and it will minimize adverse impacts on wetland and aquatic habitats. Due to the presence of mixed bunker C/diesel free product this technology will remove 50 to 80 percent of the petroleum impacts. This might be sufficient to meet cleanup standards because bioremediation will target the more soluble and toxic components of TPH, and soil TPH concentrations in the smear zone do not significantly exceed cleanup levels.

Enhanced bioremediation will be implemented using air sparging techniques. Air sparging wells will be installed across the area that exceeds the soil direct contact cleanup level in the smear zone. These wells will be installed to completely cover this area, as illustrated in Figure 6-10. Wells will be installed at 25-foot spacing, with the top of the well screen 10 feet below the low water table elevation. Air will be injected at a rate of 2 to 3 scfm per well. Some wells might need to be angle-bored to minimize impacts to the wetland. The adverse impacts of drilling and operating wells in the wetland will be less significant (both in intensity and duration) than the impacts of excavating in the wetland.

Air bubbling up through the wetland represents a less negative impact to the habitat than excavation of surface sediment or soil. Compressed air will be supplied using positive displacement blowers located on the railyard in the vicinity of the former Maloney Creek channel. The blowers will be contained in insulated sound enclosures to reduce noise impacts. Compressed air piping will be placed in trenches to the maximum extent possible; however, in order to minimize impact to the wetland habit, much of the piping might be completed aboveground.

Excavation

Excavation includes the complete removal of all soil exceeding cleanup levels from the zone, including surface sediment in the former Maloney Creek channel and the wetland areas (Figure 6-11). All brush and trees will be removed prior to excavation. A temporary dam will be placed in the channel to keep surface water away from the excavation and work will be performed in the summer to minimize the likelihood of precipitation. A bypass pump and hose will be used to pump any collected surface water around the excavation area. Disturbance of the wetland area will require mitigation by creating equal or higher value wetlands. This mitigation will occur at the existing wetland and possibly at another, as-yet undetermined location within the Maloney Creek watershed.

Impacted surface sediment will be removed first. Any clean soil between the surface impacts and the smear zone will be excavated and placed in trucks for temporary stockpiling on the railyard. Impacted soil will then be loaded into trucks for temporary stockpiling prior to treatment or disposal. As the excavation proceeds, clean soil will be used as backfill in previously excavated areas. The total excavation volume is estimated to be 7,880 cy, with 7,260 cy requiring treatment or disposal. These volumes were estimated based on the 2,000 mg/kg TPH-diesel cleanup level.

The estimated maximum depth of excavation is 12 feet. Excavation will include sloping sidewalls. Some excavation water will be managed to remove any free product that accumulates and to allow collection of excavation verification samples from the bottom of the excavation. Soil analysis will be performed with an on-site laboratory or using 48-hour turnaround at a fixed facility.

6.4.1.3 Northeast Developed Zone

The NE Developed Zone has been developed for residences, commercial buildings, streets, and institutions such as city hall. The NE Developed Zone is affected by a petroleum plume in smear zone soil and groundwater that is primarily composed of diesel fuel, generally greater than 75 percent. This petroleum is less viscous, more soluble, and more biodegradable than the petroleum present in the NW and South Developed Zones. An oil column was historically located in the vicinity of MW-21 where free product is present indicating that bunker C might be present in the immediate vicinity of MW-21 although there are no soil data to confirm this. Otherwise, the majority of the impacts appear to be associated with diesel fueling activities that occurred about 150 feet to the south of MW-21.

Cleanup technologies for this zone include:

- Natural attenuation
- Enhanced bioremediation
- Excavation

These technologies are described in the following subsections.

Natural Attenuation

Natural attenuation in the NE Developed Zone has the potential to significantly reduce soil and groundwater concentrations due to the high percentage of diesel. Diesel-range hydrocarbons are soluble and biodegradable and would be expected to attenuate in a reasonable timeframe. Soil direct contact criteria are only exceeded in a small area and groundwater currently appears to attenuate to cleanup levels prior to discharging to the Skykomish River. Natural attenuation will be monitored using compliance monitoring data. Dissolved oxygen data will also be collected because aerobic degradation is anticipated to be the primary method of petroleum degradation.

Enhanced Bioremediation

Enhanced bioremediation is considered a viable alternative for the NE Developed Zone because the primary petroleum constituent is diesel. Enhanced bioremediation has been implemented at multiple sites to achieve groundwater cleanup levels where thin accumulations (less than 2 feet) of diesel free product have been present. This is likely due to both the solubility and biodegradability of diesel constituents. RETEC's database of bench-scale testing data (Appendix J) indicates that soil concentrations of diesel are reduced, on average, by 90% due to the application of enhanced bioremediation techniques.

Air sparging wells will be installed across the area that exceeds the soil direct contact cleanup level in the smear zone and the groundwater cleanup level. Air sparging wells will be installed to completely cover the area of free product when free product is not flushed or excavated, as illustrated in Figure 6-12. Otherwise, a single row of air sparging wells will be used in this area. One or two additional rows of sparging wells will intersect the groundwater plume downgradient to the north depending on the desired restoration timeframe and accessibility of public and private property. The locations of air sparging rows have been selected to avoid generating vapors that could cause nuisance odors beneath inhabited structures; vapor extraction will be included as a contingency should nuisance odors become a problem.

Wells will be installed at 25-foot spacing in each row, with the top of the well screen 10 feet below the low water table elevation. Air will be injected at a rate of 2 to 3 scfm per well. Compressed air will be supplied using positive displacement blowers located on the railyard near the depot. The blowers will be contained in insulated sound enclosures to reduce noise impacts. Compressed air piping will be placed in trenches located on BNSF property and public right-of-ways.

Excavation

Excavation includes either the removal of free product or the removal of all free product and all soil exceeding cleanup levels (2,000 mg/kg TPH) (Figure 6-13). For the free product-only excavation approach, the objective would be to excavate as much free product as possible without significantly impacting roads or utilities. This would limit the excavation to between Railroad Avenue and the BNSF property boundary in the vicinity of MW-21.

Two or three residences will need to be temporarily relocated to excavate all free product and contaminated soil in this zone. Use of shoring might be necessary to protect some structures. Utilities are also present, including a telephone switching station and associated fiber optics cables. A 2-inch water line is present on both Railroad Avenue and 3rd Street. Overhead power is present on the north side of Railroad Avenue and will need to be moved during excavation. All utilities will need to be protected or temporarily rerouted to facilitate excavation. A bypass road will be necessary to maintain access to residences east along Railroad Avenue.

Site clearing includes removal of asphalt paving, landscaping (including some large trees), and relocation or demolition of the residences. A significant thickness of clean soil exists in the vadose zone that will be excavated and stockpiled adjacent to the excavation area. Impacted soil will be loaded into trucks for temporary stockpiling prior to treatment or disposal. The total soil excavation volume for accessible free product is estimated to be 4,861 cy, with 2,455 cy requiring treatment or disposal. The soil excavation volume for all soil exceeding cleanup levels is estimated to be 22,873 cy with 11,054 cy requiring treatment or disposal. The estimated maximum depth of excavation is 17 feet.

6.4.1.4 South Developed Zone

The South Developed Zone affects two residences and involves petroleum in surface soil, smear zone soil and groundwater that is composed of mixed bunker C and diesel. These impacts appear to be limited in extent. Free product present in MW-39 is more viscous than free product noted elsewhere on the site and appears to be coincident with a previous channel of Maloney Creek that may have been affected by railyard operations. Cleanup of this zone will have to be closely coordinated with cleanup of the Former Maloney Creek Aquatic Zone.

The cleanup technologies for this zone include:

- Natural attenuation
- Excavation

These technologies are described in the following subsections.

Natural Attenuation

Natural attenuation in the South Developed Zone would only be used following free product excavation. The high viscosity of the product in MW-39 suggests that limited residual impacts will remain after free product removal. In addition, the free product appears to be associated with an earlier channel of Maloney Creek that is now backfilled. As a result, the impacts are suspected to be limited to this earlier channel and complete removal of this limited area may be possible. Natural attenuation will be monitored using compliance monitoring data. Dissolved oxygen data will also be collected because aerobic degradation is anticipated to be the primary method of petroleum degradation.

Excavation

Due to the limited extent of impacts and the viscous nature of the free product, excavation is considered a very viable cleanup technology for this zone. The approach to excavation might have to be altered based on the cleanup technology used at the Former Maloney Creek Aquatic Zone.

Excavation includes either free product excavation or the complete removal of all free product and soil exceeding cleanup levels (2,000 mg/kg TPH as diesel) (Figure 6-14). Little to no clearing will be necessary for free product excavation, as it is primarily located in a grass area. The garage associated with one residence might need to be temporarily relocated or demolished and reconstructed to facilitate soil excavation. Utilities affected include services to the residences. All utilities will be temporarily disconnected or rerouted, as necessary.

A limited thickness of clean soil exists in the vadose zone that will be excavated and stockpiled adjacent to the excavation area. Impacted soil will be loaded into trucks for temporary stockpiling prior to treatment or disposal. The soil volume for excavating free product is estimated to be 336 cy, with 265 cy requiring treatment or disposal. The soil volume for excavating all contaminated soil is 1,979 cy, with 1,546 cy requiring treatment or disposal.

6.4.1.5 Northwest Developed Zone

The NW Developed Zone has multiple residences, commercial buildings, streets, and institutions such as the school and community center. The zone is primarily affected by petroleum contaminants in the smear zone soil and groundwater and the petroleum consists of a mixture of diesel and bunker C. This is the largest and most developed zone at the site and includes several large or historic (Washington Heritage Register and National Register of Historic Places) structures, such as Maloney's General Store, the Skykomish Hotel and the School. This zone also has a very shallow smear zone that extends to within about 2 feet of ground surface in some areas, is very close to the levee and the Skykomish River.

Free product is present in this zone as two narrow bands between the railyard and the levee. The petroleum appears to originate in the vicinity of the former oil sump that was used to transfer bunker C from railcars to the aboveground 100,000 gallon oil storage tank on a 30-foot steel tower. This interpretation is based on free product thickness measurements, the location of oil seeps to the river, soil and groundwater data, known or suspected petroleum sources, and lithologic controls.

Interim actions have been performed in the NW Developed Zone that include (1) installation of free product skimming wells in 1996; (2) construction of a free product barrier wall in 2001; and (3) installation of new skimming wells and pumps, and upgrades to existing wells and pumps in 2002. These systems are effectively containing and capturing free product at the downgradient boundary of the NW Developed Zone and preventing migration from this zone into the levee and the Skykomish River, as evidenced by monitoring data from wells located at the ends of the barrier wall and product recovery.

In addition to these existing, interim measures, the cleanup technologies for this zone include:

- Surface soil excavation
- Natural attenuation
- Free product recovery trenches
- Enhanced bioremediation
- *In situ* flushing
- Excavation

These technologies are described in the following subsections.

Surface Soil Excavation

Lead-contaminated soil (250 mg/kg) was noted at seven sample locations within the NW Developed Zone (Figure 6-15). The locations are isolated and are not contiguous with the railyard. The source(s) of this lead is unknown (RETEC, 2002a). The lead soil exists in yards near residential or commercial properties and in the schoolyard. Because the source and distribution of the lead in soil is unknown, estimating excavation volume is difficult. Assuming 2-foot-deep excavations, 400 cy of soil will be excavated from throughout town using a backhoe. The excavated soil will be placed in trucks and transported to stockpiles on the railyard. The soil will be shipped to an off-site landfill by truck or rail. These areas will be backfilled and restored to pre-excavation conditions. Given the shallow excavation, no significant impacts to utilities or structures are expected.

Natural Attenuation

Natural attenuation in the NW Developed Zone would only be effective following free product removal. Once the free product is removed, natural attenuation will help address the residual soil and groundwater impacts. In each case where residual impacts remain in the NW Developed Zone, enhanced bioremediation will be implemented in the Levee Zone to protect people and animals that use the Skykomish River. Natural attenuation will address groundwater concentrations in the NW Developed Zone in the long term. Natural attenuation will be monitored using compliance monitoring data. Dissolved oxygen data will also be collected because aerobic degradation is anticipated to be the primary method of petroleum degradation.

Free Product Recovery Trenches

Recovery trenches provide a minimally intrusive means to remove free product from the subsurface. The use of trenches relies on the hydraulic gradient to transport free product to the trenches. Trenches would be excavated using bioslurry techniques to 5 feet below the low water table. The trench backfill material would be designed to be compatible with native soil conditions and an impermeable barrier would be placed on the downgradient wall of the trench to prevent free product from escaping beyond the trench. Sumps will be placed in the trench at about 50-foot spacing.

Proposed locations of recovery trenches are illustrated in Figure 6-16. Excavation of these trenches will require work on public and private property and associated removal of pavement, landscaping or other features. Berms will be constructed around the trenching area to prevent loss of bioslurry overflows. Temporary mixing equipment, tanks, and pumps will be required near the excavation areas to supply bioslurry. Trench backfill material, impermeable barrier material, and sump material will also be stockpiled near the work area. Excavated material will be transported to the railyard for stockpiling prior to off-site shipment for disposal via rail or truck. The work surfaces will be replaced to pre-trenching conditions.

Electrically-driven skimmer pumps will be placed in vaults at each sump location and an electric control panel will be located nearby. No other aboveground features will be present. The skimming pumps will likely remain in operation for at least 10 years and may need to remain in operation for over 30 years.

Enhanced Bioremediation

Enhanced bioremediation is not an effective cleanup technology by itself in the NW Developed Zone, due to the presence of bunker C/diesel free product and significant soil impacts. This technology would only be used once the free product has been addressed by excavation or flushing. The purpose of this technology is to address residual soil and groundwater impacts to the maximum extent practicable.

Enhanced bioremediation will be implemented using air sparging techniques. Air sparging introduces oxygen to the soil and groundwater to stimulate aerobic biodegradation in the vicinity of the air sparge wells and to other areas as the oxygenated groundwater migrates downgradient. Multiple rows of air sparging wells will be installed across the zone (Figure 6-17). These wells will be installed on public and private property. The locations of the sparging wells have been selected to minimize nuisance odors near inhabited structures; vapor extraction will be retained as a contingency to address these odors should they become a concern. Wells will be installed at 25-foot spacing, with the top of the well screen 10 feet below the low water table elevation.

Air will be injected at a rate of 2 to 3 scfm per well. Compressed air will be supplied using positive displacement blowers located on the railyard. These blowers will be contained in insulated sound enclosures to reduce noise impacts. Compressed air piping will be placed in trenches to connect the equipment on the railyard with the air sparging wells.

All work surfaces will be replaced to pre-cleanup conditions. A flush-with-grade monument will be present at each wellhead. All other equipment and activities will occur on the railyard.

In Situ Flushing

In situ flushing might be used in conjunction with excavation to remove free and residual product for a number of alternatives. *In situ* flushing is an enhanced groundwater extraction and treatment system that uses a combination of heat, polymers, and surfactants to remove free product and residual soil impacts. Flushing will be performed during high water conditions to allow for removal of free or residual product from the top of the smear zone. Flushing is only considered for limited-access areas (e.g., under bridges) since it is not a proven technology at full scale for the type of contaminants at this site, and there is no established treatment method for reuse of extracted groundwater or discharge of treated water to the River.

To simplify the layout of flushing systems, two standard flushing units were created assuming 40-foot spacing between injection and extraction wells within a row and 80-foot spacing between rows of wells. These units are 90 gpm (3 injection and 3 extraction wells) and 60 gpm (2 injection and 2 extraction wells) in size with equal injection and extractions rates. All wells will be screened to 15 feet below the water table. Each unit will operate for a period of about 6 months in order to exchange 10 pore volumes of water. Figure 6-18 illustrates how these units could be combined with excavation to provide removal of free product or both free and residual product. For free product, the system includes three 90-gpm units and eight 60-gpm units for a total flow rate of 750 gpm. For both free and residual product, the system includes nine 90-gpm units and seven 60-gpm units for a total flow rate of 1,230 gpm. A non-standard system would need to be designed to address residual product beneath the school. These flushing units would likely be implemented in phases to control the size of the equipment required.

The water conditioning (heating and mixing) system will be located on the railyard as will the water treatment system. Extracted and treated water will be recycled to the maximum amount possible. These systems will be connected to the wells by piping and trenches placed on the railyard and on public and private property. Injection pipes will be insulated to minimize heat loss. Trench areas will be backfilled and replaced to pre-cleanup conditions.

Horizontal boring may be required underneath railroad tracks to connect the wells to the treatment and conditioning system.

Excavation

Excavation in the NW Developed Zone includes one of the following (Figure 6-19):

1) Excavation to remove free product, where accessible
2) Excavation to remove all free product
3) Excavation of shallow smear zone impacts
4) Excavation to remove both free and residual product
5) Complete excavation of all free product areas and all soil exceeding cleanup levels.

These five scenarios are discussed individually below; however, all excavation work would occur during low water conditions to maximize access to impacted smear zone soil. Clean overburden soil will be stockpiled as close to the excavation as possible and will be used as clean backfill. Impacted soil will be hauled to the railyard and stockpiled for on-site treatment or hauling to an off-site landfill via rail or truck. All utilities will need to be protected or temporarily rerouted to facilitate excavation. Various bypass roads will be necessary during excavation to maintain access to residences, businesses and public facilities. Site clearing includes removal of asphalt paving, landscaping (including some large trees), and relocation or demolition of several structures.

- **Excavation to remove free product, where accessible**. Excavation to remove free product, where accessible, is intended to minimize disruption to the community while removing a significant amount of free product. The long-term environmental benefit of this approach is questionable due to the patchwork of excavation that will occur (Figure 6-19). Accessibility is generally defined as anywhere a building is not present. As a result, excavation will still disrupt traffic and utilities. For the purpose of the FS/EIS, it is assumed that excavations will be sloped up to the sides of buildings that remain. Based on this approach, approximately 32,373 cy of soil will be excavated with 21,778 cy requiring treatment or disposal. All grades and surfaces will be replaced to pre-excavation conditions. This approach can be used in conjunction with *in-situ* flushing to remove all free product from the NW Developed Zone over an extended period of time, but without the need to move structures.

- **Excavation to remove all free product**. Excavation to remove all free product will require the temporary relocation and replacement or demolition and reconstruction of about eight structures and temporary structural support to allow excavation underneath several other structures (Figure 6-19). These structures include private residences, the hotel, the depot, the post office, the stove shop, the community center, and the teacher's cottage. Based on this approach, approximately 38,066 cy of soil will be excavated with 20,966 cy requiring treatment or disposal. All grades and surfaces will be replaced to pre-excavation conditions.

- **Excavation of shallow smear zone impacts**. Excavation of shallow smear zone impacts is intended to remove contaminated soil to a depth of 4 feet bgs in accessible areas (those areas not already covered by a structure). Cleanup to this depth will enable routine work in residential yards and public utility work without future exposure to contaminated soil. This work will disrupt traffic and utilities, but could be phased to allow residents to remain in their homes. Based on this approach, approximately 14,880 cy of soil will be excavated with 7,440 cy requiring treatment or disposal. All grades and surfaces will be replaced to pre-excavation conditions.

- **Excavation to remove all free and residual product, and excavation to remove all soil above cleanup levels**. Both of these scenarios require the temporary relocation and replacement or demolition and reconstruction of about 18 structures and temporary structural support to allow excavation underneath several other structures (Figure 6-19). The structures affected by these excavations would include private residences, the hotel, the depot, the post office, the stove shop, the community center, the teacher's cottage, the school and portions of the motel. Based on the excavation of al1 free and residual product, approximately 111,392 cy of soil will be excavated with 68,952 cy requiring treatment or disposal. Based on the excavation of all soil exceeding cleanup levels, approximately 136,417 cy of soil will be excavated with 83,739 cy requiring treatment or disposal. All grades and surfaces will be replaced to pre-excavation conditions and all structures will be replaced or rebuilt.

6.4.1.6 Railyard

The Railyard Zone has historically been used for industrial purposes and will continue as an industrial site for the foreseeable future. It includes BNSF property with surface and subsurface soil impacts. It also includes small areas immediately adjacent to the BNSF property: two with surface soil metals impacts, and one with surface and subsurface soil TPH impacts. The railyard has an active main line with two sidings and two other active sidings south of the main line area. Both passenger and cargo trains use the main line and sidings; approximately one train per hour passes the site.

All alternatives except one leave the rail lines in place and use *in situ* remedies to address these impacts, due to the expense and disruption associated with moving the main line. One alternative relies on excavation, as it is the only technology currently considered effective enough to result in a permanent removal of all contaminated soil throughout the site. Results of bench-scale testing might indicate that flushing or ozonation could also be effective enough to result in permanent removal on the railyard. Fiber optics, electrical, and signal lines are present within the Railyard Zone. Any crossing of the rail lines will require horizontal boring.

The cleanup technologies for this zone include:

- Excavate surface soil
- Skimming free product
- Free product recovery trenches
- Natural attenuation
- Enhanced bioremediation
- *In situ* flushing
- Excavation

These technologies are described in the following subsections.

Excavate Surface Soil

Lead, arsenic, and TPH exceed the direct-contact cleanup criteria in several locations on the railyard. The impacted areas will be excavated to 2 feet below grade and will be capped with clean soil or ballast to prevent direct contact by site workers and trespassers. Based on the excavation outlines illustrated on Figure 6-20, it is estimated that 5,700 cy are associated with metals and an additional 4,800 cy are associated with TPH. Metals-impacted soil will be excavated in all site-wide alternatives to prevent exposure via dust. Soil exceeding cleanup levels will remain in place across much of the site; dermal contact will be prevented by a protective layer of clean soil (or ballast on the railyard).

Soil will be excavated using a backhoe or excavator. The excavated soil will be placed in trucks and transported to stockpiles on the railyard. The soil will be shipped to an off-site landfill by truck or rail. The excavated area will be lined with a woven-fabric, indicator layer to separate the subsurface-impacted soil from the clean-cap material.

Skimming Free Product

For site-wide alternatives with a conditional groundwater POC at the Skykomish River, aggressive free product removal on the railyard contributes little to no benefit to the protection of human health and the environment although it reduces the restoration time frame for groundwater on the railyard. For other alternatives, installation of skimming wells will remove free product up to the BNSF property boundary (alternative SW1) and at free product plumes within the railyard (alternatives SW2, SW3, SW4, and PB1). These wells will be installed at 50-foot centers at the downgradient edge of the free product plumes. Wells will be installed using standard drilling techniques and the wells will be screened across the range of water table fluctuation. The pumps will be housed in above-ground structures protected by bollards.

Free Product Recovery Trenches

Recovery trenches provide a minimally intrusive means to remove free product from the subsurface. The use of trenches relies on the hydraulic gradient to transport free product to the trenches. Trenches would be excavated using bioslurry techniques to 5 feet below the low water table. The trench backfill material would be designed to be compatible with native soil conditions and an impermeable barrier would be placed on the downgradient wall of the trench to prevent free product from escaping beyond the trench. Sumps will be placed in the trench at about 50-foot spacing.

Proposed locations of recovery trenches are illustrated in Figure 6-21. Due to the location of free product on the railyard, recovery trenches are considered primarily for the downgradient zone/property boundary. Berms will be constructed around the trenching area to prevent loss of bioslurry overflows. Temporary mixing equipment, tanks, and pumps will be required near the excavation area to supply bioslurry. Trench backfill material, impermeable barrier material, and sump material will also be stockpiled near the work area. Excavated material will be stockpiled on the railyard prior to off-site shipment for disposal via rail or truck. The work surfaces will be replaced to pre-trenching conditions.

Electric skimming pumps will be placed in vaults at each sump location and an electric control panel will be located nearby. No other aboveground features will be present. The skimming pumps will likely remain in operation for a period exceeding 10 years.

Natural Attenuation

Natural attenuation in the Railyard Zone would only be used following free product removal. Because of the presence of oil-range petroleum throughout this zone, skimming wells and pumps, recovery trenches, excavation, or flushing will be used to remove the free product prior to relying on natural attenuation. Once the free product is removed, natural attenuation will help address the residual soil and groundwater impacts. Natural attenuation will be effective in this zone due to the distance between the railyard and the primary downgradient ecological receptor, the Skykomish River. Compliance with groundwater cleanup levels at the BNSF property boundary could be accelerated with enhanced bioremediation. Natural attenuation will be monitored using compliance monitoring data. Dissolved oxygen data will also be collected since aerobic degradation is anticipated to be the primary method of petroleum degradation.

Enhanced Bioremediation

Enhanced bioremediation is not an effective cleanup technology by itself in the Railyard Zone due to the presence of bunker C/diesel free product and significant soil impacts. This technology will only be used once the significant impacts have been addressed by recovery trenches, excavation, or flushing. Enhanced bioremediation will be implemented as a groundwater containment remedy using air sparging techniques.

As a containment remedy, enhanced bioremediation will include a single row of air sparging wells located near the downgradient zone/property boundary (Figure 6-22). This row will stretch across the whole area where groundwater exceeds the cleanup level (0.5 mg/L TPH as diesel).

Wells will be installed at 25-foot spacing, with the top of the well screen 10 feet below the low water table elevation, and air will be injected at a rate of 2 to 3 scfm per well. Compressed air will be supplied using positive displacement blowers located on the railyard. These blowers will be contained in insulated sound enclosures to reduce noise impacts. Compressed air piping will be placed in trenches to connect the equipment on the railyard with the air sparging wells.

All work surfaces will be replaced to pre-cleanup conditions. A flush-with-grade monument will be present at each wellhead. All other equipment will be restricted to a small equipment pad.

In Situ Flushing

In situ flushing might be used to remove free product for a number of alternatives (Figure 6-23). *In situ* flushing is an enhanced groundwater extraction and treatment system that uses a combination of heat, polymers, and surfactants to remove free product and residual soil impacts. Flushing will be performed during high water conditions to enable free product removal from the top of the smear zone. Flushing is only considered for limited-access areas (e.g., under active rail lines) since it is not a proven technology at full scale for the type of contaminants at this site, and there is no established treatment method for reuse of excavated water or discharge of treated water to the River.

To simplify the layout of flushing systems, two standard flushing units were created assuming 40-foot spacing between injection and extraction wells within a row and 80-foot spacing between rows of wells. These units are 90 gpm (3 injection and 3 extraction wells) and 60 gpm (2 injection and 2 extraction wells) in size with equal injection and extractions rates. All wells will be screened to 15 feet below the water table. Each unit will operate for a period of about 6 months in order to exchange 10 pore volumes of water. For the free product areas where flushing is being considered, the system includes three 90-gpm units and one 60-gpm unit for a total flow rate of 330 gpm for the two northwest plumes and one 60-gpm unit for the far east plume.

The water conditioning (heating and mixing) system will be located on the railyard as will the water treatment system. Extracted and treated water will be recycled to the maximum amount possible. These systems will be connected to the wells by piping and trenches placed on the railyard and on public and private property. Injection pipes will be insulated to minimize heat loss. Trench areas will be backfilled and replaced to pre-cleanup conditions. Horizontal borings might be required underneath railroad tracks to connect the wells to the treatment and conditioning system.

Excavation

Excavation in the Railyard Zone includes either (1) excavation of free product at the two southern free product plumes, or (2) the complete excavation of all free product areas and all contaminated soil (Figure 6-24). These two scenarios are discussed individually below; however, both scenarios would occur during low water conditions to maximize access to impacted smear zone soil. Clean overburden soil will be stockpiled as close to the excavation as possible and will be used as clean backfill. Impacted soil will be stockpiled on the railyard for on-site treatment or hauling to an off-site landfill via rail or truck. All utilities will need to be protected or temporarily rerouted to facilitate excavation. Little to no site clearing is required on the railyard although excavation of all contaminated soil will require temporary relocation of rail lines.

- **Excavation to Remove Free Product at the Two Southern Plumes.** This scenario is intended to maximize free product removal while avoiding disruption of railyard activities. This scenario will be used in conjunction with flushing to address the inaccessible free product areas. Accessibility is generally defined as anywhere a building or active rail line is not present. For the purpose of the FS/EIS, it is assumed that excavations will be sloped to maintain the stability of surface structure and rail lines. Based on this scenario, approximately 2,634 cy of soil will be excavated with 2,011 cy requiring treatment or disposal. All grades and surfaces will be replaced to pre-excavation conditions.

- **Excavation to Remove All Contaminated Soil**. This scenario is only included in one remedial alternative. The excavation will require the temporary relocation and replacement of active rail lines to provide complete site access for excavation. Based on the excavation of all free and residual product, approximately 24,543 cy of soil will be excavated with 12,682 cy requiring treatment or disposal. Based on the excavation of all soil exceeding cleanup levels, approximately 151,543 cy of soil will be excavated with 80,325 cy requiring treatment or disposal. All grades and surfaces will be replaced to pre-excavation conditions.

6.4.1.7 All Cleanup Zones (Institutional Controls)

Institutional controls are an essential component of any cleanup action. Institutional controls are legal or administrative measures designed to limit or control activities that could result in exposures to contamination before, during and after a cleanup action, particularly if contaminant residues are likely to remain above cleanup levels for an extended period of time. For the Skykomish cleanup, institutional controls would be designed to:

- Ensure access by BNSF or Ecology to remedial systems (e.g., cleanup or monitoring equipment) before, during and after active cleanup operations

- Protect residents and construction workers from exposure to hazardous substances on site during and after active cleanup operations

A common form of institutional control that satisfies these objectives is a Restrictive Covenant that limits or restricts the use of a property. The Covenant is said to “run with the land” as provided by law and is binding on all parties and all persons claiming under them including all current and future owners of any portion of or interest in the property. A Restrictive Covenant for Skykomish properties subject to institutional controls would likely contain:

- A provision prohibiting the removal of groundwater for domestic, agricultural, commercial or industrial purposes

- A requirement that property owners notify and gain the approval of Ecology and BNSF before commencing any work that would require excavating or drilling in areas where hazardous substances are located in the subsurface

- A requirement that the property Owner notify BNSF and Ecology before the Owner conveys any interest in the property, and notify a prospective buyer or tenant of the Restrictive Covenant

- A provision allowing BNSF and Ecology to enter the property at reasonable times and after reasonable notice if necessary to evaluate the cleanup action

- A provision allowing the Owner to remove or modify the Restrictive Covenant with the consent of Ecology

Another common form of institutional control is a local ordinance or a state rule or regulation. Local government, using its general land use authority, can limit the installation of groundwater wells (Skykomish already has such an ordinance) and can require permits before excavation or drilling occurs in contaminated areas. The permit would ensure that any contaminated soil or groundwater be properly managed. Ecology can adopt similar regulations (Ecology already has a rule prohibiting new wells in contaminated zones).

To the extent required by WAC 173-340-440 (11), BNSF will establish financial assurance for cleanup actions that include engineered and/or institutional controls. Financial assurance is intended to demonstrate that BNSF has sufficient resources to pay for costs associated with the operation and maintenance of the cleanup action, including institutional controls, compliance monitoring and corrective measures. BNSF currently provides financial assurance for other cleanup sites using a corporate financial test consistent with EPA requirements (40 CFR Part 264, Subpart F) and comparable state requirements.

6.4.2 Description of Site-Wide Remedial Alternatives

This section provides a summary description of each site-wide remedial alternative. More specific information regarding how each cleanup technology would be implemented in each cleanup zone is described in Section 6.4.1.

Site-wide remedial alternatives were developed to meet cleanup standards for the following three POCs: (1) off-property, conditional groundwater POC at the points of discharge to surface water (SW1 to SW4); (2) on-property, conditional groundwater POC at the property boundary (PB1 to PB4); and (3) the standard POCs (STD). Remedial alternative STD represents the most permanent alternative, and it meets cleanup levels at the standard POCs for all media. A No Action alternative is not presented in the tables but is retained in the text to satisfy SEPA requirements.

Table 6-3 summarizes how the groundwater POCs were combined with soil, sediment, and groundwater cleanup and remediation levels to develop the remedial alternatives. The matrix provides a basis for understanding the alternative development process and comparing the alternatives with respect to compliance with cleanup standards.

All of the alternatives in this FS/EIS (except No Action) can achieve cleanup standards and protect public health and the environment. Thus, the bulk of this document analyses the trade-offs between restoration time frame and degree of permanence (which includes cost), and minimizing adverse impacts to the built and natural environment. A preferred alternative will result from the analysis presented in Section 7 and public and agency comment.

Table 6-4 provides a matrix that illustrates which remedial approaches were selected for each medium in each cleanup zone. Table 6-5 further expands this matrix by providing a summary description of the remedial approach for each zone for each site-wide remedial alternative.

6.4.2.1 Alternatives With the Off-Property, Conditional Groundwater Point of Compliance

The alternatives in this section were developed to meet an off-property, conditional groundwater POC (i.e., groundwater must achieve cleanup levels before discharging to the River or Maloney Creek). The SW alternatives will improve groundwater at the site but will not meet groundwater cleanup levels between BNSF property and the River. Per WAC 173-340-720 (8)(d)(ii), the affected property owners between the railyard and the surface water body must agree in writing to the use of the conditional point of compliance. The alternatives are discussed from left to right on Table 6-5 as you proceed through the discussions below. In general, more aggressive alternatives are more costly than less aggressive alternatives, thereby reducing restoration time and increasing permanence.

Alternative SW1

The cleanup technologies that combine to make up Alternative SW1 are listed on Table 6-5. Together these remedial approaches satisfy the minimum requirements of MTCA by removing free product, satisfying groundwater cleanup standards before reaching points of discharge, and providing containment and institutional controls to prevent dermal contact with soil off the railyard (Figure 6-25). This alternative permanently addresses the higher risk pathways of:

- Groundwater and oil discharges to the Skykomish River
- Contaminated surface soil that might cause dust or be a direct contact concern

This alternative also minimizes short-term impacts to the community and the environment while relying on a long restoration timeframe and institutional controls to achieve cleanup.

Natural attenuation is used in the Former Maloney Creek Aquatic Zone to minimize the potential for habitat damage while attempting to restore soil and groundwater that is moderately impacted by petroleum.

Sediment impacts in the Levee Zone and the former Maloney Creek channel will be addressed by natural recovery to avoid damage to the habitat and to maximize the net environmental benefit of the habitat.

Alternative SW2

The cleanup technologies that combine to make up Alternative SW2 are listed on Table 6-5. Alternative SW2 builds on SW1 by adding the following elements:

- Free product recovery trenches in the NW Developed Zone to supplement the existing barrier wall and skimming system
- More aggressive free product recovery on the railyard by replacing skimming wells with recovery trenches at the property boundary and adding skimming wells to remove free product from the interior of the railyard

A plan view illustrating the SW2 site-wide remedial alternative is provided in Figure 6-26. This alternative provides some additional short-term protectiveness but does not significantly shorten the long restoration time frame.

Alternative SW3

The cleanup technologies that combine to make up Alternative SW3 are listed on Table 6-5. Alternative SW3 provides the following additional actions relative to SW2:

- Excavating or grouting of free product in the levee to reduce the time frame required to eliminate seeps
- Removing impacted surface sediment associated with the free product removal in the levee noted above

- Implementing enhanced bioremediation in the NE Developed Zone to achieve soil and groundwater cleanup levels

- Excavating free product, where accessible, in the NW Developed Zone

A plan view illustrating the SW3 site-wide remedial alternative is provided in Figure 6-27. This alternative provides additional short-term protectiveness in the Levee Aquatic Zone, reduces the time frame to permanently remove free product in the NW Developed Zones, and accelerates groundwater cleanup in the NE Developed Zone.

Alternative SW4

The cleanup technologies that combine to make up Alternative SW4 are listed on Table 6-5. Alternative SW4 is evaluated with a conditional groundwater POC at the River and Maloney Creek. This alternative provides additional cleanup actions as follows:

- Excavating, ozone sparging, or flushing in the levee to a soil remediation level that is protective of groundwater

- Removing all contaminated surface sediment in the Skykomish River

- Removing impacted surface sediment in the former Maloney Creek channel to the extent that it does not significantly damage the wetland

- Implementing enhanced bioremediation in the former Maloney Creek channel to address soil impacts and reduce the potential for recontamination of sediment

- Excavating all soil above cleanup levels from the South Developed Zone

- Excavating or flushing all free product in the NW Developed Zone

- Excavating shallow smear zone impacts in the NW Developed Zone to 4 feet bgs to reduce the likelihood of direct contact by residents and public utility workers

- Excavating surficial TPH impacts on the railyard in addition to metals.

A plan view illustrating the SW4 site-wide remedial alternative is provided in Figure 6-28. This alternative accelerates cleanup in the Levee Aquatic

Resource Zone and removal of free product, and it more permanently addresses direct contact risks.

6.4.2.2 Alternatives With the On-Property, Conditional Groundwater Point of Compliance

The alternatives in this section were developed to meet on-property conditional groundwater POC (i.e., groundwater must achieve cleanup standards as close as practicable to the source without exceeding the BNSF property boundary). Each of the PB alternatives will clean up groundwater from BNSF property to the River. The alternatives are discussed from left to right on Table 6-5 and as you proceed through the discussions below.

Alternative PB1

The cleanup technologies that combine to make up Alternative PB1 are listed on Table 6-5. Alternative PB1 removes free product, complies with groundwater cleanup standards, protects the Skykomish River and Maloney Creek, and provides containment and institutional controls to prevent dermal contact with soil off the railyard (Figure 6-29). This alternative permanently addresses the higher risk pathways of:

- Groundwater and oil discharges to the Skykomish River
- Contaminated surface soil that might be inhaled as dust or might be a direct contact concern

The alternative also looks to address impacts beyond the property boundary by:

- Excavating the South Developed Zone to remove contaminated soil
- Excavating free product from the NW Developed Zone where accessible
- Implementing enhanced bioremediation in the NW Developed Zone

A plan view illustrating the PB1 site-wide remedial alternative is provided in Figure 6-29.

Alternative PB2

The cleanup technologies that combine to make up Alternative PB2 are listed on Table 6-5. Alternative PB2 builds on PB1 by adding the following elements:

- Excavating or grouting of free product in the levee
- Removing impacted surface sediment associated with the free product removal in the levee noted above
- Implementing enhanced bioremediation in the NE Developed Zone
- Using enhanced bioremediation of groundwater at the property boundary to restore groundwater quality in the NW Developed Zone
- Using free product recovery trenches for the interior free product plumes on the Railyard rather than skimming pumps

A plan view illustrating the PB2 site-wide remedial alternative is provided in Figure 6-30.

Alternative PB3

The cleanup technologies that combine to make up Alternative PB3 are listed on Table 6-5. Alternative PB3 builds on PB2 by adding the following elements:

- Excavating, ozone sparging, or flushing free product and impacted soil in the levee
- Removing all contaminated surface sediment in the Skykomish River
- Removing contaminated surface sediment from the Former Maloney Creek channel to the extent that it does not significantly damage the wetland habitat
- Implementing enhanced bioremediation in the Former Maloney Creek Channel to address soil impacts and reduce the potential for recontamination of sediment
- Excavating or flushing all free product in the NW Developed Zone
- Excavating shallow smear zone impacts in the NW Developed Zone to 4 feet bgs to reduce the likelihood of direct contact by residents and public utility workers
- Flushing the 2 northwest free product plumes on the Railyard
- Excavating surficial TPH impacts on the Railyard in addition to metals.

A plan view illustrating the PB3 site-wide remedial alternative is provided in Figure 6-31.

Alternative PB4

The cleanup technologies that combine to make up Alternative PB4 are listed on Table 6-5. Alternative PB4 provides additional action relative to PB3 as follows:

- Excavating all free product and soil impacts in the levee
- Removing all contaminated surface sediment in the former Maloney Creek channel
- Excavating free product in the NE Developed Zone in addition to enhanced bioremediation
- Excavating or flushing all free product and impacted soil associated with groundwater concentrations above cleanup levels
- Excavating or flushing all free product areas on the railyard.

A plan view illustrating the PB4 site-wide remedial alternative is provided in Figure 6-32.

6.4.2.3 Standard Point of Compliance Alternative (STD)

This alternative is included to satisfy the MTCA requirement that one remedial alternative be included in the FS/EIS that achieves cleanup levels for all media at standard POCs. Due to the physical and chemical properties of the petroleum impacts at Skykomish, this alternative relies primarily on excavation of all free product and all impacted soil.

Figure 6-33 shows the layout of these excavations for free product, soil, and sediment. The excavations will be performed to remove all free product, all soil above cleanup levels, and all sediment above cleanup levels. The River and Maloney Creek would be restored, the levee would be rebuilt and structures, roads and utilities would be replaced or rebuilt.

7 MTCA and SEPA Evaluation of Remedial Alternatives

This section evaluates each of the proposed remedial alternatives with respect to threshold and other requirements for cleanup actions set forth in MTCA, Ch. 70.105D(WAC 173-340-360) and significant adverse environmental impacts, mitigation measures, and unavoidable adverse environmental impacts, as required by SEPA, Chapter 43.21 RCW (WAC-197-11-400). Integration of the MTCA and SEPA evaluations is encouraged by Ecology (WAC 197-11-262). A draft *Guide for the Integration of MTCA with SEPA* (Ecology, 2002a) was also consulted for the following discussion.

The requirements of MTCA and SEPA against which the alternatives are evaluated are first described in Sections 7.1 and 7.2, respectively. The action and No Action alternatives are evaluated against MTCA and SEPA requirements in Sections 7.3 to 7.12. A comparative summary of the alternatives evaluation and a substantial and disproportionate cost analysis of the alternatives are provided in Sections 7.13 and 7.14 respectively.

7.1 MTCA Requirements for Remedial Alternatives

Cleanup actions selected under MTCA must meet several requirements that address multiple factors in addition to the overarching goal of protecting human health and the environment. These requirements include threshold requirements and "other requirements" per WAC 73-340-360(2)(a) and (b) and as summarized in the following subsections. WAC 173-340-360(2)(c) through (h) minimum requirements were considered in developing the alternatives. The remedial alternatives are evaluated against these requirements in Sections 7.3 to 7.12. The final selection of a cleanup action will be based on the requirements of WAC 173-340-360(2). This complete analysis is provided in Section 8.

7.1.1 Threshold Requirements

WAC 173-340-360(2)(a)) lists four threshold requirements for cleanup actions. All cleanup actions must:

- Protect human health and the environment
- Comply with cleanup standards
- Comply with applicable state and federal laws
- Provide for compliance monitoring

All of the alternatives presented in Section 6.4.2 (except No Action) are designed to meet these threshold requirements, as described below.

7.1.1.1 Protect Human Health and the Environment and Comply with Cleanup Standards

The SW alternatives protect human health and the environment by meeting cleanup standards for groundwater at a conditional point of compliance where groundwater discharges to the Skykomish River (Table 7-1). All free product will be removed, petroleum discharges to the river will be eliminated, and surface soil contamination of the rail yard will be removed. Upland soil and groundwater between the rail yard and river will continue to exceed cleanup levels. Protection is achieved through containment (protective soil cap), institutional controls, and a long-term maintenance and monitoring program. Adverse impacts on the built and natural environment and potential mitigation measures are discussed in Section 7.4-7.7.

The PB alternatives meet groundwater standards at the railyard property boundary, another potential conditional point of compliance. All free product will be removed, petroleum discharges to the river and Maloney Creek will be eliminated, surface contamination on the rail yard will be removed and groundwater between the rail yard and river will be restored. Adverse impacts on the built and natural environment and potential mitigation measures are discussed in Section 7.8-7.11.

Subsurface soil on and off the rail yard will continue to exceed cleanup levels. Protection with respect to this material is achieved through containment, institutional controls and a long-term maintenance, inspection and monitoring program

The standard (STD) alternative achieves protection by meeting cleanup levels throughout the site for all media (sediment, groundwater, soil and surface water). Sediment cleanup is attained through some combination of natural recovery, removal, and enhanced bioremediation. All free product and contaminated soil is removed. Groundwater is restored to drinking water quality through natural attenuation following free product and soil removal. No long-term maintenance, inspection and monitoring program is required. Adverse impacts on the built and natural environment and potential mitigation measures are discussed in Section 7.12.

7.1.1.2 Comply with State and Federal Laws

Compliance with applicable state and federal laws is ensured, in part, through selection of the numeric cleanup levels (Section 5) that protect air, groundwater, surface water, and soil quality. Aside from cleanup levels, compliance must also be ensured in the manner by which prospective remedial alternatives are implemented. As described in Section 5, there are numerous laws and associated regulations that influence how any particular remedial action is implemented. Permitting by federal agencies, substantive standards promulgated by state and local agencies, best management practices, workplace safety, and off-site waste disposal practices are just a few of the aspects that must be formally addressed in the design and implementation phases of a cleanup action to ensure compliance with applicable laws. None of the alternatives possess features that cannot be designed and implemented in full compliance with these laws.

7.1.1.3 Provide for Compliance Monitoring

Compliance monitoring refers to the collection, analysis, and reporting of environmental data to determine the short and long-term effectiveness of the cleanup action and whether protection is being achieved in accordance with the cleanup objectives. Compliance monitoring plans are developed in conjunction with the Cleanup Action Plan and typically involve standard field techniques and laboratory analytical methods. All of the remedial alternatives presented in Section 6 include comprehensive compliance monitoring plans that fulfill the requirements of WAC 173-340-410.

7.1.2 MTCA "Other Requirements"

Under MTCA, alternatives that meet the threshold requirements described above must also meet the following "other requirements" (WAC 173-340-360(2)(b)):

- Use permanent solutions to the maximum extent practicable
- Provide for a reasonable restoration time frame
- Consider public concerns

As the remedial alternatives were all designed to meet threshold requirements (except for No Action), the evaluation of remedial alternatives presented in this section focuses primarily on these other requirements that are described below. Table 7-2 is a compilation of relevant evaluation outcomes for each of the "Other Requirements" of cleanup actions under MTCA.

7.1.2.1 Use Permanent Solutions to the Maximum Extent Practicable

MTCA specifies that, when selecting a cleanup action, preference shall be given to actions that are "permanent to the maximum extent practicable." Multiple approaches to cleanup are possible for this site. Selecting one that is permanent "to the maximum extent practicable" requires the weighing of costs and benefits. MTCA defines this balancing as a "substantial and disproportionate cost analysis" (WAC 173-340-360(3)(e)). The analysis can be both quantitative (e.g., degree of hazardous substance volume or mass reduction, costs) and qualitative (e.g., overall protectiveness, implementability, consideration of public concerns). Section 7.14 presents a substantial and disproportionate cost analysis for the remedial alternatives presented in this FS/EIS. The alternatives span a broad range of costs and have widely varying impacts on the community and environment. Often, however, the alternatives afford only incremental or minor degrees of protection and permanence.

One important measure of permanence is the degree to which an alternative reduces the mass or toxicity of contamination present. All of the alternatives (except No Action) remove soil contaminated with metals and thus are equivalent in this regard. Hydrocarbons (in soil and as free product) are the majority contaminants at the site, removal or treatment of hydrocarbons is a useful measure of permanence with which to differentiate the alternatives.

In Section 8, an "equivalent soil volume" removed or treated is calculated for each alternative as a surrogate for hydrocarbon mass and permanence. An equivalent volume is a normalized or weighted volume based on the level of contamination and defined as follows:

- Free product volume (yd^3 x 10)
- Remediation level soil volume (yd^3 x 5)
- Other soil (i.e., below remediation level; yd^3 x 1)

The remediation level for soil is roughly equivalent to a TPH concentration of 10,000 mg/kg. "Other Soil" refers to material ranging in TPH concentration from the cleanup level to the remediation level. Thus, 1 cubic yard of soil in the smear zone containing free product is weighted by a factor of 10 compared with, for example, vadose zone soil that is above the cleanup level but below the approximate remediation level of 10,000 mg/kg. Soil containing metals was assigned a weighting factor of 1.

7.1.2.2 Provide for a Reasonable Restoration Time Frame

A reasonable restoration time frame is another requirement for evaluating alternatives. MTCA places a preference on those alternatives that, while equivalent in other respects (e.g., permanence, implementation risks to the community and environment, costs) can be implemented in a shorter period of time. Thus, while all of the alternatives (except No Action) attain cleanup standards, they vary in the time required to do so.

7.1.2.3 Community Concerns

Community concerns are considered by Ecology in the selection of cleanup actions and are formally obtained during required Public Notice and Participation periods per WAC 173-340-600. Community concerns have been gauged informally as discussed in Appendix A. This FS/EIS will undergo a formal public comment period to solicit comments from the community on the proposed remedial alternatives after the document has been revised to incorporate Ecology feedback.

Issues of particular interest and concern to the community of Skykomish include the prospects for significant disruptions and disturbances (e.g., noise, traffic, temporary relocation of residents and structures) that could attend a cleanup action. In addition, the community has expressed concerns over the potential duration and effectiveness of cleanup actions, protection of the environment, protection of public health, public facilities such as the school, water supply, septic waste treatment and disposal, the local economy, and property values. While some of the socio-economic concerns of the community are not directly addressed through MTCA or SEPA, the alternatives presented in this document span a range of actions that attempt to balance the concerns already expressed by the community with other MTCA and SEPA factors such as permanence, effectiveness, restoration time frame, and avoiding or mitigating adverse impacts on the built and natural environment.

7.2 SEPA Requirements for Remedial Alternatives

Ecology and BNSF have agreed that cleanup of the site will have probable significant adverse impacts on the environment (Ecology, 2002). Ecology and BNSF identified the following areas for discussion in the EIS often soliciting public and agency comments:

- Impacts on health, safety, and welfare of the people in the town of Skykomish
- Impacts on fish and wildlife in the Skykomish River and Maloney Creek
- Impacts on the built environment, including buildings, roads and utilities
- Impacts on natural resources such as wetlands, groundwater and surface water

A summary of the SEPA impact analysis for the cleanup alternatives is presented in Table 7-3. Significant impacts are denoted with a "+" in Table 7-3 and presented for each alternative. Table 7-4 presents the basis for assigning adverse impacts. In general, adverse impacts, which are "more than moderate," are considered significant adverse impacts (WAC 197-11-794). Adverse impacts that are "likely or reasonably likely" are considered "probable" and those that are "remote or speculative" are not. A more-detailed discussion of adverse impacts, organized by type of impact, is presented in Appendix A. See Table 7-3 or 7-4 for the explanation for the codes presented in the SEPA impact summaries for each alternative.

The discussion in the following sections also addresses proposed mitigation measures and whether an impact is an unavoidable, significant adverse impact. Table 7-5 summarizes unavoidable significant adverse impacts. In general, short-term impacts can reasonably be mitigated. Long-term impacts are more likely to be unavoidable, or require extensive mitigation efforts that may not be reasonable.

7.3 No Action Alternative

A No Action alternative is required as part of the FS/EIS. This alternative includes continued use of the existing barrier wall and associated free product skimming system. This system (wall and skimmers) is collecting free product at the site at the leading edge of the plume and should ultimately result in the cessation of seeps to the Skykomish River. A dust suppressant will continue to be applied to metals-impacted surface soils on the railyard to minimize airborne exposures. Oil recovery booms will continue to be maintained along the River to recover oil. Long-term groundwater monitoring will also be performed. The alternative will not restore groundwater or sediment quality in Maloney Creek and the River. Further, the alternative will not fully protect people or ecological receptors from exposure to surface or subsurface contamination. The No Action alternative will effectively satisfy the MTCA requirement to collect free product.

No Action would not significantly affect the built environment. No roads, buildings or utilities would be physically damaged or disrupted. The long-term presence of contamination could deter future investment in the built environment and the community. The natural environment would continue to be significantly and adversely impacted by the contamination present.

7.4 Alternative SW1

Alternative SW1 consists of:

- Enhancing bioremediation in the Levee Aquatic Resource Zone
- Monitoring natural attenuation in the Former Maloney Creek Aquatic Resource Zone
- Monitoring attenuation in the NE Developed Zone
- Excavating free product, excavating surface TPH and monitoring natural attenuation in the South Developed Zone
- Excavating surface metals, maintaining the barrier wall and recovery system, and monitoring natural attenuation in the NW Developed Zone

- Excavating surface metals, capping, skimming free product, and monitoring natural attenuation in the Railyard Zone

7.4.1 Model Toxics Control Act

Protection of human health is achieved in the short-term (less than 1 year) through excavation of surface soil containing metals and implementation of institutional controls. Soil exceeding the cleanup level remains in place across much of the site and is isolated from the ground surface by a protective layer of clean soil (or ballast on the railyard). Enhanced bioremediation and natural attenuation of free product between the barrier wall and the river achieve groundwater cleanup levels at the conditional point of compliance within 10 years. Natural recovery returns sediments to protective levels in less than 10 years. Threshold requirements are met after free product is recovered site wide, a process likely to take more than 30 years to complete.

SW1 is implementable from both a technical and administrative standpoint. Further, short-term risks during implementation are minor and manageable using standard methods and procedures for protecting workers and the community. Access agreements to private property are needed for monitoring.

Protection of human health is achieved by free product and removal/disposal of surface soil containing metals. Isolation of soil exceeding cleanup levels and institutional controls to prevent exposures to contaminated media (soil, free product, and groundwater) is not permanent. In the long term groundwater will achieve protective concentrations due to the removal of free product. However, protection with respect to these media is achieved through long-term maintenance, inspection and monitoring.

7.4.2 State Environmental Policy Act

The tabulation below summarizes the remediation activities the significant adverse impacts and mitigation measures. Refer to Table 7-3 and Appendix A for more detailed analysis and a comparison of significant impacts among alternatives.

Zone	SW1 Remediation Activity	Impacts/*Mitigation*
Aquatic Resource Zone – Levee	Biosparging (enhanced bioremediation)	Product seeps along levee will continue to be an impact until enhanced bioremediation takes effect Disturb levee riparian habitat and wildlife during implementation of enhanced bioremediation system / ***minimize disturbance by avoiding removing large trees, re-vegetate with native species*** Noise, traffic, limits on land use / ***limit work hours***

Aquatic Resource Zone – Former Maloney Creek Channel	Monitoring natural attenuation	Long-term presence of contaminant sediment and potential discharge to groundwater may create impacts until natural recovery occurs No significant impacts expected from TPH in surface sediment, groundwater, or smear zone
Developed Zone – NE	Monitoring natural attenuation	Limits on land use Restriction of pumping of groundwater
Developed Zone – South	Excavating free product Excavating surface TPH Monitoring natural attenuation	Traffic / ***limit work hours*** Greater noise during working hours / ***limit work hours*** Loss of approx. 0.11 acres of topsoil, in part from residential gardens / ***replace topsoil in residential areas*** Dust / ***monitor dust and suppress dust, e.g. by applying water or dust suppressant during construction, covering railcar/truck loads*** Erosion and increased sediment loads in stormwater / ***divert stormwater from excavation & control runoff using hay bails, silt fences, sediment ponds, etc., work during dry season***
Developed Zone – NW	Excavating surface metals Maintaining the barrier wall and recovery system, Monitoring natural attenuation	Traffic / ***limit work hours*** Greater noise during working hours / ***limit work hours, limit work around the school when in session*** Approx. 12.9 acres of topsoil lost / ***replaced by excavated soil*** Dust / ***monitor dust and suppress dust, e.g. by applying water or dust suppressant during construction, covering railcar/truck loads*** Erosion & increased sediment loads in stormwater / ***divert stormwater from excavation & control runoff using hay bails, silt fences, sediment ponds, etc., work during dry season***
Railyard Zone	Excavating surface metals Capping Skimming free product Monitoring natural attenuation	Greater noise during working hours / ***limit construction to weekdays, limit work around the school when in session.*** Dust / ***monitor dust and suppress dust, e.g. by applying water or dust suppressant during construction, covering railcar/truck loads*** Erosion and increased sediment loads in stormwater / ***divert stormwater from excavation & control runoff using hay bails, silt fences, sediment ponds, etc., work during dry season***

7.4.2.1 Levee and River Sediments

Adverse impacts to this zone are limited to minor and temporary impacts to levee riparian habitat and wildlife due to disturbances during the implementation of the enhanced bioremediation system, and minor impacts from noise, traffic, and land use (institutional controls). Product seeps along the levee will continue to be a major impact until product remaining downstream of the barrier wall is addressed by enhanced bioremediation or is collected in the sorbent booms.

7.4.2.2 Former Maloney Creek Channel

No adverse impacts to this zone are expected as a result of natural attenuation. The benefits of this cleanup action would be realized after a long period of time. The long-term presence of impacted sediment and potential discharge to groundwater may create moderate impacts until natural recovery occurs. There is no data to indicate significant impact from TPH in surface sediment, groundwater or the smear zone. No damage would occur in the wetland due to construction.

7.4.2.3 Northeast Developed Zone

Minor impacts to this zone are expected on land use due to institutional controls. Another minor impact is the restriction of pumping of groundwater.

7.4.2.4 Northwest Developed Zone

Surface soil excavation to clean up metals results in adverse impacts including moderate impacts on traffic Noise impacts (greater than 60 dBA during working hours) will be unavoidable. Moderate but short-term impacts to soil (approximately 12.9 acres of topsoil lost) will be mitigated by replacement of excavated soil with comparable material. Minor or temporary impacts may occur to air quality, topography, flooding, runoff, habitat and wildlife, and aesthetics. The continued presence of free product will have a minor long-term impact in land use and public services due to institutional controls.

7.4.2.5 South Developed Zone

Excavation of free product and surface soil in this zone results in moderate impacts to traffic and noise (greater than 60dBA during working hours). No major adverse impacts are expected. Minor or temporary impacts may occur to soil (approximately 0.11 acres of topsoil, in part in residential gardens lost), topography, air quality, odors, flooding, runoff, groundwater quality and quantity, land use (institutional controls), wildlife and habitat, aesthetics, hazardous substances, and public services (utilities and/or septic tanks and leach fields). Contaminated soil above cleanup levels will continue to be present under this alternative but is not a major impact due to the depth of contamination, the availability of public water and implementation of institutional controls which will limit exposure and provide a mechanism for BNSF to manage contaminated soil and water generated during construction activities on affected properties.

7.4.2.6 Railyard

Moderate impacts from noise (greater than 60 dBA during construction) may be expected. No significant major impacts are expected. Minor or temporary impacts in this zone include topography (due to temporary soil piles), air quality (due to emissions from excavation equipment), odors, runoff (impacts due to trenching), habitat and wildlife, land use (institutional controls), transportation, and traffic. There are no significant impacts resulting from the continued presence of free product, as the skimming system will reduce migration off the railyard.

7.4.2.7 Proposed Specific Mitigation Measures

Proposed specific mitigation measures include standard construction best management practices (BMPs) for the protection of soil and water, air quality, fish and wildlife, vegetation, aesthetic and historical resources, human health and public property, including construction timing restrictions, implemented under all alternatives. In addition, replacement of excavated soil mitigates for soil impacts in the developed areas. Specific mitigation measures are provided in the tabulation above.

Impacts on land use from contaminated soil and groundwater can be mitigated by maintaining a clean soil cover at the surface, continuing to make public water available, and implementing institutional controls which will limit exposure and provide a mechanism for BNSF (or the Town with technical and financial assistance from BNSF) to safely manage contaminated soil and water encountered during construction activities on private and public properties.

7.4.2.8 Unavoidable Significant Adverse Impacts of Alternative SW1

Unavoidable significant impacts of Alternative SW1 include increased truck traffic in the town of Skykomish and on U.S. 2. Local truck traffic is estimated at 40 truck trips for each of 2 days around town. There would be approximately 4-8 days of increased truck traffic (defined for the purposes of the FS/EIS as 50-100 truck trips per day resulting in an increase of approximately 2.1-4.2% in traffic) along U.S. 2. There would also be relatively high noise levels in town during working hours.

7.5 Alternative SW2

Alternative SW2 consists of:

- Enhancing bioremediation in the Levee Aquatic Resource Zone
- Monitoring natural attenuation in the Former Maloney Creek Aquatic Resource Zone

- Monitoring attenuation in the NE Developed Zone
- Excavating free product, excavating surface TPH and monitoring natural attenuation in the South Developed Zone
- Installing free product recovery trenches, excavating surface metals and monitoring natural attenuation in the NW Developed Zone
- Excavating surface metals, capping, skimming free product, recovering free product with trenches and monitoring natural attenuation of groundwater in the Railyard Zone

7.5.1 Model Toxics Control Act

The MTCA evaluation of Alternative SW2 is nearly equivalent to that for SW1 because of the minor technical differences between the two alternatives. With SW2, free product removal time decreases because of the greater number and density of free product recovery elements (trenches and well-based recovery equipment).

Access agreements to private property are needed to service and monitor free product recovery equipment.

As with SW1, protectiveness of human health is achieved by removal/disposal of surface soil containing metals. Isolation of subsurface soil exceeding cleanup levels and institutional controls to prevent exposures to contaminated media (soil, free product and groundwater) are effective but lack permanence and long-term protectiveness, as defined by MTCA.

7.5.2 State Environmental Policy Act

The tabulation below summarizes the significant adverse impacts described in the text as major or unavoidable for this alternative. In general, the impacts are very similar to those previously described for Alternative SW1. Exceptions are noted below for the NE Developed Zone, the NW Developed Zone, and the Railyard Zone. See Table 7-3 and Appendix A for more details and a comparison among alternatives. The tabulation below summarizes the remediation activities, significant impacts and mitigation measures, described in the text.

Zone	SW2 Remediation Activity	Impacts / *Mitigation*
Aquatic Resource Zone – Levee	Same as SW1	Same as SW1
Aquatic Resource Zone – Former Maloney Creek Channel	Same as SW1	Same as SW1
Developed Zone – NE	Same as SW1	Same as SW1
Developed Zone – South	Same as SW1	Same as SW1
Developed Zone – NW	Same as SW1, except: Installing free product recovery trenches (instead of maintaining the barrier wall)	Same as SW1, with this addition: Trench work for free product recovery products additional impacts to odors, roads, and temporary housing inconvenience for residents. Odors & housing disruption / ***provide temporary housing for affected residents*** Road blockages / ***setup work areas to ensure emergency vehicle access and alternate routes*** Safety / ***ensure no public access to work areas, secure areas when unattended***
Railyard Zone	Same as SW1, but adds: Recovering free product with trenches	Same as SW1 (additional free product skimming in the interior of the railyard does not significantly increase impacts)

7.5.2.1 Northeast Developed Zone

Minor impacts to this zone are expected on land use due to institutional controls. Another minor impact is the restriction of pumping of groundwater.

7.5.2.2 Northwest Developed Zone

Adverse impacts to this zone are similar to those for Alternative SW1. Trench work for free product recovery results in additional minor or temporary impacts to odors, roads, and housing (temporary inconvenience for residents). Trench installation would be expected to increase the efficiency and rate at which the free product is recovered.

7.5.2.3 Railyard

The additional free product skimming in the interior of the railyard does not lead to different or substantially more extensive impacts than described for Alternative SW1.

7.5.2.4 Proposed Specific Mitigation Measures

Proposed specific mitigation measures include standard construction BMPs for the protection of soil and water, air quality, fish and wildlife, vegetation, aesthetic and historical resources, human health and public property, including construction timing restrictions, implemented under all alternatives. In addition, replacement of excavated soil mitigates for soil impacts in the developed areas. In addition to the mitigation measures identified in Section 7.4, specific mitigation measures are presented in the tabulation above.

7.5.2.5 Unavoidable Significant Adverse Impacts of Alternative SW2

Unavoidable significant impacts of Alternative SW2 include:

- Increased truck traffic in the town of Skykomish
- 4-8 days of increased truck traffic on U.S. 2
- Relatively high noise levels in town during working hours.

7.6 Alternative SW3

Alternative SW3 consists of:

- Excavating or pressure grouting free product, excavating sediment to remediation levels and enhancing bioremediation in the Levee Aquatic Resource Zone

- Monitoring natural attenuation in the Former Maloney Creek Aquatic Resource Zone

- Enhancing biodegradation in the NE Developed Zone

- Excavating free product, excavating surface TPH, and monitoring natural attenuation in the South Developed Zone

- Excavating free product where accessible, excavating surface metals and monitoring natural attenuation in the NW Developed Zone

- Excavating surface metals, capping, skimming free product, recovering free product with trenches and monitoring natural attenuation in the Railyard Zone

7.6.1 Model Toxics Control Act

This alternative increases permanence and protectiveness over the previous alternatives (SW1 and SW2) by excavating free product in the NW Developed Zone (where accessible), excavating or solidifying free product in the levee, removing contaminated sediments from the Skykomish River, and free product treatment in the NE Developed Zone using enhanced bioremediation. Free product remaining after excavation is prevented from reaching the Skykomish River by the existing barrier wall and passive recovery systems (trenches and skimmers).

Access agreements are needed to excavate and monitor on private property. Disruption to the community occurs as a result of excavation work near homes and other infrastructure. Temporary road and utility service disruptions are likely.

This alternative reduces the restoration time frame relative to previous alternatives, for attainment of sediment and groundwater cleanup levels at the off-property, conditional point of compliance at the levee. While increasing protectiveness and permanence with respect to free product removal, soil and groundwater are likely to remain above cleanup levels across most of the site in the long-term. As with SW1 and SW2, protection is ensured through institutional controls.

7.6.2 State Environmental Policy Act

Excavation in the NW Developed Zone and increased cleanup activity in the levee contribute to greater impacts on the natural and built environment from this alternative. The majority of impacts remain minor, temporary or moderate. See Table 7-3 and Appendix A for more details and a comparison among alternatives. The tabulation below summarizes the remediation activity, significant impacts described in the text, and proposed mitigation measures.

Zone	SW3 Remediation Activity	Impacts / *Mitigation*
Aquatic Resource Zone – Levee	Same as SW2, adding: Excavating or pressure grouting free product Excavating sediment to remediation levels	Impacts and mitigation same as SW2, adding: Greater noise during working hours Construction of access roads / ***provide stormwater & sediment control with silt fences, hay bales, etc*** Traffic Loss of topsoil on levee / ***replace and replant with native vegetation*** Possible use of coffer dam / ***conduct work during dry season when river level is low and work area is dry*** Riparian vegetation removal resulting in temporary reduction in salmonid habitat function / ***perform work during salmon window (July 1 – Sept. 15), only remove necessary vegetation, replant area with native species, re-establish or enhance existing topography***

Aquatic Resource Zone – Former Maloney Creek Channel	Same as SW2	Same as SW2
Developed Zone – NE	Enhanced biodegradation	Wells located in the street / ***flush mount wells,*** Greater noise during working hours / ***limit work hours*** Rerouted utilities due to wells in street
Developed Zone – South	Same as SW2	Same as SW2
Developed Zone – NW	Same as SW2, except: Excavating the shallow smear zone	Impacts and mitigation same as SW2, adding: Trucks Loss of topsoil in residential yards and public areas / ***replace topsoil*** Greater noise during working hours Excavations near or adjacent to residences / ***shore when near excavation,*** Excavations in historic district / ***shore when near excavation, move buildings as necessary.*** Excavation of septic systems / ***provide temporary alternative sewage system*** Utilities (including water mains) disrupted and rerouted / ***reroute utilities prior to excavation to ensure no loss of service.*** Leach fields affected / ***provide temporary alternative sewage system, replace septic systems*** Runoff from clean and contaminated soils piles / ***cover and use run-on/off controls,***
Railyard Zone	Same as SW2	Same as SW2

7.6.2.1 Levee and River Sediments

Excavation of hot spots on the levee and/or solidification combined with limited sediment removal at seep locations results in moderate adverse impacts to noise (greater than 60 dBA during working hours), roads and transportation (access road), and traffic (trucks). No major adverse impacts are expected. Minor or temporary impacts may occur to soil (topsoil loss on levee); these impacts will be mitigated by replacement of excavated soil. Minor impacts may occur to topography, air emissions, odors, river hydrology (possible use of coffer dam), floods, runoff, water quality, habitat and wildlife, aquatic resources (riparian vegetation removal resulting in temporary reduction in salmonid habitat function), sediment, land use (institutional controls), aesthetics, and hazardous substance exposure.

7.6.2.2 Northeast Developed Zone

Enhanced bioremediation in this zone results in moderate adverse impacts to aesthetics (wells located in the street), noise (greater than 60 dBA during working hours), and public services (rerouted utilities from wells in the street). Minor or temporary adverse impacts may be expected for habitat and wildlife, land use (institutional controls), roads, and traffic.

7.6.2.3 Northwest Developed Zone

Excavation of accessible free product and surface soil may cause major adverse impacts to traffic. Moderate adverse impacts may occur to soil (loss of topsoil in residential yards and public areas); these effects will be mitigated by replacement of excavated soil. Moderate adverse impacts may occur to noise (greater than 60 dBA during working hours), housing (excavations near or adjacent to residences), aesthetic and historical structures (excavations in historic district), and public services (excavation of septic systems). Minor or temporary impacts may be expected to topography, air quality, odors, groundwater quality and quantity, flooding, runoff, land use (due to institutional controls), hazardous substance exposure, and habitat and wildlife (vegetation clearing and disturbance).

7.6.2.4 Proposed Specific Mitigation Measures

Proposed specific mitigation measures include standard construction BMPs for the protection of soil and water, air quality, fish and wildlife, vegetation, aesthetic and historical resources, human health and public property, including construction timing restrictions, implemented under all alternatives. In addition, replacement of excavated soil mitigates for soil impacts in the developed areas. In addition to the mitigation measures identified for alternative SW-2 proposed specific mitigation measures are described in the tabulation above.

7.6.2.5 Unavoidable Significant Adverse Impacts of Alternative SW3

Unavoidable significant impacts of Alternative SW3 include:

- Increased truck traffic in the town of Skykomish
- Increased truck traffic on U.S. Highway 2 for 16-32 days
- Temporary road closures
- Relatively high noise levels in town during working hours
- Effects to housing, historical structures, aesthetics and public services as a result of excavation in and near residential areas.

7.7 Alternative SW4

Alternative SW4 consists of:

- Ozone sparging, flushing or excavating soil and free product, excavating sediment to cleanup levels and enhancing bioremediation in the Levee Aquatic Resource Zone
- Enhancing bioremediation and excavating sediment to remediation levels in the Former Maloney Creek Aquatic Resource Zone
- Enhancing bioremediation in the NE Developed Zone
- Excavating all soil above cleanup levels in the South Developed Zone
- Excavating or flushing free product, excavating surface metals, excavating the shallow smear zone and monitoring natural attenuation in the NW Developed Zone
- Excavating surface metals and TPH, capping, skimming free product, recovering free product using trenches and monitoring natural attenuation in the Railyard Zone

7.7.1 Model Toxics Control Act

This alternative increases permanence and effectiveness over the previous alternative (SW3) by excavating or surfactant flushing all free product in the NW Developed Zone, removing shallow soil contamination in the NW Developed Zone (where accessible), removing near-surface, TPH-contaminated soil in the railyard and more aggressively attending to sediment impacts at the Skykomish River and Former Maloney Creek. Either excavation, ozone sparging or surfactant flushing are used at the levee to remediate free product and soil contamination. Both *in situ* technologies require testing to confirm effectiveness and implementability.

Access agreements are needed to excavate, surfactant flush, and monitor on private property. Disruption to the community occurs as a result of excavation work near homes and other infrastructure. Temporary road and utility service disruptions are likely.

This alternative reduces restoration time frames (relative to the previous alternatives), primarily with respect to attainment of cleanup levels at the Aquatic Resource Zones. Actions in the Former Maloney Creek have significant impacts on the natural environment (See SEPA analysis below) and may outweigh any benefit from restoration measures more aggressive than natural recovery.

Protectiveness and permanence are increased in the NW Developed Zone in that free product efficiency is greater (flushing can be used to remove free product from beneath structures). Nevertheless, soil and groundwater are likely to remain above cleanup levels across most of the site in the long-term. As with SW1, SW2 and SW3, protection is ensured through institutional controls.

7.7.2 State Environmental Policy Act

Excavation and surfactant flushing in the NW Developed Zone and increased cleanup activity in the Former Maloney Creek and Levee Zones contribute to greater impacts on the natural and built environment from this alternative. The majority of impacts remain minor, temporary or moderate. See Table 7-3 and Appendix A for more details and a comparison among alternatives. The tabulation below summarizes the remediation activities, significant impacts and proposed mitigation measures.

Zone	SW4 Remediation Activity	Impacts / *Mitigation*
Aquatic Resource Zone – Levee	Same as SW3, except: Ozone sparging or flushing instead of excavation or pressure grouting Excavating sediment to cleanup levels (instead of to remediation levels)	Impacts and mitigation same as SW3, adding: Groundwater quality may be impacted if flushing agents are used / ***control flushing agents, monitor water quality during activities and suspect if impacts occur.***
Aquatic Resource Zone – Former Maloney Creek Channel	Enhancing bioremediation Excavating sediment to remediation levels	Clearing of approx. 0.5 acres of forested wetland habitat during excavation and an additional 0.4 acres for installation of air sparging wells / ***avoid removing mature trees, only clear necessary vegetation, revegetate with native wetland species, control sedimentation by conducting work during dry season and using BMPs for sediment control, compensatory mitigation*** Loss of sediment with slow natural recovery / ***reestablish or enhance pre-existing topography, mitigate wetland loss under Wetland Compensatory Mitigation Plan*** Greater noise during working hours / ***limit working hours*** Reduction in or temporary loss of access to salmonid habitat / ***restrict salmonid access to wetland until work and restoration is complete.***
Developed Zone – NE	Same as SW3	Same as SW3

Developed Zone – South	Same as SW3, except: Excavating all soil above cleanup levels and not including monitored natural attenuation	Same as SW3, adding:**.** One building affected / ***shore building during excavation*** Removal of part of developed habitat adjacent to wetland / ***reestablish habitat in accordance with applicable regulations***
Developed Zone – NW	Same as SW2, except: Excavating free product where accessible (instead of recovery trenches)	Same as SW3, adding: Full excavation of all free product and excavation of shallow smear zone soil is worse case scenario Traffic / ***address dust by covering loads, using wheel washes, washing site roads as necessary.*** Public roads closed for lengthy periods / ***ensure alternate access for fire service access, temporarily re-house affected residents*** Large portions of school property affected / ***conduct activities during recess as much as possible, limit work around school when in session, provide access restrictions to work area, monitor air quality and use dust suppression as necessary.*** Remove large quantities of soil / ***replace soil with clean fill, restore areas consist with former use.***
Railyard Zone	Same as SW3, adding: Excavating TPH as well as surface metals	Similar to SW2. Excavation of surface soils contaminated with TPH will slightly increase impacts over SW2.

7.7.2.1 Levee and River Sediments

Sediment excavation to cleanup levels and ozonation, flushing, or excavation of levee will result in moderate adverse impacts to noise (greater than 60 dBA during working hours), aquatic resources (removal of riparian vegetation and coarse substrates resulting in short-term loss of salmonid habitat), and roads (duration of excavation and well installation). No major adverse impacts are expected. Minor or short-term impacts may include topography, air quality, odors, groundwater quality (if flushing agents are used), wildlife and habitat, sediment, hydrology (use of coffer dam during low-flow period), floods, runoff, surface water quality, aesthetics, land use (institutional controls), hazardous substance exposure, and traffic.

7.7.2.2 Former Maloney Creek Channel

Major adverse impacts are expected as a result of sediment excavation to habitat and wetlands in Maloney Creek. Approximately 0.5 acre of forested wetland habitat would be cleared during excavation, and an additional 0.4 acres cleared for installation of air sparging wells. Moderate adverse impacts are expected to sediment (loss of resource with slow natural recovery), noise (greater than 60 dBA during working hours), and aquatic resources. A reduction in salmonid habitat and temporary loss of access to salmonid habitat would occur as a result of removal of surface sediment and use of the cofferdam. In addition, minor or temporary impacts are likely for topography, former Maloney Creek hydrology, runoff, floods, traffic, and aesthetics.

7.7.2.3 Northwest Developed Zone

This alternative may include flushing, excavation or a combination of excavation and flushing of all free product. The worst case with respect to impacts to the community includes excavation of all free product (including under buildings) and excavation of shallow smear zone soil to cleanup levels. This worst case is the scenario evaluated here. Details regarding the impacts associated with flushing are available in Appendix A.

Major adverse impacts to aesthetic and historic buildings, traffic, and public services are likely, although less extensive than under the standard alternative. The volume of free product to excavate is less than that for the standard alternative. Utilities, including water mains, will be disrupted and rerouted due to the need to excavate in right-of-ways. Leach fields will be affected. Public roads will be closed off for lengthy periods. Large portions of the school property will be impacted. Moderate adverse impacts are likely for runoff (from clean and contaminated soils piles). Other adverse impacts are roads (frequency of truck trips), noise (greater than 60 dBA during working hours), housing (impacts are considerably reduced if excavation under buildings is avoided), and hazardous substance exposure (due to open excavations in populated areas with the potential for hydrocarbon contact). Minor or temporary impacts are likely for topography, air quality, odors, groundwater quantity and quality (under the flushing scenario), flooding, habitat and wildlife (vegetation clearing and disturbance), and land use (due to institutional controls).

7.7.2.4 South Developed Zone

Full excavation to cleanup levels for this zone results in major adverse impacts to traffic. Traffic impacts include 200 truck trips for 2 days (locally) and increased traffic along U.S. 2 to Everett for excavation of all impacted soil and free product.

Moderate adverse impacts may occur to noise (greater than 60dBA during working hours), housing (one building), and aesthetics. Impacts to aesthetics are due to the removal of part of the developed habitat adjacent to the wetland.

Minor or temporary impacts are likely to soil, topography, air quality, odors, groundwater quality and quantity, floods, runoff, wildlife and habitat, land use (institutional controls), roads, public services, and hazardous substance exposure. With the exception of effects to land use due to institutional controls, these impacts will be offset through the implementation of construction best management practices.

7.7.2.5 Railyard

The impacts from this alternative are similar to those for SW2. The additional excavation of surface soils with TPH contamination will increase the extent of impacts somewhat over those described for SW2 without changing the overall impacts.

7.7.2.6 Proposed Specific Mitigation Measures

Proposed specific mitigation measures include standard construction BMPs for the protection of soil and water, air quality, fish and wildlife, vegetation, aesthetic and historical resources, human health and public property, including construction timing restrictions, implemented under all alternatives. In addition to the mitigation measures identified for SW-3, the tabulation above describes proposed specific mitigation measures for the impacts associated with the alternative. In addition, replacement of excavated soil mitigates for soil impacts in the developed areas. Affected septic systems in the developed zones can be mitigated by replacement of septic systems. Compensatory wetland mitigation would be detailed in a Wetland Mitigation Plan to off-set impacts to the former Maloney Creek channel wetlands consistent with the requirements of the Skykomish Critical Areas Ordinance and the U.S. Army Corps of Engineers regulations.

7.7.2.7 Unavoidable Significant Adverse Impacts of Alternative SW4

Unavoidable significant impacts of Alternative SW4 include:

- Increased truck traffic in the town of Skykomish
- Increased truck traffic on U.S. 2 lasting approximately 15-30 days
- Road closures
- Relatively high noise levels in town during working hours
- Temporary reduction in sediment and potential fish habitat in Former Maloney Creek side channel
- Increased risk of exposure to hazardous substances
- Housing (temporary relocation of some; nuisance for others)

- Historic structures (temporary relocation) and change of town character aesthetics and public services during excavation (water mains) in and near residential areas.

7.8 Alternative PB1

Alternative PB1 consists of:

- Enhancing bioremediation in the Levee Aquatic Resource Zone
- Monitoring natural attenuation in the Former Maloney Creek Aquatic Resource Zone
- Monitoring natural attenuation in the NE Developed Zone
- Excavating all soil above cleanup levels in the South Developed Zone
- Excavating free product where accessible, excavating surface metals and enhancing biodegradation in the NW Developed Zone
- Excavating surface metals, capping, skimming free product, recovering free product with trenches and monitoring natural attenuation in the Railyard Zone

7.8.1 Model Toxics Control Act

Alternative PB1 protects human health and the environment and meets cleanup standards through a combination of sediment natural recovery, excavation, enhanced bioremediation, passive free product recovery, isolation of subsurface contaminated soil and institutional controls.

Excavation of metals contaminated surface soil, accessible free product in the NW Developed Area, and soil in the South Developed Zone can be accomplished within a 2-year planning horizon. These elements of Alternative PB1 are both permanent and protective. Remaining soil in excess of cleanup levels is isolated below a protective clean soil layer and cannot be contacted except under controlled circumstances (as stipulated in institutional controls). While effective, these measures are not considered permanent and protective under MTCA.

Enhanced bioremediation promotes restoration of groundwater quality between the railyard and the point at which groundwater discharges to the Skykomish River. This may require a restoration time frame of up to 20 years in the NW Developed Zone depending on effectiveness and size of the system installed. Pending the outcome of bench and pilot testing, enhanced bioremediation is anticipated to be both permanent and effective as the hydrocarbon contaminants are biodegradable, the technology is well developed, and system components are reliable.

7.8.2 State Environmental Policy Act

There is only one major impact to the natural and built environment associated with this alternative. In general, the minor, temporary or moderate impacts are very similar to those previously described for Alternative SW1. Exceptions are noted below for the NW Developed Zone and the Railyard Zone. See Table 7-3 and Appendix A for more details and a comparison among alternatives. The tabulation below summarizes remediation activities, the significant impacts and mitigation.

Zone	PB1 Remediation Activity	Impacts / *Mitigation*
Aquatic Resource Zone – Levee	Same as SW1 (biosparging)	Same as SW1
Aquatic Resource Zone – Former Maloney Creek Channel	Same as SW1 (monitoring natural attenuation)	Same as SW1
Developed Zone – NE	Same as SW1 (monitoring natural attenuation)	Same as SW1
Developed Zone – South	Same as SW4 (excavating all soil above cleanup levels)	Same as SW4
Developed Zone – NW	Excavating free product where possible Excavating surface metals Enhancing biodegradation	Traffic / ***wash roads as necessary*** Impacts to Stormwater / ***divert stormwater from excavation, cover truck loads*** Disturbance of approx. 0.3 acres of soil in residential yards, schoolyard, garden areas / ***replace the soil and revegetate as necessary.*** Major excavations near existing structures, including homes / ***shore near excavations, replace septic systems, provide temporary housing, regrade after excavation*** Excavation in public areas / ***restrict access to work area*** Greater noise during working hours / ***limit work hours*** Impacts to roads and public services / ***stage work area to ensure emergency vehicle access*** Enhanced bioremediation will require wells in street, noise, and rerouted utilities

Railyard Zone	Same as SW2 (excavating surface metals; capping; skimming free product; recovering free product with trenches; monitoring natural attenuation)	Same as SW2

7.8.2.1 Northwest Developed Zone

Major adverse impacts to traffic are expected in this zone, due to the need for 200 truck trips per day for 7 weeks for local transport, and trucks for transport down U.S. 2 to Everett. This is in addition to truck trips required for the surface soil excavation. Moderate impacts to soil (disturbance of approximately 0.3 acre in residential yards, school yard, and other garden areas, equal to approximately 3,680 cy soil removed and replaced), housing (major excavations near existing structures), aesthetics (excavation in public areas), noise (greater than 60 dBA during working hours), roads, and public services were identified. Minor or temporary adverse impacts on topography, air quality, odors, groundwater quantity and quality, flooding, runoff, land use (imposition of institutional controls limiting excavation), habitat and wildlife, and hazardous substances were identified. Enhanced bioremediation in this zone results in moderate adverse impacts to aesthetics (wells located in the street), noise from well installation (greater than 60 dBA during working hours), and public services (rerouted utilities from wells in the street). Minor or temporary adverse impacts may be expected for habitat and wildlife, land use (institutional controls), roads, and traffic.

7.8.2.2 South Developed Zone

Adverse impacts to this zone are the same as those for Alternative SW4 and are associated with excavation and transport of contaminated soil. Full excavation to cleanup levels for this zone results in major adverse impacts to traffic. Traffic impacts include 200 truck trips for 2 days (locally) for excavation of all impacted soil and free product. Moderate adverse impacts may occur to noise (greater than 60 dBA during working hours), one residential garage, and aesthetics. Impacts to aesthetics are due to the removal or part of the developed habitat adjacent to the wetland. Minor or temporary impacts are likely to soil, topography, air quality, odors, groundwater quality and quantity, floods, runoff, wildlife and habitat, land use (institutional control), roads, public services, and hazardous substance exposure.

7.8.2.3 Proposed Specific Mitigation Measures

Proposed mitigation measures include standard construction BMPs for the protection of soil and water, air quality, fish and wildlife, vegetation, aesthetic and historical resources, human health and public property, including construction timing restrictions, implemented under all alternatives. In addition, replacement of excavated soil with comparable material mitigates for soil impacts in the developed areas. Impacts to the septic systems in the developed zones can be mitigated by replacement of septic systems. Impacts on land use from contaminated soil and groundwater can be mitigated by maintaining a clean soil cover at the surface, continuing to make public water available, and implementing institutional controls which will limit exposure and provide a mechanism for BNSF (or the Town with technical and financial assistance from BNSF) to safely manage contaminated soil and water encountered during construction activities on private and public properties. Additional proposed specific mitigation measures are provided in the tabulation above.

7.8.2.4 Unavoidable Significant Adverse Impacts of Alternative PB1

Unavoidable significant impacts of Alternative PB1 include:

- Increased truck traffic in the town of Skykomish
- 17 - 34 days of increased truck traffic on U.S. 2
- Road closures
- Relatively high noise levels in town during working hours
- Effects to housing, historical structures, aesthetics and public services during excavation in and near residential areas.

7.9 Alternative PB2

Alternative PB2 consists of:

- Excavating or pressure grouting free product, excavating sediment to remediation levels and enhancing bioremediation in the Levee Aquatic Resource Zone
- Monitoring natural attenuation in the Former Maloney Creek Aquatic Resource Zone
- Enhancing biodegradation in the NE Developed Zone
- Excavating all soils above cleanup levels in the South Developed Zone

- Excavating, flushing, or a combination of flushing and excavating all free product, excavating surface metals and enhancing biodegradation in the NW Developed Zone

- Excavating surface metals, capping, skimming free product, recovering free product and enhancing biodegradation in the Railyard Zone

7.9.1 Model Toxics Control Act

Alternative PB2 builds on provisions of PB1 by increasing the amount of enhanced bioremediation for developed areas north of the railyard and by increasing the permanence and effectiveness of soil and sediment cleanup actions at the levee through selective removal (excavation) and grouting. PB2 addresses all free product, not just accessible free product.

The more aggressive removal or stabilization efforts (i.e., grouting) and removal of soil and free product at seep locations reduce the time required to restore sediment quality to protective levels. The greater enhanced bioremediation infrastructure, particularly in the NE Developed Zone, reduces the time required to restore groundwater quality. The complete removal of free product in the NW Developed Zone reduces the restoration timeframe for both soil and groundwater.

7.9.2 State Environmental Policy Act

Impacts associated with this alternative are very similar to those previously described for Alternative PB1. Exceptions are noted below for the applicable zones.

See Table 7-3 and Appendix A for more details and a comparison among alternatives. The tabulation below summarizes the remediation activities, significant impacts, and proposed mitigation of impacts.

Zone	PB2 Remediation Activity	Impacts / *Mitigation*
Aquatic Resource Zone – Levee	Same as SW3	Same as SW3
Aquatic Resource Zone – Former Maloney Creek Channel	Same as PB1 and SW1	Same as PB1 and SW1
Developed Zone – NE	Same as SW3 and SW4	Same as SW3 and SW4
Developed Zone – South	Same as PB1 and SW4	Same as PB1 and SW4

Developed Zone – NW	Same as PB1, except: Excavating or flushing free product (instead of excavating free product where possible)	Same as PB1, except for the following. Excavation under buildings and historic structures / *relocate then replace buildings, provide housing* Excavation under school / *relocate school, make alternative arrangements for schooling*
Railyard Zone	Same as PB1, except: Enhancing biodegradation (instead of monitoring natural attenuation)	Greater noise during working hours during well installation

7.9.2.1 Levee and River Sediments

Excavation of hot spots in the levee and/or solidification combined with limited sediment removal at seep locations results in moderate adverse impacts to noise (greater than 60 dBA during working hours), roads and transportation (access road), and traffic (trucks). No major adverse impacts are expected. Minor or temporary impacts may occur to soil (topsoil loss on levee), topography, air quality, odors, river hydrology (possible use of coffer dam), floods, runoff, water quality, habitat and wildlife, aquatic resources (riparian vegetation removal resulting in temporary reduction in salmonid habitat function), sediment, land use (institutional controls), aesthetics, and hazardous substance exposure.

7.9.2.2 Northwest Developed Zone

This alternative may include either flushing or excavation of all free product or a combination of excavation and flushing. The worst case with respect to impacts to the community includes excavation of all free product (including under buildings). This worst case is the scenario evaluated here. Details regarding the impacts associated with flushing are available in Appendix A.

Major adverse impacts are likely to aesthetic and historic buildings, traffic, and public services, although less extensive than under the standard alternative or alternative SW4. The volume of free product to excavate is less than that for the standard alternative and the shallow smear zone is not being excavated like in alternative SW4. Utilities, including water mains, will be disrupted and rerouted due to the need to excavate in right-of-ways. Leach fields will be affected. Public roads will be closed off for lengthy periods. Large portions of the school property will be impacted. Moderate adverse impacts are likely for runoff (from clean and contaminated soils piles). Construction best management practices mitigate this impact, and no unavoidable impacts are present. Other adverse impacts are roads (frequency of truck trips), noise (greater than 60 dBA during working hours), housing (impacts are considerably reduced if excavation under buildings is avoided), and hazardous substance exposure (due to open excavations in populated areas with the potential for hydrocarbon contact). Minor or temporary impacts are likely for topography, air quality, odors, groundwater quantity and quality (under the flushing scenario), flooding, habitat and wildlife (vegetation clearing and disturbance), and land use (due to institutional controls).

7.9.2.3 Northeast Developed Zone

Enhanced bioremediation in this zone results in moderate adverse impacts to aesthetics (wells located in the street), noise (greater than 60dBA during working hours), and public services (rerouted utilities from wells in the street). Minor or temporary adverse impacts may be expected for habitat and wildlife, land use (institutional controls), roads, and traffic.

7.9.2.4 Railyard

No major adverse impacts are expected as a result of this alternative. A moderate impact to noise and vibrations is expected (greater than 60 dBA during working hours for well installation). Minor or temporary impacts are expected to soil, topography, air emissions, odors, runoff, habitat and wildlife, land use (institutional control), and traffic.

7.9.2.5 Proposed Specific Mitigation Measures

Proposed specific mitigation measures are similar to those described in Sec. 7.8.2.3 and include standard construction BMPs for the protection of soil and water, air quality, fish and wildlife, vegetation, aesthetic and historical resources, human health and public property, including construction timing restrictions, implemented under all alternatives. In addition, replacement of excavated soil with comparable material mitigates for soil impacts in the developed areas. Replacement of septic systems can mitigate impacts to leach fields in the developed zones. Impacts on land use from contaminated soil and groundwater can be mitigated by maintaining a clean soil cover at the surface, continuing to make public water available, and implementing institutional controls which will limit exposure and provide a mechanism for BNSF (or the Town with technical and financial assistance from BNSF) to safely manage contaminated soil and water encountered during construction activities on private and public properties.

7.9.2.6 Unavoidable Significant Impacts of Alternative PB2

Unavoidable significant impacts of Alternative PB2 include:

- Relatively high noise levels in town during working hours
- Increased truck traffic in the town of Skykomish
- 19-38 days of increased truck traffic on U.S. 2

- Road closures
- Effects to public services, school, community center, post office, housing, historic structures, and aesthetics

7.10 Alternative PB3

Alternative PB3 consists of:

- Ozone sparging or flushing, excavating sediment to cleanup levels and enhancing bioremediation in the Levee Aquatic Resource Zone
- Enhancing biodegradation and excavating sediment to remediation levels in the Former Maloney Creek Aquatic Resource Zone
- Enhancing biodegradation in the NE Developed Zone
- Excavating all soils above cleanup levels in the South Developed Zone
- Excavating or flushing free product, excavating surface metals, excavating the shallow smear zone and enhancing biodegradation in the NW Developed Zone
- Excavating surface metals and TPH, capping, recovering free product with trenches, flushing and enhancing biodegradation in the Railyard Zone

7.10.1 Model Toxics Control Act

Alternative PB3 builds on provisions of PB2 primarily by reducing the restoration time frame for the Aquatic Resource Zones. More aggressive action is also taken at the levee to restore sediment and soil and groundwater quality at both the Levee and the former Maloney Creek.

Actions in the Former Maloney Creek have significant impacts on the natural environment (See SEPA analysis below) and may outweigh any benefit from restoration measures more aggressive than natural recovery.

7.10.2 State Environmental Policy Act

Impacts to the natural and built environment under this alternative are similar to those described previously for Alternative PB2. Significant differences in terms of impacts are as follows (refer to Table 7-3 and Appendix A for more details and a comparison among alternatives). The tabulation below summarizes the remediation activities, significant impacts and mitigation.

Zone	PB3 Remediation Activity	Impacts / *Mitigation*
Aquatic Resource Zone – Levee	Same as SW4	Same as SW4
Aquatic Resource Zone – Former Maloney Creek Channel	Same as SW4	Same as SW4
Developed Zone – NE	Same as PB2, SW3 and SW4	Same as PB2, SW3 and SW4
Developed Zone – South	Same as PB1, PB2 and SW4	Same as PB1, PB2 and SW4
Developed Zone – NW	Same as PB2, adding: Excavating shallow smear zone	Similar to PB2
Railyard Zone	Same as PB2, except: Flushing free product (instead of skimming) Adding: Excavating TPH as well as surface metals	Same as PB2

7.10.2.1 Levee and River Sediments

This alternative includes the possible excavation of the levee. The impacts described here assume excavation of the levee. Excavating the levee and associated sediment to the cleanup levels results in major impacts to roads due to the need to construct an access road to the levee area. Moderate impacts are likely for flooding (risk for catastrophic flooding is low from July 1st through September 15th, but the risk is increased while the levee is down), runoff (temporary blockage of two storm drain culverts), surface water quality (potential for releases during construction), sediment (complete loss of resource, but expected natural recovery within a few seasons), aesthetics (unsightly construction and loss of riparian area), and noise (greater than 60 dBA during working hours), traffic (trucks), and aquatic resources (removal of riparian vegetation and coarse substrates resulting in short-term loss of salmonid habitat). Excavating the levee in increments as well as stockpiling sandbags to temporarily seal the breach can mitigate the flooding risk. Moderate impacts are likely for soil (loss of established topsoil along levee). Minor or temporary impacts can be expected for topography, air quality, odors, groundwater quality and quantity, river hydrology (coffer dam), surface water quality, land use (impacts to Critical Areas), habitat and wildlife (clearing of habitat and disturbance during construction), land use (institutional controls), housing (removal of one abandoned older house for the access road), and hazardous substances.

7.10.2.2 Former Maloney Creek Channel

Major adverse impacts are expected as a result of sediment excavation to habitat and wetlands in Maloney Creek. Approximately 0.5 acres of forested wetland habitat would be cleared during excavation, and an additional 0.4 acres cleared for installation of air sparing wells. Moderate adverse impacts are expected to sediment (loss of resource with slow natural recovery), noise (greater than 60dBA during working hours), and aquatic resources. A reduction in salmonid habitat and temporary loss of access to salmonid habitat would occur as a result of removal of surface sediment and use of the cofferdam. In addition, minor or temporary impacts are likely for topography, former Maloney Creek hydrology, runoff, and floods, traffic, and aesthetics.

7.10.2.3 Railyard

No major adverse impacts are expected for the combination of flushing, trenching, enhanced bioremediation, and surface soil excavation in this alternative. Moderate impacts are limited to noise (greater than 60 dBA during working hours). Minor or temporary impacts are expected for topography, air emissions, odors, groundwater quality and quantity, runoff, habitat and wildlife, aesthetics and historic structures, land use (institutional controls), hazardous substance exposure, roads, and traffic.

7.10.2.4 Proposed Specific Mitigation Measures

Proposed specific mitigation measures are similar to those described in Sec. 7.9.2.5 and include standard construction BMPs for the protection of soil and water, air quality, fish and wildlife, vegetation, aesthetic and historical resources, human health and public property, including construction timing restrictions, implemented under all alternatives. In addition, replacement of excavated soil with comparable material mitigates for soil impacts in the developed areas and the aquatic resource zones. Replacement of septic systems can mitigate the impact to the leach fields. Mitigation measures focusing on appropriate timing of work in the riverfront area mitigates against risk of flooding and hydrologic impacts. Compensatory wetland mitigation would be detailed in a Wetland Mitigation Plan to off-set impacts to the former Maloney Creek channel wetlands consistent with the requirements of the Skykomish Critical Areas Ordinance and the U.S. Army Corps of Engineers regulations. Impacts on land use from contaminated soil and groundwater can be mitigated by maintaining a clean soil cover at the surface, continuing to make public water available, and implementing institutional controls which will limit exposure and provide a mechanism for BNSF (or the Town with technical and financial assistance from BNSF) to safely manage contaminated soil and water encountered during construction activities on private and public properties.

7.10.2.5 Unavoidable Significant Impacts of Alternative PB3

Unavoidable significant impacts of Alternative PB3 include:

- Relatively high noise levels in town during working hours
- Increased truck traffic in the town of Skykomish
- 23-46 days of increased truck traffic on U.S. 2
- Road closures
- Effects to public services, housing, historic structures, and aesthetics
- Temporary loss of salmonid habitat

7.11 Alternative PB4

Alternative PB4 consists of:

- Excavating the smear zone, excavating sediment to cleanup levels, and enhancing bioremediation in the Levee Aquatic Resources Zone
- Enhancing biodegradation and excavating sediment to cleanup levels in the Former Maloney Creek Aquatic Resource Zone
- Excavating free product, and enhancing biodegradation in the NE Developed Zone
- Excavating all soils above cleanup levels in the South Developed Zone
- Excavating, flushing, or a combination of excavating and flushing free and residual product, excavating surface metals and the shallow smear zone and enhancing biodegradation in the NW Developed Zone
- Excavating surface metals and TPH, capping, flushing all free product, and enhancing biodegradation in the Railyard Zone

7.11.1 Model Toxics Control Act

Alternative PB4 meets cleanup standards in approximately 5 years. All free product and residual product are removed either by excavation or surfactant flushing. Sediment is removed to cleanup levels at the Skykomish River and in the former Maloney Creek channel.

Federal (Nationwide 38) permitting is required for sediment removal along the levee.

This alternative, while technically feasible, is very disruptive to the community and environment given the extended reach of cleanup operations in the NW Developed Zone. Residents would need to be temporarily displaced during excavation and surfactant flushing operations near homes. Residual contamination above soil cleanup levels would remain, thereby necessitating institutional controls to ensure protection.

7.11.2 State Environmental Policy Act

Impacts to the natural and built environment under this alternative are similar to those described previously for Alternative PB3. Significant differences in terms of impacts are as follows (refer to Table 7-3 for more details and a comparison among alternatives). The tabulation below summarizes the remediation activities, significant impacts and mitigation.

Zone	PB4 Remediation Activity	Impacts / *Mitigation*
Aquatic Resource Zone – Levee	Same as PB3 and SW4, except: Excavating smear zone (instead of ozone sparge or flushing smear zone)	Same as PB3 and SW4, adding Flooding risk increased while levee down / *coffer dams, work during dry season* Increased traffic Temporary blockage of two storm drain culverts / *work during dry season, provide alternate temporary stormwater conveyance* Complete loss of sediment with recovery expected in a few seasons / *regrade to encourage sediment accumulation* One older house to be removed for access road / *provide temporary housing, replace after construction complete*

Aquatic Resource Zone – Former Maloney Creek Channel	Same as PB3, except: Excavating sediment to cleanup level (instead of to remediation level)	Same as PB3, adding: Increased traffic Clearing 1.1 acre forested wetland / *compensatory mitigation* Loss of green area in town (decreased wetland aesthetics) Long-term loss of salmonid habitat / *compensatory mitigation* Rerouting former Maloney Creek storm drainage could impact runoff / *re-design and construct drainage as necessary* Siltation / *use of construction BMPs, silt fences, hay bales, excavation during dry season, silt collection ponds* Loss of all sediment in an area of slow recovery Increased noise during working hours Coffer dam / *conduct work during dry season to reduce hydraulic impacts* Impacts on Critical Area
Developed Zone – NE	Same as PB3, except: Excavating free product	Same as PB3, adding: Increased noise during working hours Relocation of utilities Traffic: 48 trucks per day for a week
Developed Zone – South	Same as PB1, PB2, PB3 and SW4	Same as PB1, PB2, PB3 and SW4
Developed Zone – NW	Same as PB3, adding: Excavating residual product	Same as PB3 and SW4
Railyard Zone	Same as PB3, except: Flushing (instead of using trenches)	Generally same as PB3

7.11.2.1 Levee and River Sediments

This alternative calls for excavation of the levee to the remediation level and excavation of all sediment to cleanup levels. The impacts are similar to those of the excavation scenario for PB3.

7.11.2.2 Former Maloney Creek Channel

Major adverse impacts are expected from the excavation of all surface sediment to the cleanup level (in addition to enhanced bioremediation of smear zone) to aquatic resources, wetland and habitat, aesthetics, and traffic (12 truck trips per day for 1 week locally). Excavation to cleanup levels and installation of wells will include clearing of approximately 1.1 acre of forested wetland. In addition, major adverse impacts are expected for aesthetics of the wetland (loss of a valuable green area in town) and for aquatic resources (long-term loss of salmonid habitat). Moderate adverse impacts may be expected to runoff (due to the need to reroute the former Maloney Creek storm drainage), surface water quality (silting), sediment (due to the loss of all sediment in an environment of slow recovery), traffic, and noise (greater than 60 dBA during working hours for well installation for approximately 3 weeks). Minor or temporary impacts include topography, air emissions, odors, groundwater quality and quantity, hydrology (of Maloney creek), floods (use of coffer dam), land use (impacts on a Critical Area and institutional controls), and hazardous substance exposure.

7.11.2.3 Northeast Developed Zone

This alternative (excavation of free product) results in major adverse impacts to aesthetics (wells located in the street), noise (greater than 60 dBA during working hours for 3 weeks), public services (movement of utilities because of well installation in the street), and traffic (48 truck trips per day for a week locally). Minor or temporary impacts to soil, topography, air quality, odors, groundwater quantity and quality, floods, runoff, habitat and wildlife, land use, housing, traffic, hazardous substances, and roads.

7.11.2.4 Northwest Developed Zone

Adverse impacts under this alternative are similar to those for PB3 under the worst-case scenario, but impacts are major for housing and roads. Excavation of roads and septic systems will cause rerouting utilities as a result of excavation to the remediation level.

7.11.2.5 Railyard

The combination of flushing, free product excavation, surface soil excavation, and enhanced bioremediation in this alternative will result in major adverse impacts to traffic (trucks). Moderate adverse impacts may be expected to runoff (blockage of existing runoff from railyard to north side and to former Maloney Creek via culverts), noise (greater than 60 dBA during working hours), public services (possible impact to existing water mains), and roads. Minor or temporary impacts are possible to topography, air quality, odors, groundwater quality and quantity, habitat and wildlife, land use (institutional controls), aesthetics, and hazardous substances.

7.11.2.6 Proposed Specific Mitigation Measures

Proposed specific mitigation measures are similar to those described in Section 7.10.2.4 and include standard construction BMPs for the protection of soil and water, air quality, fish and wildlife, vegetation, aesthetic and historical resources, human health and public property, including construction timing restrictions, implemented under all alternatives. In addition, replacement of excavated soil with comparable material mitigates for soil impacts in the developed areas and the aquatic resource zones. Replacement of septic systems mitigates the impact to the leach fields. Mitigation measures focusing on appropriate timing of work mitigates against risk of flooding and hydrologic impacts in the aquatic zones. Compensatory wetland mitigation would be detailed in a Wetland Mitigation Plan to off-set impacts to the former Maloney Creek channel wetlands consistent with the requirements of the Skykomish Critical Areas Ordinance and the U.S. Army Corps of Engineers regulations. Impacts on land use from contaminated soil and groundwater can be mitigated by maintaining a clean soil cover at the surface, continuing to make public water available, and implementing institutional controls which will limit exposure and provide a mechanism for BNSF (or the Town with technical and financial assistance from BNSF) to safely manage contaminated soil and water encountered during construction activities on private and public properties.

7.11.2.7 Unavoidable Significant Impacts of Alternative PB4

Unavoidable significant impacts of Alternative PB4 include:

- High and medium-term noise levels in town during working hours
- Much increased truck traffic in the town of Skykomish
- 47-94 days of increased truck traffic on U.S. 2
- Road closures
- Major effects to public services, housing (temporary relocations), historic structures (temporary relocations), and aesthetics (permanent changes to town character)
- Effects to surface water (runoff, water quality)
- Temporary loss of sediment with natural recovery over time
- Temporary loss of salmonid habitat.

7.12 Standard Alternative (STD)

Alternative STD consists of:

- Excavating the smear zone and excavating sediment to cleanup levels in the Levee Aquatic Resource Zone
- Excavating the smear zone and excavating sediment to cleanup levels in the Former Maloney Creek Aquatic Resource Zone
- Excavating free product and the smear zone in the NE Developed Zone

- Excavating all soil above cleanup levels in the South Developed Zone
- Excavating all soil above cleanup levels in the NW Developed Zone
- Excavating all soil above cleanup levels in the Railyard Zone

7.12.1 Model Toxics Control Act

The standard alternative requires excavation of all free product and soil exceeding cleanup levels and is, therefore, the only alternative that meets the cleanup standard without the need for institutional controls. While technically feasible and possessing the maximum levels of permanence protectiveness of all alternatives, the standard alternative requires the removal or destruction and replacement of all homes and infrastructure in identified excavation areas. These are major short-term consequences for the community.

Excavation of sediment in the levee and former Maloney Creek channel will result in short-term attainment of cleanup levels for soil and sediment at the expense of the existing natural habitat. Sediment and soil removal below the stream high water marks will require federal permitting (Nationwide 38).

7.12.2 State Environmental Policy Act

Impacts to the natural and built environment under this alternative are as follows (refer to Table 7-3 for more details and a comparison among alternatives). The tabulation below summarizes the significant impacts described in the text.

Zone	STD Remediation Activity	Impacts
Aquatic Resource Zone – Levee	Same as PB4	Same as PB4
Aquatic Resource Zone – Former Maloney Creek Channel	Excavating smear zone Excavating sediment	Similar to PB4, but more extensive
Developed Zone – NE	Excavating free product Excavating smear zone	Traffic: 185 trucks per day for 5 weeks; 3 trains per week for 4 weeks or 48 trucks per day for 5 weeks. Two to three houses would be impacted / *provide temporary housing, move then replace houses* Removal of 0.53 acres of topsoil and 6,080 cubic yards / *replace, regrade and revegetate*

		Impacts to stormwater flow / *divert stormwater around excavation* Increased noise / *limit working hours* Impacts to public services /
Developed Zone – South	Excavating all soil above cleanup levels	Same as PB4
Developed Zone – NW	Excavating all soil above cleanup levels	Similar to PB4 but more extensive.
Railyard Zone	Excavating all soil above cleanup levels	Similar to PB4, but more extensive. Excavation around main line railroad track will require rerouting the main line and utilities.

7.12.2.1 Levee and River Sediments

Excavating the levee and associated sediment to the cleanup level results in major impacts to roads and traffic. Locally approximately 200 truck trips would be required per day for 1 month for levee excavation in addition to 11 truck trips per day for 2 weeks for the sediment excavation. Moderate impacts are likely for flooding (risk for catastrophic flooding is low from July 1 to September 15, but the risk is increased while the levee is down), runoff (temporary blockage of two storm drain culverts), sediment (complete loss of resource, but expected natural recovery within a few seasons), aquatic resources (removal of riparian vegetation and coarse substrates resulting in short-term loss of salmonid habitat function), aesthetics (unsightly construction and loss of riparian area), and noise (greater than 60 dBA during working hours). Moderate impacts are likely for soil (loss of established topsoil along levee); however, these effects will be mitigated by replacement of excavated soil. Minor or temporary impacts can be expected for topography, air quality, odors, groundwater quality and quantity, river hydrology (cofferdam), surface water quality (potential for releases during construction), land use (impacts to Critical Areas), habitat and wildlife (clearing and disturbance), housing (razing of one abandoned older house for the access road), and hazardous substances.

7.12.2.2 Former Maloney Creek Channel

Excavation of all sediment and smear zone soil to cleanup levels results in impacts similar to those described for PB4, but notably more extensive.

7.12.2.3 Northeast Developed Zone

Excavation of soils in this zone to the cleanup levels result in major adverse impacts to housing, aesthetics, historic structures, and traffic. Approximately 185 truck trips per day for 5 weeks locally and possibly three trains per week for 4 weeks will be needed to transport excavated material for disposal. Two to three houses would be impacted. Moderate adverse impacts will occur to soil (removal of 0.53 acre of topsoil disturbed and 6,080 cy removed and replaced), runoff (loss of infiltration area), noise (greater than 60 dBA during working hours), and public services. Minor or temporary adverse impacts can be expected for topography, air emissions, odors, groundwater quality and quantity, floods, habitat and wildlife, hazardous substances, and roads.

7.12.2.4 Northwest Developed Zone

Excavation of soils in this zone to the cleanup levels results in adverse impacts similar to those described for PB4.

7.12.2.5 Railyard

Excavation of all soils in this zone to the cleanup levels results in adverse impacts similar to those described for PB4, but considerably more extensive. Impacts to transportation and public services are major because excavation around the main line railroad track will require rerouting the main line and utilities that run along it.

7.12.2.6 Proposed Specific Mitigation Measures

Proposed specific mitigation measures include standard construction BMPs for the protection of soil and water, air quality, fish and wildlife, vegetation, aesthetic and historical resources, human health and public property, including construction timing restrictions, implemented under all alternatives. In addition, replacement of excavated soil with comparable material could mitigate for soil impacts in the developed areas and the aquatic resource zones. Replacement of septic systems could mitigate the impact to the leach fields. Mitigation measures focusing on appropriate timing of work mitigates against risk of flooding and hydrologic impacts in the aquatic zones. Excavating the levee in increments as well as stockpiling sandbags to temporarily seal the breach can mitigate the flooding risk. Compensatory wetland mitigation would be detailed in a Wetland Mitigation Plan to off-set impacts to the former Maloney Creek channel wetlands consistent with the requirements of the Skykomish Critical Areas Ordinance and the U.S. Army Corps of Engineers regulations. Short-term impacts on land use from contaminated soil and groundwater (while the remedy is being implemented over 5+ years) can be mitigated by maintaining a clean soil cover at the surface, continuing to make public water available, and implementing institutional controls which will limit exposure and provide a mechanism for BNSF (or the Town with technical and financial assistance from BNSF) to safely manage contaminated soil and water encountered during construction activities on private and public properties. These institutional controls could be removed once the cleanup is completed.

7.12.2.7 Unavoidable Significant Impacts of Standard Alternative

Unavoidable significant impacts of the Standard Alternative include:

- Relatively high noise levels in town during working hours
- Dramatically increased truck traffic in the town of Skykomish
- 73-146 days of increased on U.S. 2
- Road closures
- Effects to public services, housing (temporary relocations), historic structures (temporary relocations), and aesthetics (permanent change to town character and character of former Maloney Creek area)
- Effects to surface water (water quality)
- Temporary loss of sediment with natural recovery over time
- Temporary loss of salmonid habitat.

7.13 Summary of Remedial Alternatives Evaluation

This section summarizes the evaluation of remedial alternatives provided in Sections 7.3 to 7.12 in terms of MTCA requirements and the overall environmental impact analysis.

Table 7-5 presents a summary of significant unavoidable adverse impacts relative to the No Action Alternative (following mitigation). In general, the severity or intensity of construction-related impacts on the built environment increases and the severity or intensity of impacts from hazardous substances on the natural environment decreases with more invasive remedial alternatives.

Table 7-6 provides a summary of the remedial alternatives, including the cleanup action proposed for each cleanup zone and the associated costs. Costs are based on the detailed calculations provided in Appendix L.

7.13.1 No Action

The No Action alternative does not satisfy MTCA threshold requirements for meeting cleanup standards.

No Action would not significantly affect the built environment. No roads, buildings or utilities would be physically damaged or disrupted. The long-term presence of contamination could deter future investment in the built environment and the community. The natural environment would continue to be significantly and adversely impacted by the contamination present.

7.13.2 Standard Alternative

The Standard Alternative removes all material from the site that exceeds cleanup levels. Following excavation, groundwater returns to protective levels by natural attenuation. While technically feasible and achieving a high level of protectiveness and permanence, this alternative would cause severe disruption to the community and local ecology. Residents would be displaced for at least several months depending on how the excavation work is phased. Houses and other buildings would be moved or demolished and utilities would need to be moved or demolished and ultimately replaced. The main track of the BNSF rail line would need to be moved. The wetland ecology of the former Maloney Creek channel would be destroyed. Restoration measures at the former Maloney Creek channel could eventually create a biologically healthy ecology; however, the restoration of a wetland area with diverse and robust wetland ecology equivalent to what exists today cannot be ensured.

This alternative would yield a high level of protection through permanent removal of contamination from the site. Short-term risks could be managed with engineering controls commonly practiced at construction and hazardous material cleanup projects. Based on prior community involvement, community acceptance of this alternative may vary because of the substantial disruption to residents and facilities during implementation of this alternative. This should be further evaluated during the formal public comment period for the FS/EIS.

7.13.3 SW Alternatives

The SW alternatives are designed for a conditional point of compliance where groundwater discharges to surface water (Skykomish River). Adoption of any SW alternative and a conditional point of compliance at the River require the agreement of affected property owners. Approximately 25 properties are affected by contaminated groundwater (see Appendix M).

MTCA Evaluation Summary – As a group, the SW alternatives focus on groundwater cleanup through removal of free product and *in situ* bioremediation of groundwater before it affects the Skykomish River and former Maloney Creek. The need for and duration of bioremediation of groundwater depends on the effect removing free product has on reducing groundwater impacts to the River. Alternatives SW1 and SW2 will require long-term bioremediation of groundwater in the levee because they rely on passive recovery of free product upgradient of the barrier wall in the NW Developed Zone. Alternatives SW3 and SW4 ultimately transition from enhanced bioremediation to natural attenuation. Both offer more permanent and effective removal of free product and associated smear zone soil in the NW Developed Zone.

Soil cleanup is achieved, in all cases, by removing surface soil exceeding cleanup levels and applying institutional controls to protect against exposures to contaminated soil remaining at depth. As mentioned above, SW3 and SW4 remove greater quantities of smear zone soil contamination than SW1 and SW2. Contaminated soil remaining at depth is isolated under a protective layer of clean overburden soil. The institutional controls protect against exposures to this material by obligating BNSF to assist property owners and other affected entities (e.g., utilities, the town of Skykomish) with managing contaminated soil and groundwater from construction work. Current institutional controls prohibit new well installation in contaminated areas.

All of the SW alternatives protect human health and the environment. Alternatives SW3 and SW4 are more permanent than SW1 and SW2 through removal of greater amounts of material, particularly in the NW and South Developed Zones (Table 7-2).

SEPA Evaluation Summary – Under SW1 and SW2, significant unavoidable impacts from construction-related activities to the natural environment are generally negligible. Alternatives SW3 and SW4 involve excavation in the aquatic habitat zone thereby generating some unavoidable impacts to riparian areas, sediment and salmonid habitat. Over time, the habitat will recover but for a period of years will be degraded. The SW4 alternative additionally leads to major adverse impacts to the former Maloney Creek wetland and riparian area. These impacts can be mitigated through appropriate compensatory wetland reconstruction.

The major unavoidable significant adverse impacts of the SW alternatives relative to the No Action Alternative are associated with the built environment. Noise and traffic are inevitable effects of most SW alternatives. In general, the level of impact increases with the extent and length of the cleanup project and the aggressiveness of the cleanup method. For alternatives with extensive excavation needs in several cleanup zones (e.g., SW3 and SW4), the traffic impacts due to truck traffic in town and down U.S. 2 can be major. In general, the small size of the NE and South Developed Zones relative to the NW Developed Zone mean that their relative contribution to these impacts is less. Details on the extent of impacts are discussed in Appendix A.

Impacts to utilities/public services, housing, roads, aesthetics, and historic structures are another potentially major impact in the developed zones. Alternatives SW1 and SW2 entail installation of treatment or recovery systems and excavation of surface soil limited to accessible areas. This results in an unavoidable adverse nuisance and disturbance factor to residents and visitors due to activities in yards, roads, and near dwellings. These impacts are relatively short-term and limited to the construction period.

SW3 and SW4 involve progressively more extensive actions in the NW Developed Zone. The area of excavation is significantly expanded to remove free product and, in the case of SW4, shallow smear zone soil. Property surrounding existing structures (buildings) is impacted by deeper excavation work and construction/operation of surfactant flushing equipment (wells, piping). These options lead to more severe and longer-lasting unavoidable adverse impacts due to the need for property access, excavation and construction work on residential and other properties, and the likely need for temporary relocation of residents during such operations.

7.13.4 PB Alternatives

The PB alternatives assume a conditional point of compliance for groundwater located at the BNSF property boundary rather than at the River.

MTCA Evaluation Summary – As with the SW alternatives, the PB alternatives focus on attainment of the groundwater cleanup standard through removal of free product and either natural attenuation, enhanced bioremediation or a combination of the two. The need for and duration of bioremediation of groundwater depends on the effect of removing free product has on reducing groundwater impacts at the BNSF property boundary.

All of the PB alternatives achieve soil cleanup by removing surface soil and subsurface soil to varying degrees after which institutional controls are invoked to protect against exposures to remaining contaminated soil at depth. Contaminated soil remaining at depth after the cleanup actions is isolated under a protective layer of clean overburden soil. The institutional controls protect against exposures to this material by obligating BNSF to assist property owners and other affected entities (e.g., utilities, the town of Skykomish) with managing contaminated soil and groundwater from construction work. Alternatives PB3 and PB4 achieve greater permanence with respect to soil cleanup by removing or treating substantially greater amounts of contaminated soil in the NW Developed Zone (Table 7-2).

Cleanup of the Northeast Developed Zone is more likely to achieve cleanup standards due to the presence of more biodegradable petroleum constituents. Cleanup of the South Developed Zone is more likely to achieve cleanup standards due to the limited source area and the small area of concern.

All of the PB alternatives protect human health and the environment. Alternatives PB3 and PB4 are more permanent than PB1 and PB2 through removal of greater amounts of material, primarily in the NW Developed Zone (Table 7-2).

SEPA Evaluation Summary – The PB alternatives similarly have negligible unavoidable impacts to the natural environment, except where excavation of the aquatic zones under alternatives PB3 and PB4 result in unavoidable impacts to sediment and salmonid habitat. Impacts to the wetland area are also associated with excavation options, but are considered mitigated through appropriate compensatory wetland mitigation.

The impacts to the built environment are the same as those from the SW alternatives. Details on the extent of impacts are discussed in Appendix A. However, unlike the SW alternatives, buildings in the historic zone would require temporary relocation under alternative PB4. This alternative leads to permanent, major impacts to the overall aesthetic character of the town; therefore, it is considered to have the most severe impact in this SEPA evaluation.

8 Selecting a Preferred Remedial Alternative

The purpose of the feasibility study as stated in WAC 173-340-350 (8)(a) "is to develop and evaluate cleanup action alternatives to enable a cleanup action to be selected for the site." This section of the FS/EIS follows the requirements for selecting cleanup actions. It summarizes how each alternative complies with MTCA's minimum requirements (WAC 173-340-360(2)(a)) and it illustrates how each remedial alternative is consistent with MTCA's "other requirements" (WAC 173-340-360(2)(b)). This section also provides a comparison of the significant adverse environmental impacts and reasonable mitigation measures of the alternatives, consistent with SEPA.

8.1 Threshold Requirements

All cleanup actions shall fulfill the "threshold requirements" as specified in WAC 173-340-360(2)(a). This section describes how all the remedial alternatives presented in the FS/EIS meet these threshold requirements.

8.1.1 Protect Human Health and the Environment

Cleanup levels that protect human health and the environment are provided in Section 5. Protection can be achieved by excavating all contaminated soil and sediments and attaining these cleanup levels throughout the site, as described in alternative STD, or by containing contaminated soil and groundwater and using institutional controls to minimize long-term exposure. The use of containment and institutional controls is acceptable under MTCA (WAC 173-340-360(2)(e)) as long as the cleanup action meets threshold and other requirements, the institutional controls reduce risk, and the cleanup action does not "rely primarily on institutional controls where it is technically practicable to implement a more permanent cleanup action." At a minimum, each alternative (other than No Action) will remove free product, eliminate discharges of petroleum to surface water, and remove contaminated surface soil.

8.1.1.1 Human Health

Section 5 demonstrates that the risks to human health under existing conditions at the site are the following:

- Direct contact with soil containing concentrations of TPH (based on the sum of EPH/VPH data) greater than 2,130 mg/kg in the vadose zone and 2,765 mg/kg in the smear zone, arsenic above 20 mg/kg, and lead above 250 mg/kg. These numeric criteria are based on a child ingesting 200 grams of soil per day for 6 years.

- The ingestion of groundwater or surface water and aquatic organisms for water containing greater than 477 µg/L TPH (based on the sum of EPH/VPH).

In order to eliminate these risks, each alternative addresses metal impacts in surface soil. The No Action alternative includes the continued application of Soil Sement™ while all of the other alternatives include the excavation and capping of all surface metals in soil in both the NW Developed and Railyard Zones. All other soil impacts are not present in surface soil and, therefore, require some form of excavation before there is human exposure. The soil TPH concentration to protect a construction worker, utility worker, or resident conducting occasional soil excavation from exposure is >100,000 mg/kg TPH (based on the sum of EPH/VPH), a concentration that has not been exceeded in any soil samples analyzed for EPH/VPH, including samples collected from free product areas These intermittent exposures can be controlled by institutional controls such as a city-managed grading permit process that includes environmental review to ensure direct contact exposures to subsurface soil are avoided and contaminated soil and groundwater are safely managed. Alternatives SW3 and PB1 include excavation of accessible free product in the NW Developed Zone and alternatives SW4, PB2, PB3, PB4, and STD include the complete removal of free product from the NW Developed Zone. These alternatives provide more permanent means of protecting residents and utility or construction workers from being accidentally exposed to soil that presents a risk while working in yards or public rights-of-way. Remedial alternatives SW4, PB3, and PB4 include an additional layer of permanence and protectiveness by excavating subsurface soil impacts to satisfy the cleanup levels wherever soil contamination is within 4 feet of the ground surface.

The community currently has a public drinking water supply that is not at risk of contamination from the site. State and local institutional controls prohibit installation of wells within contaminated areas. These include the King County Board of Public Health, *Public Water System Rules and Regulations* (Title 12) and the *Declaration of Covenant for Individual Water Supply*, both managed by the Department of Health; Town of Skykomish Ordinance; and Department of Ecology *Minimum Standards for Construction and Maintenance of Wells*, WAC 173-160. Even though human health risk related to groundwater is already controlled by the existing water supply system and institutional controls, MTCA generally requires that groundwater be cleaned-up to drinking water standards.

Human health cleanup levels for groundwater and surface water are based on restoring the water for use as drinking water. Off-railyard exceedances of the 477-µg/L groundwater cleanup level are concurrent with free product (see Figure 3-9). Alternatives SW4, PB2, and PB3 aggressively address all free product in all off-railyard areas and achieve the groundwater cleanup level in all off-railyard areas in a relatively short timeframe (<10 years). Alternatives SW3 and PB1 also address free product and achieve the groundwater cleanup level over a longer timeframe (<30 years) in off-railyard areas, but in a manner than creates less disturbance to the community.

8.1.1.2 Environment

Section 5 demonstrates that risks to the environment under existing conditions at the site are the following:

- Sediment in the Skykomish River that failed bioassay tests due to the presence of product seeps.

- Groundwater discharging to the Skykomish River and the Former Maloney Creek channel that may cause sediment to accumulate contaminants to levels that would present a risk to aquatic receptors. A groundwater TPH cleanup level of 64 µg/L (sum of EPH/VPH) was developed using conservative assumptions related to groundwater-sediment interaction.

- Groundwater discharging to the surface water of the Skykomish River and the Former Maloney Creek channel that would present a risk to aquatic receptors. A groundwater TPH cleanup level of 700 µg/L (sum of EPH/VPH) was developed based on WET testing bioassays on water column organisms.

Each alternative (other than No Action) provides groundwater treatment at the levee to treat groundwater to acceptable levels prior to discharge to the Skykomish River. More aggressive remedies, including free product or soil removal at the levee, are proposed for six of the nine remedial alternatives. With respect to the former Maloney Creek channel, it is not clear that groundwater above cleanup levels is discharging into the channel, although it may be inferred from the data. Aggressive cleanup is proposed for all alternatives for the South Developed Zone, which is immediately upgradient of the former Maloney Creek channel and would be a source of groundwater that may discharge to the channel during certain times of the year. In addition, active groundwater treatment within the former Maloney Creek channel is proposed for alternatives SW4, PB3, and PB4.

Based on bioassays, some sediment in the Skykomish River has been identified for cleanup. In addition, a correlation of the bioassay results with TPH concentrations produces a numeric cleanup level of 100 mg/kg NWTPH-Dx. Some sediment in the former Maloney Creek channel has also been identified for cleanup based on this cleanup level. Six of the nine remedial alternatives include actively addressing these sediment impacts in the

Skykomish River while four of the nine alternatives include actively addressing sediment impacts in the former Maloney Creek channel. Less aggressive approaches are included for other alternatives in an effort to avoid or minimize significant adverse environmental impacts that may outweigh the benefits of excavating sediments.

8.1.2 Comply With Cleanup Standards

Cleanup standards consist of both a cleanup level and a point of compliance where the cleanup level must be met (WAC 173-340-700). Per the regulation, "a cleanup level is the concentration of a hazardous substance in soil, water, air, or sediment that is determined to be protective of human health and the environment under specified exposure conditions." For each alternative presented in this FS/EIS, standard points of compliance are used for all media except groundwater. Cleanup standards applicable to groundwater at the site include:

- For all SW alternatives, groundwater must achieve a cleanup level of 64 µg/L TPH (sum of EPH/VPH) prior to discharging to surface water (Skykomish River and Former Maloney Creek channel).

- For all PB alternatives, groundwater must achieve a cleanup level of 477 µg/L TPH (sum of EPH/VPH) in all areas of town, except the railyard, and a cleanup level of 64 µg/L TPH (sum of EPH/VPH) prior to discharging to the Skykomish River and the Former Maloney Creek channel.

- For the STD alternative, groundwater must achieve a cleanup level of 64 µg/L TPH (sum of EPH/VPH) throughout the site.

Only remedial alternative STD can achieve groundwater cleanup levels at the standard point of compliance (i.e., throughout the site, including the railyard and off-railyard properties). STD is considered a permanent groundwater cleanup action. Per WAC 173-340-360(2)(c)(ii), the less permanent groundwater cleanup actions shall include "removal [of] free product consisting of petroleum and other light nonaqueous phase liquid (LNAPL) from the groundwater using normally accepted engineering practices" and "[g]round water containment…to the maximum extent practicable to avoid lateral and vertical expansion of the ground water volume affected by the hazardous substance." All of the SW and PB alternatives address these requirements through the use of barrier walls, skimming pumps, or recovery trenches, all of which are normal engineering practice for removing heavy, viscous free product. More aggressive approaches have been included such as excavation near higher risk areas and nonstandard approaches such as ozone sparging and surfactant/thermal flushing are being considered. Enhanced bioremediation can effectively remove the diesel-range free product from the

NE Developed Zone. Monitored natural attenuation is proposed in some areas to avoid or minimize significant adverse effects on the built and natural environment.

STD achieves all groundwater, soil, surface water and sediment cleanup levels at the standard points of compliance. It is, therefore, the most permanent alternative considered in this FS/EIS. Institutional controls are required to ensure compliance with cleanup standards and must be implemented in accordance with WAC 173-340-440. For the STD alternative, institutional controls are required in the short-term (<8 years) to minimize the risk of exposure while the remedy is being implemented. For all of the other alternatives (PB and SW), long-term (10+ years) institutional controls are required to comply with cleanup standards. Institutional controls include restrictive covenants on individual properties and legal or administrative mechanisms. Restrictive covenants require the consent of the property owner of the property with contamination above cleanup levels to which the restrictive covenant is applied. Legal or administrative mechanisms include "zoning overlays, placing notices in local building department records or state lands records, public notices and education mailings." State and local institutional controls already in place prohibit installation of wells within contaminated areas. Additional institutional controls (ordinances and private agreements) can further limit exposure and provide a mechanism for BNSF (or the Town with technical and financial assistance from BNSF) to safely manage contaminated soil and water encountered during construction activities on private and public properties. Any of these institutional controls could be removed or modified once the cleanup is completed.

All of the proposed remedial alternatives comply with cleanup standards. Compliance with cleanup standards would be demonstrated by monitoring during implementation of the cleanup action and over the long-term.

8.1.3 Comply With Applicable Local, State and Federal Laws

Several applicable local, state and federal laws have been incorporated into the cleanup level development process included in this FS/EIS. These include the Sediment Management Standards (WAC 173-204) and the State Environmental Policy Act (WAC 197-11-400). Additional laws may apply to implementation of the cleanup action. An example is Section 404 of the Clean Water Act that will require permitting and mitigation associated with cleanup actions that impact the Skykomish River or the wetland at the former Maloney Creek channel. All of the alternatives included in the FS/EIS can be designed to comply with applicable local, state and federal laws.

8.1.4 Provide for Compliance Monitoring

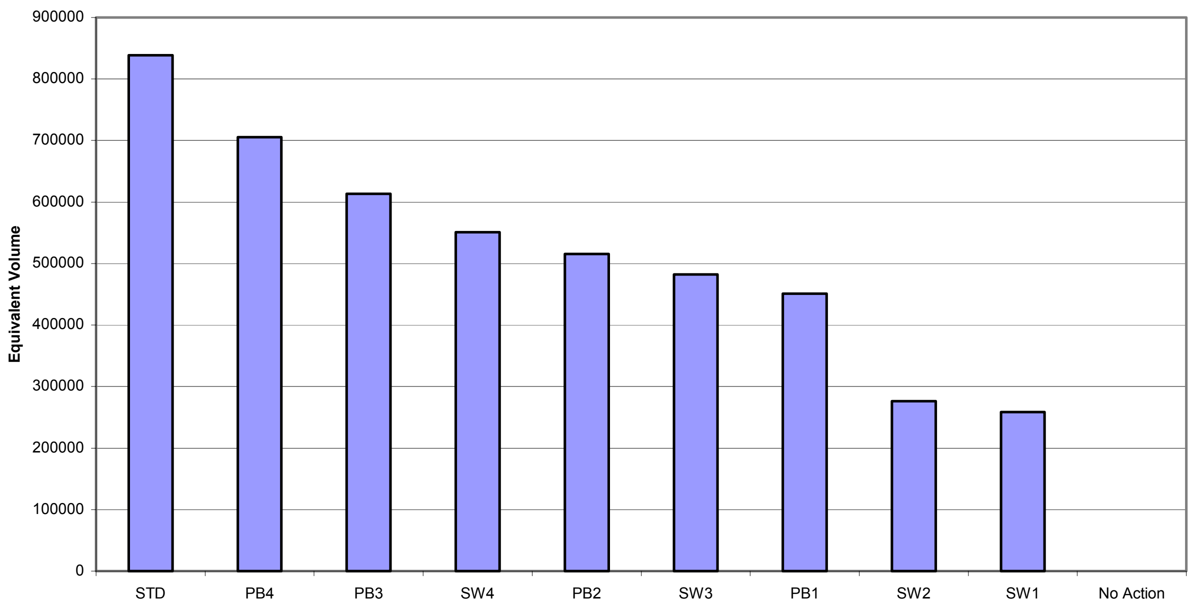
Compliance monitoring is not a cleanup element that is described in detail during the FS/EIS process. These provisions are better developed in the Cleanup Action Plan and detailed Compliance Monitoring Plans are developed during Engineering Design of the cleanup action. Compliance Monitoring Plans provide for a monitoring program to ensure that cleanup levels are obtained and include provisions for contingent remedies should the initial remedy fail. All of the alternatives in the FS/EIS can be designed to provide all phases of compliance monitoring, including protection, performance and conformational monitoring.

8.2 Use Permanent Solutions to the Maximum Extent Practicable

The first of three “other requirements” for selection of cleanup actions under MTCA is the use of permanent solutions to the maximum extent practicable. The procedure for determining whether a cleanup action uses permanent solutions to the maximum extant practicable is provided in WAC 173-340-360(3). This section presents a “disproportionate cost analysis” to compare the relative costs and benefits of all the alternatives. Costs are disproportional to benefits if the incremental cost of an alternative exceeds the incremental benefit achieved with the additional cost. The analysis may be quantitative or qualitative. The analysis begins by ranking alternatives from the most permanent to the least permanent. Once alternatives are ranked from the most permanent to the least permanent, they are evaluated based on seven criteria in WAC 173-340-360(f).

A ”permanent cleanup action” achieves cleanup standards without further action at the site, such as long-term monitoring, maintenance or institutional controls (WAC 173-340-200). Section 7.1.2.1 describes a process for quantifying permanence. The measure was termed “equivalent soil volume.” An alternative that treats or removes a greater equivalent soil volume may be considered more permanent because it represents a larger reduction in the volume of hazardous substances at the site and a reduced need for long-term monitoring, maintenance or institutional controls. The remedial alternatives are ranked in Figure 8-1 from the most permanent (STD) to the least permanent (No Action).

Figure 8-1 Remedial Alternatives Ranked By Permanence



8.2.1 Protectiveness

Protectiveness of human health and the environment includes the degree to which existing risks are reduced, time required to reduce risk at the site and attain cleanup standards, on-site and off-site risks resulting from implementing the alternative, and improvement of the overall environmental quality.

As discussed in Section 8.1.1.1, all of the remedial alternatives are designed to aggressively address possible human health risk associated with exposure to impacted surface soil. With respect to subsurface soil, alternatives SW4, PB3, and PB4 provide some additional protectiveness from dermal contact relative to the other alternatives by removing all impacts from within 4 feet of ground surface. While human health risk associated with consumption of groundwater is already controlled, alternatives SW3, SW4, PB1, PB2, and PB3 all aggressively address free product in the NW Developed Zone which are the only off-railyard areas that exceed the human health groundwater cleanup level of 477 µg/L outside of the NE Developed Zone (diesel impacts). 2A-W-6 has a TPH (sum of EPH/VPH) in excess of the criteria but is just outside the free product plume in the NE Developed Zone; however, this area will be addressed via enhanced bioremediation for the same alternatives listed above (SW3, SW4, PB1, PB2, PB3).

Alternatives SW4, PB3, and PB4 provide the greatest level of environmental protectiveness by addressing soil and sediment in the Former Maloney Creek channel and by addressing soil, sediment, and free product at the Levee. SW3 and PB2 provide a moderate level of environmental protectiveness by actively addressing sediment and free product at the Levee. SW1, SW2, and PB1 all provide a lower level of environmental protectiveness.

8.2.2 Permanence

Permanence was discussed earlier and the relative permanence of the remedial alternatives was illustrated in Figure 8-1.

8.2.3 Cost

Costs for each remedial alternative were developed as part of the FS process. Figure 8-2 indicates the cost for each alternative with the alternatives ranked by level of permanence. Detailed cost estimates are provided in Appendix L. The largest cost elements are associated with cleanup of the NW Developed Zone, the levee, and the railyard. Cleanup of the other three zones combined contribute on the order of 15 percent or less of total costs. The total project costs range from less than $10 million to over $40 million. The estimated total costs for the alternatives include only the least cost approach where multiple technologies may be applied. This usually means that the cost of excavation is included in the alternative cost rather than alternative approaches such as ozone sparging or flushing.

Figure 8-2 Remedial Alternative Costs

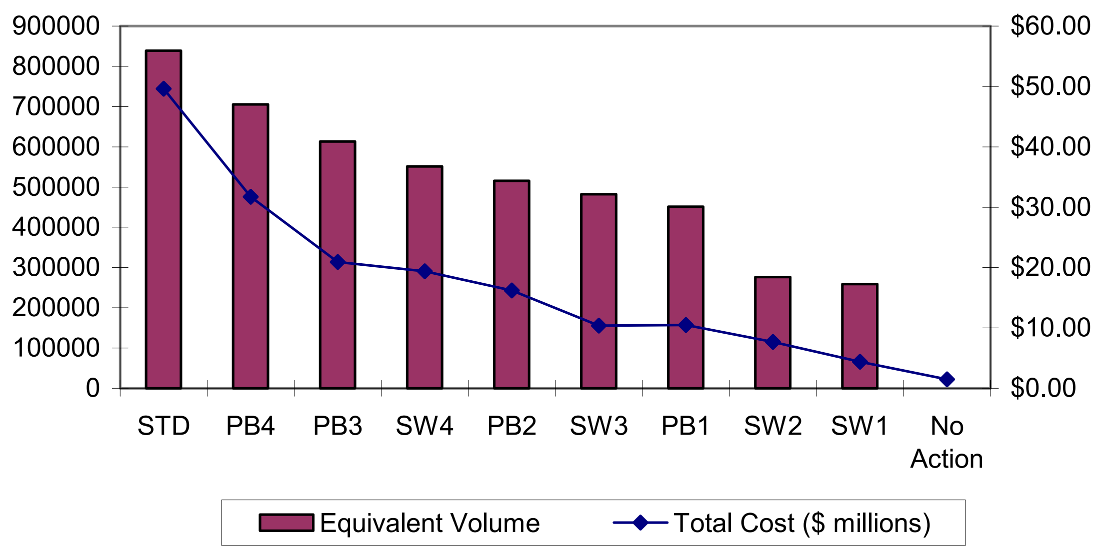
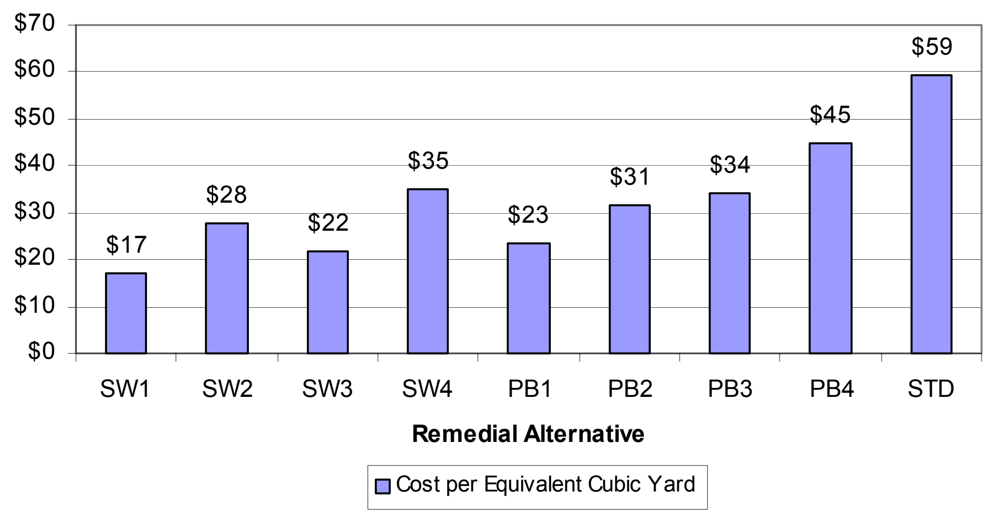


Figure 8-3 illustrates the cost to achieve the increasing levels of permanence. Lower unit costs (total cost divided by total equivalent soil volume) indicate increased cost-effectiveness of the remedial alternative with respect to equivalent soil volume removal or treatment where equivalent soil removal volumes are used as a surrogate for contaminant mass removal and permanence.

Figure 8-3 Unit Equivalent Soil Removal Cost



8.2.4 Effectiveness Over the Long-Term

Long-term effectiveness includes "the degree of certainty that the alternative will be successful, the reliability of the alternative during the period of time hazardous substances are expected to remain on-site at concentrations above cleanup levels, the magnitude of residual risk with the alternative in place, and the effectiveness of controls required to manage treatment residues or remaining wastes." MTCA suggests the use of the use of the following hierarchy of cleanup action components in descending order of long-term effectiveness:

1) Reuse or recycling
2) Destruction or detoxification
3) Immobilization or solidification
4) On- or off-site disposal
5) On-site isolation or containment
6) Institutional controls.

The remedial technologies in the proposed remedial alternatives fit this hierarchy as follows:

Reuse or recycling (free product skimming or trenches and free product flushing with free product recovery and recycling)

1) Destruction or detoxification (natural attenuation, enhanced bioremediation, and ozone sparging)

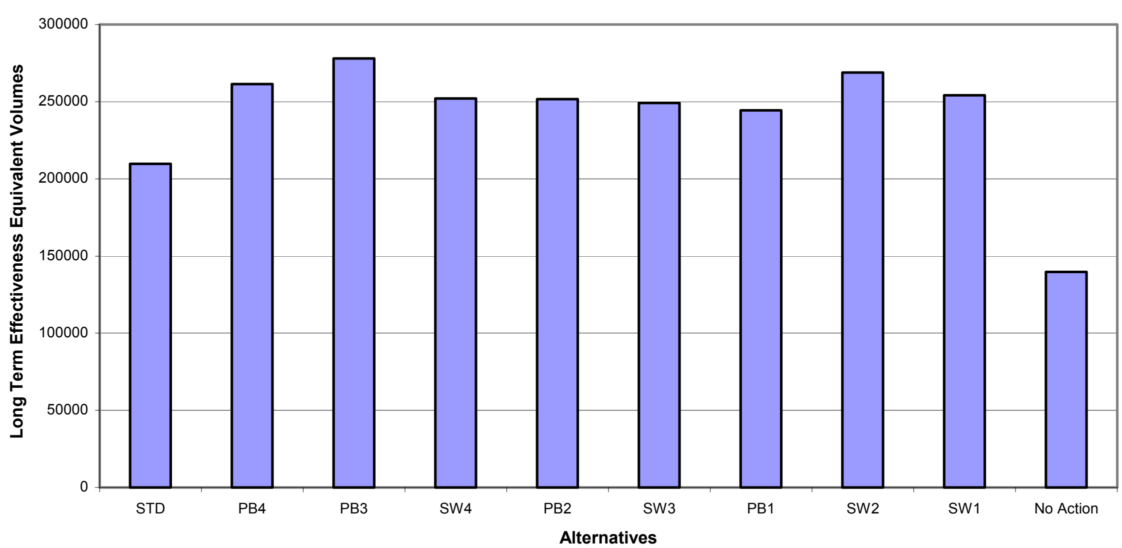
2) Immobilization or solidification (pressure grouting)

3) Excavation (requires off-site disposal)

4) Institutional controls.

Based on the suggestion in MTCA, equivalent soil volumes were calculated for each cleanup action component for each alternative (see Appendix K). The volumes were then divided by the hierarchy number and summed for each alternative to derive a normalized equivalent soil volume. The higher normalized equivalent soil volume suggests a higher level of long-term effectiveness. All of the alternatives have similar long-term effectiveness (see Figure 8-4), although PB4 rates low due to significant excavation and off-site disposal and the No Action alternative rates low due to reliance on institutional controls as the primary remedial technology.

Figure 8-4: Long Term Effectiveness Equivalent Volumes By Alternative Sorted By Permanence



8.2.5 Management of Short-Term Risks

Impacts from remedial action implementation include vehicle traffic, temporary relocation of residences/structures, odor, open excavations, and noise, dust and safety concerns associated with extensive heavy equipment activity. The greatest short-term risk to human health is related to safety and general construction activity. As a result, the short-term risks to human health would be greatest for the more permanent alternatives. In all cases, similar measures would be taken to manage risk such as fencing, signage, dust controls, and traffic control.

With respect to short-term risks to the environment, more aggressive remedies in the aquatic resource zones present a greater short-term risk to the environment. So, similar to human health risks, the short-term risks to the environment would be greatest for the more permanent alternatives. In all cases, similar measures would be taken to manage risk such as temporary dams to prevent surface water discharges, angle boring to minimize drilling in sensitive areas, and scheduling work to avoid sensitive species during critical stages.

8.2.6 Technical and Administrative Implementability

Three major administrative concerns with the remedial alternatives are institutional controls, permitting, and relocating residents, businesses, transportation facilities and public facilities such as the school. All SW and PB alternatives require long-term institutional controls on off-railyard properties where soil and/or groundwater will remain above cleanup levels for extended periods of time. Alternatives SW3, SW4, PB2, PB3, PB4 and STD will treat soil and groundwater to cleanup levels in a shorter timeframe in the NE Developed Zone. Alternatives SW4, PB1, PB2, PB3, PB4, and STD will achieve cleanup levels in the South Developed Zone. Alternatives SW4, PB2, PB3, PB4, and STD will achieve groundwater cleanup levels in the NW Developed Zone. Alternative PB4 will substantially reduce the number of properties with soil above cleanup levels while only alternative STD will result in no properties with soil above cleanup levels in the shortest period of time. The administrative implementability of these alternatives would be proportionate to the number of properties requiring some from of institutional control and the length of time these controls must be enforced.

The second administrative implementability issues relates to permitting and mitigating cleanup actions at the Levee and the former Maloney Creek channel. Permits are required from the US Army Corps of Engineers under Section 404 of the Clean Water Act, and the Endangered Species Act requires the Corps to consult with NOAA-Fisheries and the U.S. Fish and Wildlife Service. In addition, incidental take permits may be required under the Endangered Species Act. Permitting of environmental cleanup activities under this process is expected to take 1 to 2 years. Natural attenuation in the former Maloney Creek channel and enhanced bioremediation or ozone sparging in the Levee would not involve these administrative requirements (as well as the adverse environmental impacts associated with excavating in wetlands and streams). All other approaches would likely require this permit. In addition, any invasive work on or in the Levee will require coordination with King County to ensure the structural integrity of the Levee is not compromised. This applies to all remedial alternatives affecting the Levee.

Finally, the more aggressive remedies (PB4 and STD) necessarily involve administrative and technical challenges associated with extensive excavation around and under buildings and facilities such as the school, the community center, residences, businesses, the main rail line, streets and utilities. Alternative facilities would be required for students, faculty and staff. Temporary dwellings would be required for residents. Businesses and the community center would have to close or relocate to other buildings that may be available in town. Rail traffic (24 trains/day) might have to be rerouted or temporary alternative routes would have to be constructed through town. Even for some of the less aggressive alternatives (such as SW2, SW3 and PB1) if technologies such as natural attenuation, free product recovery and sparging in the NW Developed Zone prove ineffective, then excavation may be needed near or beneath structures. In general, however, technical and administrative implementability decreases with increasing permanence.

8.2.7 Consideration of Public Concerns

The public comment process includes review of this FS/EIS. With respect to MTCA, specific comments regarding whether the proposed alternatives use permanent solutions to the maximum extent practicable are welcome and will be used to select a final cleanup action.

8.2.8 Permanence to the Maximum Extent Summary

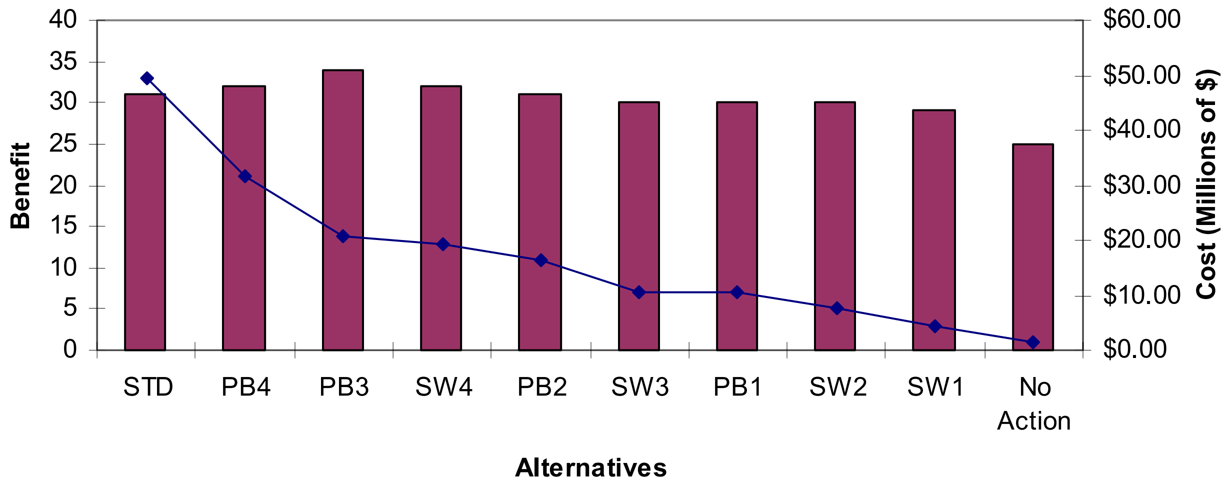
As noted at the beginning of this section, the analysis of whether an alternative is permanent to the maximum extent practicable involves the comparison of the alternatives based on the seven evaluation criteria as described above. The goal is to determine whether the incremental cost of an alternative is disproportionate to the incremental benefit relative to the lower cost alternative (WAC 173-340-360(e)(i). A systematic approach was developed to quantify the relative benefit of the alternatives. The total benefit of each alternative was calculated as the sum of ratings for five of the evaluation criteria:

1) Protectiveness
2) Permanence
3) Effectiveness over the long-term

4) Management of short-term risks
5) Technical and administrative feasibility.

Consideration of public concerns will be based on the public comment received on the FS/EIS and cost is part of the analysis to determine if the incremental cost of an alternative is disproportionate to the incremental benefit relative to the lower cost alternative. The benefit ratings are provided in Table 8-1 and Figure 8-5 illustrates these benefit ratings and alternative costs.

Figure 8-5: Benefit and Cost By Remedial Alternative Ranked By Permanence



To further evaluate the ratings, benefit was plotted versus cost in Figure 8-6. Where a tangent to this curve is steeper (closer to vertical) indicates a greater incremental benefit per incremental dollar expended. Another representation of this analysis is presented in Figure 8-7 where the column height represents the measure of incremental benefit per incremental cost compared to the next lowest cost alternative where the alternatives are presented from least cost to highest cost (left to right). A shorter column or a negative result represents a more disproportionate incremental cost relative to the incremental benefit.

Figure 8-6: Benefit vs. Cost

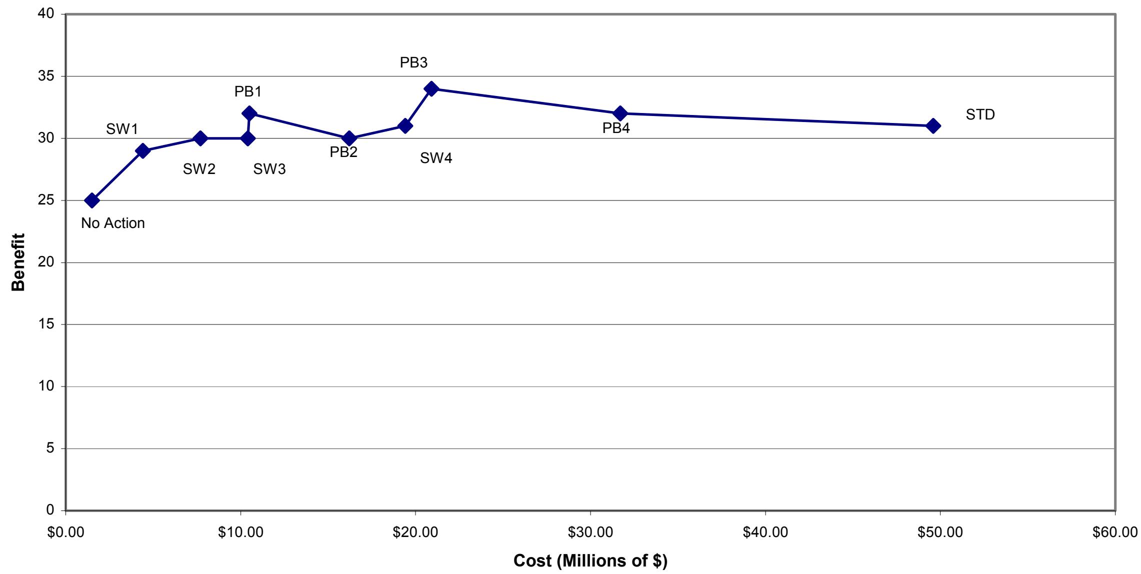
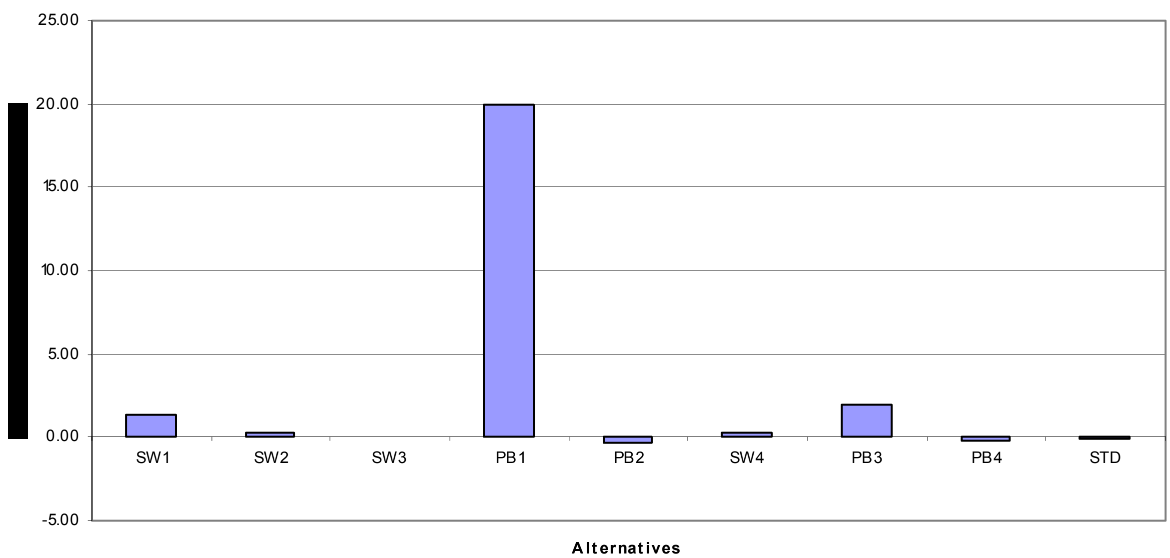


Figure 8-7: Incremental Benefit/Incremental Cost By Remedial Alternative Ranked By Cost



MTCA also states that the most practicable permanent alternative shall be the "baseline cleanup action" against which other alternatives are compared (WAC 173-340-360(e)(ii)(B)). To evaluate the alternatives using this criterion, the data was further evaluated using two approaches. In the first approach, alternative STD was considered the most practicable permanent alternative and the other alternatives were plotted based on the percentage incremental benefit and percentage decrease in cost versus STD (Figure 8-8). This analysis indicates that PB3 is permanent to the maximum extent practicable. In the second approach, PB3 was considered the most practicable permanent alternative since it had the highest benefit rating. Figure 8-9 illustrates the percentage incremental benefit and percentage decrease in cost of each alternative versus PB3. This analysis indicates that either alternative PB1 or SW1 is permanent to the maximum extent practicable.

Figure 8-8: Incremental Benefit versus Cost Savings Relative to STD

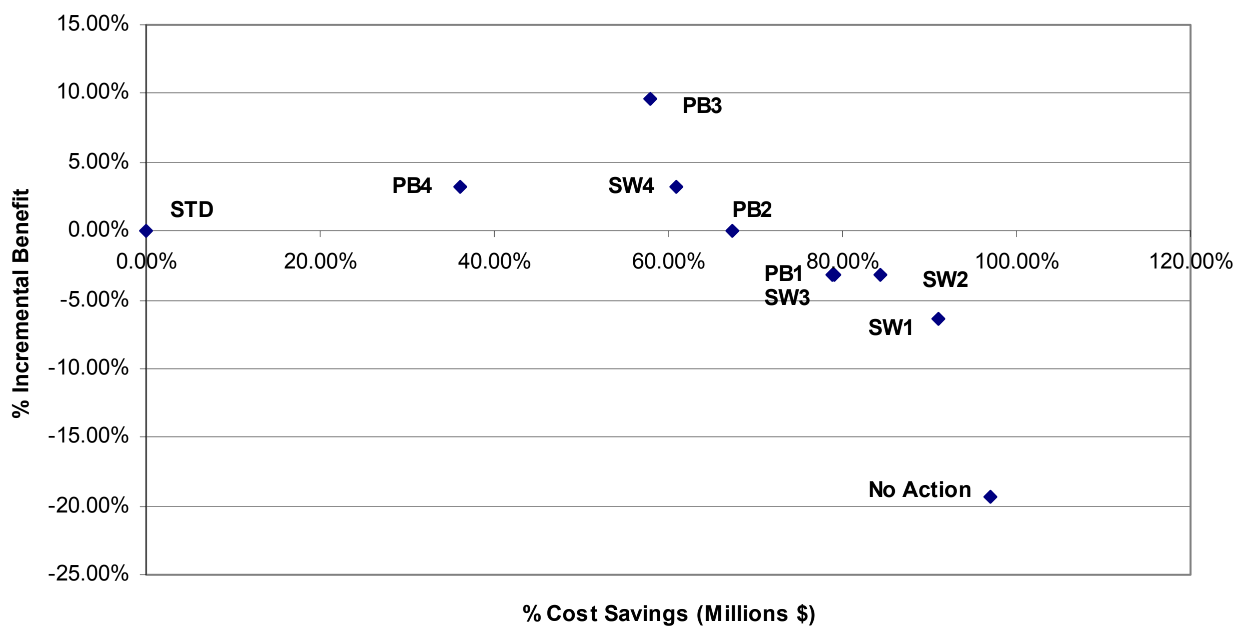
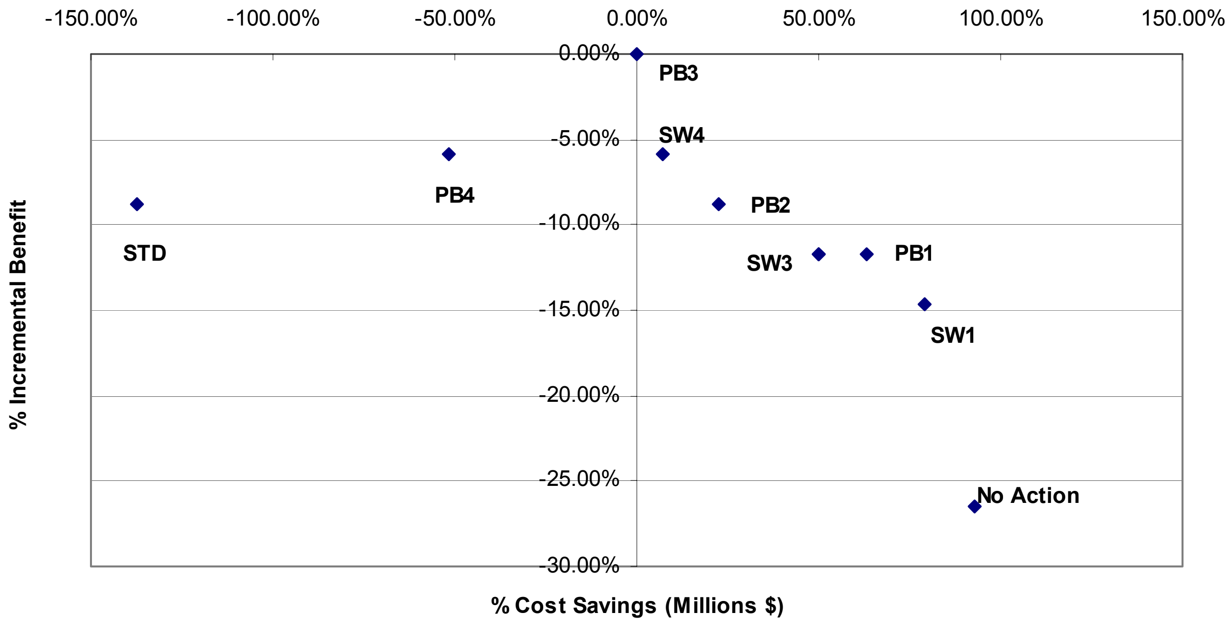


Figure 8-9: Incremental Benefit versus Cost Savings Relative to PB3



8.3 Provide for a Reasonable Restoration Timeframe

The second of three "other requirements" for selection of cleanup actions under MTCA is a reasonable restoration timeframe. Restoration timeframe is the time it takes to meet cleanup standards; i.e., to meet all cleanup levels in all media at all points of compliance. A cleanup action can meet cleanup standards through the use of treatment, removal or containment, or some combination of these three approaches. Each alternative relies on removal of free product and restoring groundwater before it discharges to surface water. The PB alternatives rely on containment and institutional controls for soil in off-railyard areas while the SW alternatives rely on containment and institutional controls for both soil and groundwater in off-railyard areas.

Estimates of time to remove free product and restoration timeframes for groundwater and soil were generated for each zone and remedial alternative. These estimates are based on excavation where there is a choice between remedial technologies and they assume that containment and institutional controls can be established for off-railyard areas for soil and groundwater for the SW alternatives and for soil for the PB alternatives. Figures 8-10 through 8-12 illustrate the estimated restoration timeframes. These charts present the mid-point from estimated ranges in Table 7-2, as follows:

- "4 years" represents a 3 to 5 year range
- "8 years" represents a 5 to 10 year range
- "15 years" represents a 10 to 20 year range
- "25 years" represents a 20 to 30 year range
- "40 years" represents greater than 30 years

Figure 8-10 Free Product Removal Timeframe

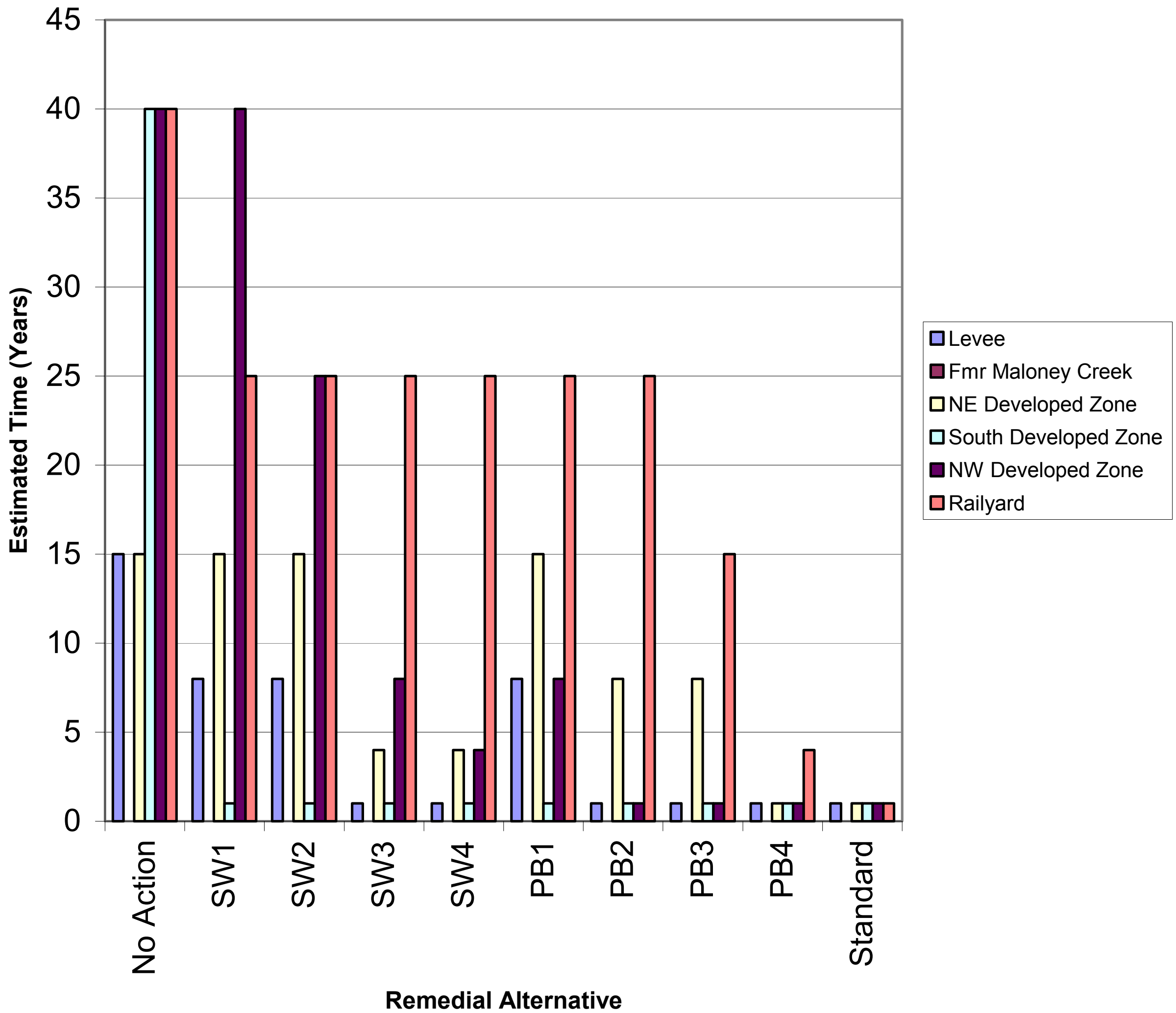


Figure 8-11 Groundwater Restoration Timeframe

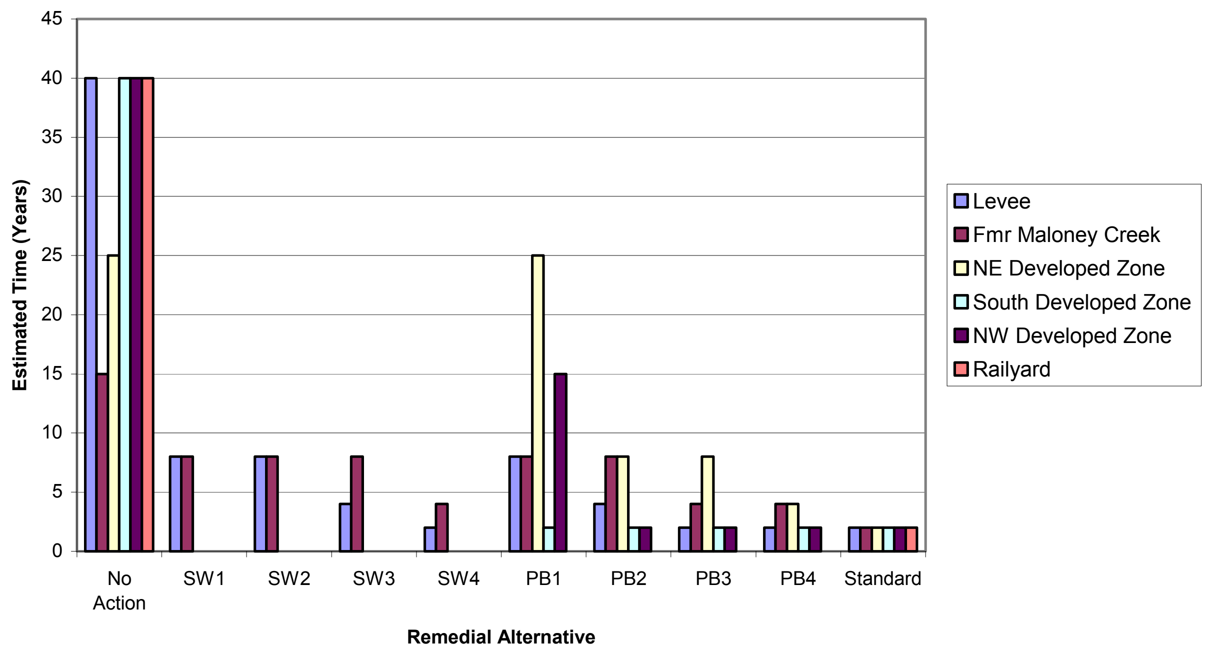
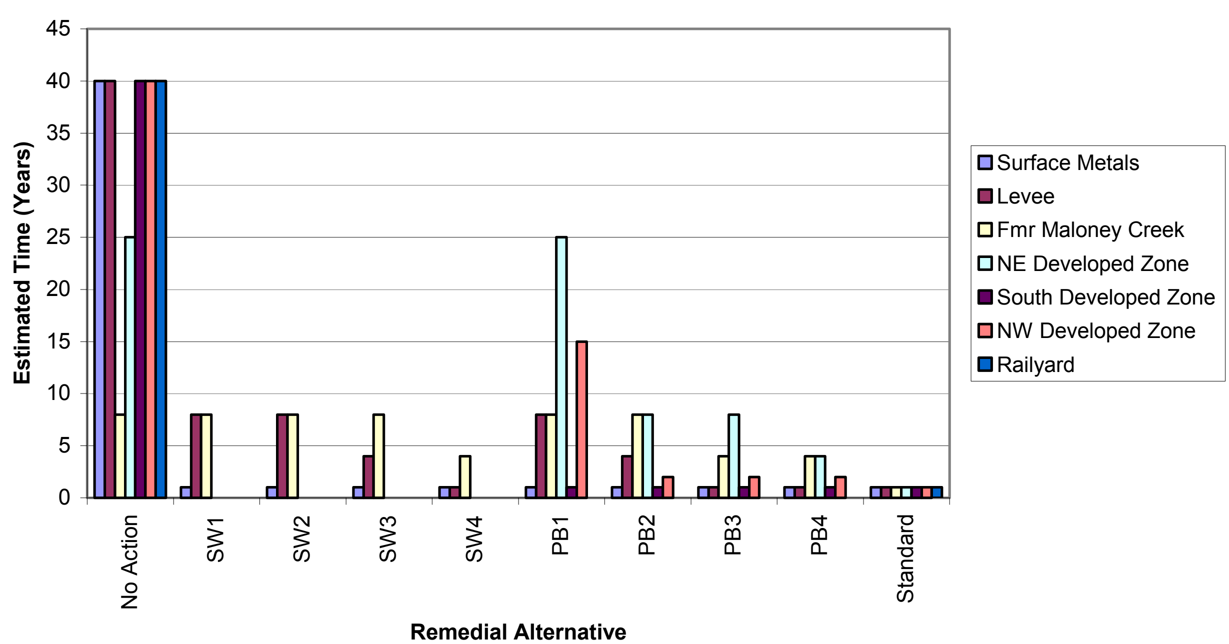


Figure 8-12 Soil Restoration Timeframe



The procedure for determining whether a cleanup action provides for a reasonable restoration timeframe is provided in WAC 173-340-360(4). The nine factors used to determine whether a cleanup action provides for a reasonable restoration timeframe are provided in the rule and include:

1) Potential risks posed by the site to human health and the environment

2) Practicability of achieving a shorter restoration timeframe

3) Current use of the site, surrounding areas, and associated resources that are, or may be, affected by releases from the site

4) Potential future use of the site, surrounding areas, and associated resources that are, or may be, affected by releases from the site

5) Availability of alternative water supplies

6) Likely effectiveness and reliability of institutional controls

7) Ability to control and monitor migration of substances from the site

8) Toxicity of hazardous substances at the site

9) Natural processes that reduce concentrations of hazardous substances and have been documented to occur at the site or under similar conditions.

The rule (WAC 173-340-360(4)(c)) also states that: "a longer period of time may be used for the restoration timeframe for a site to achieve cleanup levels at the point of compliance if the cleanup action selected has a greater degree of long-term effectiveness than on-site or off-site disposal, isolation, or containment options".

Figure 8-10 indicates that free product will be removed from all off-railyard areas within 10 years for alternatives SW3, SW4, PB2, PB3, PB4, and STD. Free product is removed within 30 years from the railyard for alternatives SW3, SW4, and PB2. PB3 decreases this timeframe to less than 20 years while alternatives PB4 and STD reduce this timeframe to less than 5 years.

Figures 8-11 and 8-12 indicate that all alternatives achieve cleanup standards for soil and groundwater within 10 years, except for PB1. Alternatives SW4, PB4, and STD achieve cleanup standards within 5 years. However, alternatives SW1, SW2, SW3, PB2, and PB3 exceed the 5 years because they rely on destruction or detoxification technologies that provide a greater degree of long-term effectiveness, such as natural attenuation and enhanced bioremediation. The technologies are applied in the Levee, the Former Maloney Creek Channel, and the NE Developed Zone.

8.4 Consider Public Concerns

The third of the three "Other requirements" in MTCA is to consider public concerns. The public comment process includes review of this FS/EIS. With respect to MTCA, specific comments regarding whether the proposed alternatives provide for a reasonable restoration timeframe are welcome and will be considered prior to selecting a final cleanup action.

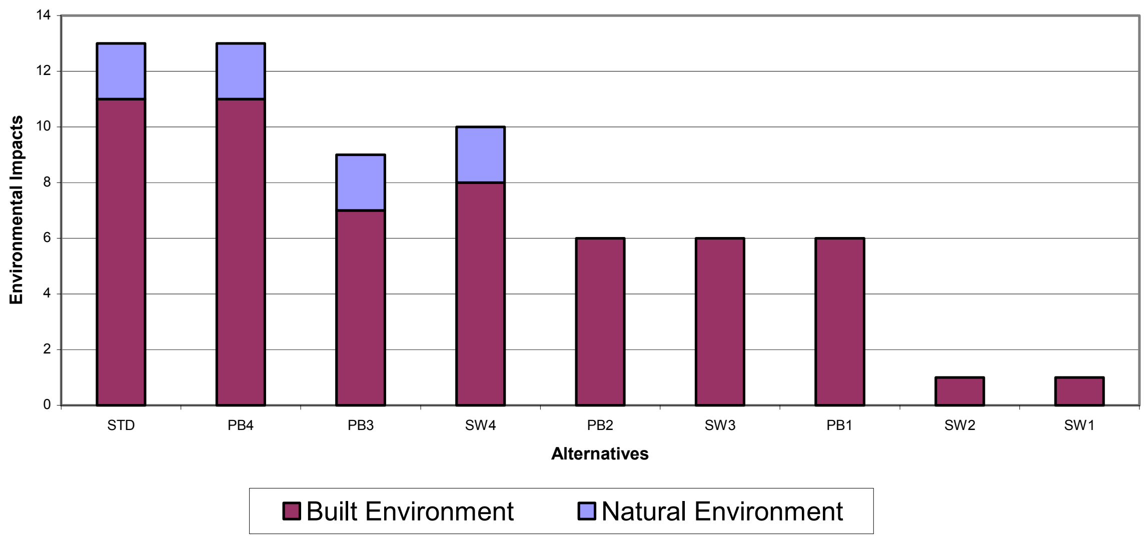
8.5 SEPA Analysis

An EIS is generally required when one or more of the alternatives in the FS will have probable, significant, adverse environmental impacts. The EIS analyzes the probable significant adverse environmental impacts of each reasonable alternative to clean up the site consistent with MTCA and the reasonable measures that could reduce or mitigate those impacts (WAC 197-11-400). These impacts include short- and long-term impacts, direct and indirect impacts and cumulative impacts.

The EIS process is used to analyze alternatives and possible mitigation measures to reduce the environmental impacts of the proposal. Table 7-5 summarized the significant unavoidable impacts of the cleanup alternatives in spite of efforts to mitigate for these impacts. The number of these impacts generally increases as the remedial alternatives become more permanent.

A rating scheme was developed to help evaluate the relative impacts. Where an impact was noted in Table 7-5, it was scored a '1' if it was a moderate impact as noted on Table 7-4 or a '2' if it was a major impact as noted on Table 7-4. Figure 8-13 illustrates the result of this analysis where the alternatives are listed from left to right in order of permanence. As expected, the more permanent alternatives result in more impact except that SW4 has more impact that PB3. The purpose of this figure is to provide a guide in comparing environmental impacts of the remedial alternatives. Impacts to the natural environment vary from a score of '0' for alternatives SW1, SW2, SW3, PB1, and PB2 to a score of '2' for alternatives SW4, PB3, PB4, and STD. Impacts to the built environmental score '1' for alternatives SW1 and SW2 to '11' for alternatives PB4 and STD. Alternatives SW3, SW4, PB1, PB2, ad PB3 have moderate impacts to the built environment of between '6' and '8'. Any comparison using this chart is only relevant if the alternatives are permanent to the maximum extent practicable, provide for a reasonable restoration timeframe, and consider public concerns.

Figure 8-13 Environmental Impacts By Remedial Alternatives Ranked By Permanence



8.6 Preferred Alternative Selection

Ecology will choose the cleanup action based on an analysis similar to that presented in this Section 8. The selected cleanup alternative must:

- Satisfy MTCA threshold requirements (Section 8.1)
- Be permanent to the maximum extent practicable (Section 8.2)
- Provide for a reasonable restoration timeframe (Section 8.3)
- Consider public concerns (Section 8.4)
- Minimize environmental impacts through alternative selection and mitigation (Section 8.5)

The selected cleanup alternative may or may not be one of the remedial alternatives presented in this FS/EIS. It may combine cleanup actions by zone in a manner that better satisfies MTCA and SEPA requirements or it may use technologies that were retained (Appendix J) but not included in any of the remedial alternatives. For example, a final cleanup action based on SW3 might also include free product and soil excavation in the Levee Zone rather than just free product removal or grouting. As another example, a final cleanup action based on PB2 might include permeation grouting to solidify free product under buildings in the NW Developed Zone rather than excavation or flushing.

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Glossary

Agreed Order: A legal document, issued by Ecology, which formalizes an agreement between Ecology and the potentially liable persons for the actions needed at a site. An Agreed Order may be used for all remedial actions except for non-routine cleanup actions and interim actions that constitute a substantial majority of a cleanup action likely to be selected. Since an Agreed Order is not a settlement, it shall not provide for mixed funding, a covenant not to sue, or protection from claims for contribution. An agreed order means that the potentially liable person agrees to perform remedial actions at the site in accordance with the provisions of the agreed order, and that Ecology will not take additional enforcement action against the potentially liable person to require those remedial actions specified in the agreed order, so long as the potentially liable person complies with the provisions of the order. Agreed orders are subject to public comment. If an order substantially changes, an additional public comment period is provided.

Built Environment: The elements of the environment that are generally built or made by people as contrasted with natural processes, including roads, utilities, buildings and bridges.

Cleanup: The implementation of a cleanup action or interim action.

Cleanup Action: Any remedial action, except interim actions, taken at a site to eliminate, render less toxic, stabilize, contain, immobilize, isolate, treat, destroy, or remove a hazardous substance that complies with cleanup levels; utilizes permanent solutions to the maximum extent practicable; and includes adequate monitoring to ensure the effectiveness of the cleanup action.

Cleanup Action Plan: A document that selects the cleanup action and specifies cleanup standards and other requirements for a particular site. The cleanup action plan, which follows the remedial investigation/feasibility study report, is subject to a public comment period. After completion of a comment period on the draft cleanup action plan, Ecology issues a final cleanup action plan.

Cleanup Level: The concentration of a hazardous substance in soil, water, air, or sediment that is determined to be protective of human health and the environment under specified exposure conditions.

Cleanup Process: The process for identifying, investigating, and cleaning up hazardous waste sites.

Consent Decree: A legal document, approved and issued by a court, which formalizes an agreement reached between Ecology and potentially liable persons on the actions needed at a site. A consent decree is subject to public comment, and a public meeting is required. If a consent decree substantially changes, an additional comment period is provided. After satisfying the public comment and meeting requirements, Ecology files the consent decree with the appropriate superior court or federal court having jurisdiction over the matter.

Containment: A container, vessel, barrier, or structure, whether natural or constructed, which confines a hazardous substance within a defined boundary and prevents or minimizes its release into the environment.

Contaminant: Any hazardous substance that does not occur naturally or occurs at greater than natural background levels.

Dissolved-Phase Contaminants: Chemicals that are constituents of LNAPL and have dissolved into groundwater over time (see also LNAPL).

Exposure Pathway: The path a hazardous substance takes or could take from a source to an exposed organism. An exposure pathway describes the mechanism by which an individual or population is exposed or has the potential to be exposed to hazardous substances at or originating from a site.

Feasibility Study (FS): Provides identification and analysis of site cleanup alternatives and is usually completed within a year. The entire Remedial Investigation/Feasibility Study process takes about two years and is followed by the cleanup action plan. Remedial action evaluating sufficient site information to enable the selection of a cleanup action plan.

Free Product: A hazardous substance that is present as a nonaqueous phase liquid (that is, liquid not dissolved in water). Free product flows and accumulates as a liquid separate from water in wells.

Groundwater: Water found beneath the earth's surface that fills pores between materials such as sand, soil, or gravel. In aquifers, groundwater occurs in sufficient quantities that it can be used for drinking water, irrigation, and other purposes.

Hazardous Site List: A list of ranked sites that require further remedial action. These sites are published in the Site Register.

Interim Action: Any remedial action that partially addresses the cleanup of a site. It is an action that is technically necessary to reduce a threat to human health or the environment by eliminating or substantially reducing one or more pathways for exposure to a hazardous substance at a facility; an action that corrects a problem that may become substantially worse or cost substantially more to address if the action is delayed; an action needed to provide for completion of a site hazard assessment, state remedial investigation/feasibility study, or design of a cleanup action.

Light Non-Aqueous Phase Liquid (LNAPL): Liquid that floats on groundwater and accumulates on top of water in wells, groundwater or surface water is called mobile (free-phase) LNAPL. See also residual LNAPL.

Model Toxics Control Act (MTCA): Refers to RCW 70.105D. Voters approved it in November 1988. The implementing regulation is WAC 173-340 and was amended in 2001.

Monitoring Wells: Special wells drilled at specific locations on or off a hazardous waste site where groundwater can be sampled at selected depths and studied to determine the direction of groundwater flow and the types and amounts of contaminants present.

Natural Environment: The elements of the environment frequently referred to as natural elements, or resources, such as earth, air, water and wildlife.

Polynuclear Aromatic Hydrocarbon (PAH): A class of organic compounds, common in some petroleum products, some of which are long lasting and carcinogenic. These compounds are formed from the combustion of organic material and are ubiquitous in the environment.

Public Notice: At a minimum, adequate notice mailed to all persons who have made a timely request of Ecology and to persons residing in the potentially affected vicinity of the proposed action; mailed to appropriate news media; published in the local (city or county) newspaper of largest circulation; and the opportunity for interested persons to comment.

Public Participation Plan: A plan prepared under the authority of WAC 173-340-600 to encourage coordinated and effective public involvement tailored to the public's needs at a particular site.

Recovery Wells: Special wells drilled at specific locations on or off a hazardous waste site where petroleum products can be recovered from the groundwater and recycled or disposed in accordance with state law and regulations.

Redd: A depression created in gravel beds by the upstroke of the female salmon's body and tail, used by spawning salmon to create “nests” for their eggs.

Release: Any intentional or unintentional entry of any hazardous substance into the environment.

Remedial Action: Any action to identify, eliminate, or minimize any threat posed by hazardous substances to human health or the environment, including any investigative and monitoring activities of any release or threatened release of a hazardous substance, and any health assessments or health effects studies conducted in order to determine the risk or potential risk to human health.

Remedial Investigation (RI): Any remedial action, which provides information on the extent and magnitude of contamination at a site. This usually takes 12 to 18 months and is followed by the feasibility study. The purpose of the Remedial Investigation/Feasibility Study is to collect and develop sufficient site information enabling the selection of a cleanup action.

Residual LNAPL: The oily residue that is caught up in the soil pores due to capillary pressure following the removal of mobile LNAPL (see LNAPL). Residual LNAPL can provide a continuous source of contamination to groundwater from soluble constituents.

Responsiveness Summary: A compilation of all questions and comments to a document open for public comment and their respective answers/replies by Ecology. The responsiveness summary is mailed, at a minimum, to those who provided comments, and its availability is published in the Site Register.

Risk: The probability that a hazardous substance, when released into the environment, will cause an adverse effect in exposed humans or other living organisms.

Risk Assessment: The determination of the probability that a hazardous substance, when released into the environment, will cause an adverse effect in exposed humans or other living organisms.

Seep: A point on the riverbank where the groundwater has carried the petroleum products, and those products are released into the river.

Total Petroleum Hydrocarbons (TPH): A scientific measure of the sum of all petroleum hydrocarbons in a sample (without distinguishing one hydrocarbon from another). The "petroleum hydrocarbons" include compounds of carbon and hydrogen that are derived from naturally occurring petroleum sources or from manufactured petroleum products (such as refined oil, coal, and asphalt).

Toxicity: The degree to which a substance at a particular concentration is capable of causing harm to living organisms, including people, plants and animals.

Table 2 – 1 South Fork Skykomish River Measurements

Month	Mean River Height at 5th Street Bridge, Skykomish, Washington (ft) (June 1999 – Feb 2001)	Mean (Standard Deviation) River Flow at Goldbar Gauging Station (cfs) (1990 – 2001)
January	3.74 – 6.16	4536 (1531)
February	3.87 – 5.72	4320 (2715)
March	3.94 – 4.7	3536 (1151)
April	4.33 – 6.99	4612 (1104)
May	5.45 – 6.64	6490 (1852)
June	5.02 – 8.33	5826 (2641)
July	4.83 – 8.78	3137 (2029)
August	3.91 – 7.38	1255 (667)
September	3.54 – 5.67	1060 (598)
October	3.38 – 4.46	3061 (2076)
November	3.33 – 6.34	6561 (5173)
December	3.68 – 9.57	4631 (2093)

Table 2-2 Occurrence of Federal Threatened and Endangered Species in the Site Vicinity

Common Name and Scientific Name	Federal Status	Occurrence in Site Vicinity
Bald eagle *Haliaeetus leucocephalus*	Threatened; proposed for delisting 1999	Occasional winter use of South Fork of Skykomish River corridor near site
Marbled murrelet *Brachyramphus marmoratus*	Threatened	No suitable habitat at site; suitable habitat present within basin, occurrence unknown
Northern spotted owl *Strix occidentalis caurina*	Threatened	No suitable habitat at site; suitable habitat present within basin; occurrence documented

Table 2-3 Salmonid Presence and Timing Within the South Fork and Former Maloney Creek Channel

Species	South Fork, near Skykomish			Former Maloney Creek Channel		
	Spawning	Emergence	Rearing	Spawning	Emergence	Rearing
Chinook[1]	Late Sept. – Oct.	Feb. – mid-Mar.	Feb. – July	None	None	None
Bull Trout[1, 2]	None	None	None	None	None	None
Coho	Late Oct. – Jan.	Mar. – May	Mar. – July	Late Oct. – Jan.	Mar. – May	Mar. – July
Pink	Mid-Sept. – Oct.	Mar. – April	Mar. – Apr.	Mid Sept. – Oct.	Mar. – Apr.	Mar. – Apr.
Chum	Mid-Nov. – mid-Jan.	Feb. – May	Feb. – May	Mid Nov. – mid-Jan.	Feb. – May	Feb. – May
Steelhead	Feb. – mid-June	June – Aug.	June – Aug.	Feb. – mid- June	June – Aug.	June – Aug.

[1] – These species have not been documented in Maloney Creek.
[2] – Bull trout only use the South Fork as a migration corridor to and from spawning grounds in the East Fork Foss River.

Table 2-4 Typical Sound Levels Measured in the Environment and Industry[1]

Typical Sound Levels at a Given Distance from Noise Source	A-Weighted Sound Level in Decibels	Noise Environment	Subjective Impression
	140		
Civil Defense Siren (100’)	130		
Jet Takeoff (200’)	120		Pain Threshold
	110	Rock Concert	
Diesel Pile Driver (100’)	100		Very Loud
	90	Boiler Room Printing Press Plant	
Freight Cars (50’) Pneumatic Drill (50’) Freeway (100’) Vacuum Cleaner (10’)	80		
	70	In Kitchen with Garbage Disposal Running	Moderately Loud
	60	Data Processing Center	
Light Traffic (100’) Large Transformer (200’)	50	Department Store	
	40	Private Business Office	Quiet
Soft Whisper (5’)	30	Quiet Bedroom	
	20	Recording Studio	
	10		Threshold of Hearing
	0		

[1]Source: Illingworth & Rodkin, Inc., 1999

Table 3-1 Potentiometric Surface Elevations for Selected Wells, December 2002 to March 2003

Well Number	1/2002		2/2002		3/2002		4/2002		5/2002		6/2002		7/2002	
	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)
1A-W-1			922.65		922.65		922.68		922.68		922.72			
1A-W-2			924.66		924.66		924.61		924.61		924.04			
1A-W-3			920.08		920.08		920.75		920.75		921.63			
1A-W-4			920.78		920.78									
1B-W-1			925.31		925.31									
1B-W-2			923.45											
1B-W-3			922.63											
1C-W-1			924.05											
1C-W-2			925.75											
2A-W-1			924.72				924.43		924.43					
2A-W-2			925.21				924.85		924.85		924.40			
2A-W-3			924.83											
2A-W-4			925.25											
2A-W-5			926.86											
2A-W-6			924.24											
2A-W-7			926.17											
2A-W-8			927.62											
2A-W-9			928.04											
2A-W-10			928.98											
2A-W-11			927.07											
2B-W-1			928.07											
2B-W-4														
5-W-1			922.39		922.39		922.49		922.49		922.29			
5-W-2			**920.35**	**0.32**	**920.35**	**0.29**								
5-W-3			**920.75**	**0.77**	**920.75**	**0.69**								
5-W-4			921.06				921.11		921.11		920.99			
5-W-5														
DW-4			919.25											
DMW-4														
MW-1			926.52											
MW-2			926.85											
MW-3			**927.57**											
MW-4			929.23											
MW-5			927.66											
MW-6			925.46											
MW-7			925.13											
MW-8			925.91											

Note: Bold well names indicates product is or has been present

Table 3-1 Potentiometric Surface Elevations for Selected Wells, December 2002 to March 2003

Well Number	1/2002		2/2002		3/2002		4/2002		5/2002		6/2002		7/2002	
	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)
MW-9			925.58											
MW-10			925.89											
MW-11														
MW-12			926.84											
MW-13			926.12											
MW-14			925.72											
MW-15			924.82											
MW-16			920.27											
MW-17			926.57	0.46										
MW-18			926.28											
MW-19			922.20		922.20		922.23		922.23		921.72			
MW-20			924.78	0.54			**925.24**	**0.71**	**925.24**	**0.71**	**923.53**	**1.33**		
MW-21			**924.77**	**0.42**										
MW-22			**919.47**		**919.47**		**919.93**	**0.54**	**919.93**	**0.54**	**920.34**	**0.16**		
MW-23	**922.78**		**919.64**		919.64		920.36		920.36		920.91			
MW-24	922.80		919.25		919.25		920.29		920.29		921.34			
MW-25	920.40	1.25	919.13	0.90	**919.13**	**0.75**	**920.11**	**0.88**	**920.11**	**0.88**	**921.29**	**0.84**		
MW-26			923.50		923.50		923.32		923.32		922.67			
MW-27			**925.02**		**925.02**	**0.13**	**924.94**	**0.84**	**924.94**	**0.84**	**924.31**	**0.16**		
MW-28			**926.48**											
MW-30			**916.95**											
MW-31			**919.28**											
MW-32							917.24		917.24		917.56			
MW-34			924.35											
MW-35			924.48											
MW-36			**922.04**	**4.15**	**922.04**	**3.92**	**922.22**	**0.25**	**922.22**	**0.25**	**922.41**	**0.02**		
MW-37			924.27		924.27		924.10		924.10		923.15			
MW-38			917.54		917.54		917.85		917.85		918.14			
MW-39			928.13											
MW-40			925.08											
MW-41	**920.07**	**0.26**	**919.57**	**0.33**	**919.57**	**0.38**	**920.15**		**920.15**		**920.92**	**0.02**		
MW-42	919.47		917.67		917.67		918.32		918.32		918.99			
MW-43	918.41		916.66		916.66		917.00		917.00		917.43			
MW-44	920.49		917.41		917.41		917.88		917.88		918.48			
MW-45	**922.50**		**919.17**		**919.17**		**919.70**		**919.70**		**920.45**			
MW-46	923.23		919.69		919.69		920.32		920.32		920.87			
PZ-1	921.92		918.79		918.79		919.52		919.52		920.24			
PZ-3	**922.79**	**0.17**	**919.34**	**0.29**	**919.34**	**0.33**	**919.88**	**0.46**	**919.88**	**0.46**	**920.54**	**0.33**		
PZ-4	922.94		919.55		919.55		920.04		920.04		920.62			
PZ-5	923.49		920.66		920.66		921.34		921.34					
R-1	**919.99**	**0.12**	**919.02**		**919.02**		**918.29**		**918.29**		**920.16**			
R-2	**922.00**		**919.21**		**919.21**		**919.73**		**919.73**		**920.54**			
R-3	922.18		919.28		919.28		919.83		919.83		920.58			
R-4	**920.39**	**0.29**	**919.25**	**0.15**	**919.25**		**920.25**		**920.25**		**921.48**			
R-6														
R-8	**920.87**	**0.17**	**918.96**	**0.67**	**918.96**	**0.71**	**919.29**	**1.08**	**919.29**	**1.08**	**921.27**	**0.79**		
R-9														

Note: Bold well names indicates product is or has been present

Table 3-1 Potentiometric Surface Elevations for Selected Wells, December 2002 to March 2003

Well Number	8/2002		9/2002/		10/2002		11/2002		12/2002		1/2003		2/2003		3/2003	
	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)
1A-W-1	921.47		920.82	--	920.78		920.07	-	923.14	-	923.49	-	923.04	-	923.99	-
1A-W-2	922.66		921.94	--	921.76		921.19	-	925.52	-	925.10	-	925.46	-	923.56	-
1A-W-3	919.26		919.02	--	918.12		918.48	-	921.08	-	920.52	-	920.88	-	919.68	-
1A-W-4	920.05															
1B-W-1	923.02	0.04														
1B-W-2	922.11															
1B-W-3	921.49															
1C-W-1	922.84															
1C-W-2	924.86															
2A-W-1	921.76		921.56	--	921.42		920.91	-	925.54	-	925.20	-	925.45	-	923.34	-
2A-W-2	923.47		922.38	--	922.21		921.72	-	926.15	-	925.85	-	926.22	-	924.13	-
2A-W-3	921.99															
2A-W-4																
2A-W-5	924.47															
2A-W-6	922.97															
2A-W-7	924.84															
2A-W-8	925.82															
2A-W-9	924.50															
2A-W-10	925.12															
2A-W-11	924.05															
2B-W-1																
2B-W-4	925.43															
5-W-1	920.47		920.06	trace	919.95		919.37	-	923.47	-	922.12	-	923.40	-	922.22	-
5-W-2	**918.86**	**0.31**							921.61	trace	919.99	0.08	921.45	0.10	919.99	0.08
5-W-3	**918.87**	**0.42**	**918.41**	**0.25**			917.50	-	921.80	-	921.04	0.04	920.29	0.10	918.83	0.04
5-W-4	918.99		918.70	--	918.54		917.83	-	921.88	-	920.49	-	921.80	-	920.11	-
5-W-5							-	-	-	-	919.43	-	919.87	-	918.80	-
DW-4																
DMW-4	918.41															
MW-1	925.36															
MW-2	925.76															
MW-3	**925.80**															
MW-4	925.49															
MW-5	924.44															
MW-6	923.11	trace														
MW-7	922.39															
MW-8	921.99	0.81														

Note: Bold well names indicates product is or has been present

Table 3-1 Potentiometric Surface Elevations for Selected Wells, December 2002 to March 2003

Well Number	8/2002		9/2002/		10/2002		11/2002		12/2002		1/2003		2/2003		3/2003	
	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)	Potentiometric Elevation	Product Thickness (ft)
MW-9	923.20															
MW-10	923.26															
MW-11	924.12															
MW-12	923.67															
MW-13	923.68															
MW-14	923.07															
MW-15	922.01															
MW-16	921.72															
MW-17	925.01	1.44														
MW-18	918.53															
MW-19	919.99		919.80	--	919.69		919.01	-	923.12	-	922.70	-	922.95	-	921.17	-
MW-20	**921.88**	**0.31**	**921.67**	**0.15**	921.41	0.16	920.91	0.17	925.60	0.25	-	-	925.73	0.25	923.47	0.04
MW-21	**923.17**	**1.06**														
MW-22	**918.07**	**0.18**	**917.67**	**0.13**	917.39	0.39	916.47	0.04	920.50	1.22	919.30	0.08	920.56	trace	919.05	0.08
MW-23	918.54		918.12	--	917.88		917.52	-	921.00	-	920.25	-	920.82	-	919.11	-
MW-24	918.42		918.03	--	917.88		917.38	-	921.04	-	920.01	-	920.56	-	918.76	-
MW-25	**918.56**	**0.50**	**918.65**	**--**	917.73	0.27	917.40	0.08	919.80	0.58	919.48	0.08	920.23	0.01	918.88	trace
MW-26	920.92		920.48	--	920.30		919.61	-	924.44	-	924.11	-	924.25	-	922.28	-
MW-27	**922.57**	**0.35**	**922.18**	**0.25**	921.48	0.17	920.65	0.08	-	-	925.40	trace	925.79	-	923.90	-
MW-28	**925.38**	**trace**														
MW-30	**916.47**															
MW-31	**918.31**															
MW-32	916.48		916.64	--	915.25		915.04	-	917.53	-	917.21	-	917.33	-	916.74	-
MW-34	923.62															
MW-35	922.86															
MW-36	**920.51**	**0.19**	**920.03**	**0.19**	918.85	0.85	916.89	2.60	-	-	921.81	0.83	922.93	0.01	921.10	1.38
MW-37	921.52		921.32	--	921.22		920.74	-	925.13	-	924.78	-	925.03	-	923.01	-
MW-38	916.93		916.71	--	916.64		915.91	-	918.21	-	917.89	-	918.00	-	917.29	-
MW-39	924.63															
MW-40	922.21															
MW-41	**918.47**	**0.33**	**918.23**	**0.25**	917.57	0.50	917.23	0.27	920.73	0.55	920.06	0.25	920.65	0.10	919.15	0.67
MW-42	917.04		916.87	--	916.76		916.31	-	-	-	918.04	-	918.37	-	917.40	-
MW-43	916.03		915.99	--	915.96		915.30	-	917.27	-	916.87	-	917.04	-	916.45	-
MW-44	916.78		916.62	--	916.52		915.90	-	918.20	-	917.73	-	917.95	-	917.09	-
MW-45	**917.19**		**917.70**	**--**	917.64		916.97	0.08	920.23	sheen	919.66	-	920.24	-	918.72	0.02
MW-46	919.22		918.32	--	918.27		917.87	-	920.97	-	920.30	-	920.87	-	919.16	-
PZ-1	917.80		917.55	--	917.42		916.93	-	920.10	-	919.37	-	919.94	-	918.35	-
PZ-3	**918.23**	**1.00**	**917.88**	**0.92**	917.05	0.73	916.88	0.37	920.44	0.40	919.80	0.04	920.41	0.53	-	-
PZ-4	918.25		918.95	--	917.81		917.41	-	920.67	-	920.10	-	920.55	-	918.99	-
PZ-5	919.56		919.16	--	919.10		918.58	-	921.81	-	920.35	-	921.64	-	920.05	-
R-1	**918.04**	**trace**	**917.85**	**0.02**	917.56	0.06	917.04	-	920.23	-	919.67	-	920.14	0.65	919.17	-
R-2	**918.21**	**trace**	**917.96**	**0.08**	917.67		917.00	-	920.30	-	919.65	sheen	920.33	-	918.74	-
R-3	919.08		917.85	--	917.74		917.18	-	920.48	-	919.76	sheen	920.31	-	918.78	-
R-4	**918.71**		**918.23**	**--**	918.19		917.60	-	920.47	-	919.70	sheen	920.33	-	919.05	-
R-6							-	-	-	-	919.79	0.02	918.74	sheen	917.67	-
R-8	**918.45**	**0.35**	**916.99**	**0.29**	917.79	0.09	916.17	1.21	920.50	-	919.61	-	919.95	-	918.94	-
R-9							-	-	-	-	918.26	-	920.29	-	918.61	0.02

Note: Bold well names indicates product is or has been present

Table 3-2 Petroleum Hydrocarbon Concentrations in Groundwater January 2002 and January 2003

Well ID	TPH-D*				TPH-MO*			
	RL (mg/L)	Jan 2002 (mg/L)	Jan 2003 (mg/L)	Difference	RL (mg/L)	Jan 2002 (mg/L)	Jan 2003 (mg/L)	Difference
Section 1A								
1A-W-1	0.25	—	0.865	—	0.5	—	BRL	—
1A-W-2	0.25	—	0.686	—	0.5	—	BRL	—
1A-W-3	0.25	0.25	BRL	BRL	0.5	BRL	BRL	BRL
1A-W-4	0.25	BRL	BRL	BRL	0.5	BRL	BRL	BRL
Section 1B								
1B-W-1	0.25	—	0.458	—	0.5	—	BRL	—
1B-W-2	0.25	0.39	0.502	0.112	0.5	BRL	BRL	BRL
1B-W-3	0.25	BRL	BRL	BRL	0.5	BRL	BRL	BRL
Section 1C								
1C-W-1	0.25	1.1	1.650	0.55	0.5	BRL	BRL	BRL
1C-W-2	0.25	BRL	—	—	0.5	BRL	—	—
MW-34	0.25	BRL	—	—	0.5	BRL	—	—
MW-35	0.25	1.2	—	—	0.5	BRL	—	—
Section 2A								
2A-W-1	0.25	1.1	—	—	0.5	BRL	—	—
2A-W-2	0.25	—	1.860	—	0.5	—	0.503	—
2A-W-3	0.25	0.87	1.160	0.29	0.5	BRL	BRL	BRL
2A-W-4	0.25	0.43	—	—	0.5	BRL	—	
2A-W-5	0.25	0.26	0.430	0.170	0.5	BRL	BRL	BRL
2A-W-6	0.25	2.6	3.330	0.730	0.5	BRL	BRL	BRL
2A-W-7	0.25	BRL	—	—	0.5	BRL	—	—
2A-W-8	0.25	BRL	—	—	0.5	BRL	—	—
2A-W-9	0.25	0.54	0.464	-0.076	0.5	BRL	BRL	BRL
2A-W-10	0.25	BRL	BRL	BRL	0.5	BRL	BRL	BRL
2A-W-11	0.25	—	1.090	—	0.5	—	BRL	—
MW-1	0.25	BRL	—	—	0.5	BRL	—	—
MW-2	0.25	BRL	—	—	0.5	BRL	—	—
MW-3	0.25	BRL	—	—	0.5	BRL	—	—
MW-4	0.25	BRL	—	—	0.5	BRL	—	—
MW-5	0.25	BRL	BRL	BRL	0.5	BRL	BRL	BRL
MW-7	0.25	0.28	—	—	0.5	BRL	—	—
MW-9	0.25	0.34	0.569	0.229	0.5	BRL	BRL	BRL
MW-10	0.25	0.31	—	—	0.5	BRL	—	—
MW-11	0.25	2.3	2.160	-0.140	0.5	BRL	BRL	BRL
MW-12	0.25	BRL	—	—	0.5	BRL	—	—
MW-13	0.25	BRL	—	—	0.5	BRL	—	—
MW-14	0.25	BRL	—	—	0.5	BRL	—	—
MW-15	0.25	0.28	BRL	>=-0.03	0.5	BRL	BRL	BRL
MW-16	0.25	BRL	—	—	0.5	BRL	—	—
MW-18	0.25	1.9	—	—	0.5	BRL	—	—
MW-40	0.25	BRL	—	—	0.5	BRL	—	—
Section 2B								
2B-W-4	0.25	BRL	BRL	BRL	0.5	BRL	BRL	BRL
MW-39	0.25	0.52	1.070	0.550	0.5	BRL	BRL	BRL
Section 4								
MW-31	0.25	BRL	—	—	0.5	BRL	—	—
Section 5								
5-W-2	0.25	1.2	—	—	0.5	BRL	—	—
5-W-4	0.25	0.42	0.859	0.439	0.5	BRL	BRL	BRL
MW-19	0.25	BRL	BRL	BRL	0.5	BRL	BRL	BRL
MW-23	0.25	BRL	—	—	0.5	BRL	—	—
MW-24	0.25	0.49	0.615	0.125	0.5	BRL	BRL	BRL
MW-26	0.25	1.1	1.780	0.680	0.5	BRL	0.559	>0.059
MW-37	0.25	0.86	—	—	0.5	BRL	—	—
MW-42	0.25	BRL	—	—	0.5	BRL	—	—
MW-43	0.25	BRL	—	—	0.5	BRL	—	—
MW-44	0.25	BRL	BRL	BRL	0.5	BRL	BRL	BRL
MW-45	0.25	1	—	—	0.5	BRL	—	—
MW-46	0.25	BRL	BRL	BRL	0.5	BRL	BRL	BRL
R-3	0.25	0.48	0.541	0.061	0.5	BRL	BRL	BRL

Notes:
* Analytical method used: NWTPH-Dx.
BRL – Below reporting limit.
RL – Reporting limit.
"—" – No data available.

Table 3-3 PAH Concentrations in Groundwater

Chemical Name:	Acenaphthene (µg/L)			Acenaphthylene (µg/L)			Anthracene (µg/L)			Benzo(a)anthracene (µg/L)			Benzo(a)pyrene (µg/L)		
Location ID	**RL**	**Result 1/2002**	**Result 8/2002**	**RL**	**Result 1/2002**	**Result 8/2002**	**RL**	**Result 1/2002**	**Result 8/2002**	**RL**	**Result 1/2002**	**Result 8/2002**	**RL**	**Result 1/2002**	**Result 8/2002**
Outside Rail Yard															
1A-W-1	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL
1A-W-2	0.10	—	BRL UJ	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL
1A-W-3	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
1A-W-4	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
1A-W-4	0.13	BRL	—	0.13	BRL	—	0.13	BRL	—	0.13	BRL	—	0.13	BRL	—
1B-W-2	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
1B-W-3	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
1C-W-2	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
2A-W-1	0.10	**0.55**	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
2A-W-2	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL
2A-W-6	0.13	**2.60**	—	0.13	BRL	—	0.13	**0.31**	—	0.13	BRL	—	0.13	BRL	—
2B-W-4	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
5-W-1	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL
5-W-2	0.10	**0.10**	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—
5-W-2	0.13	**0.13** J	—	0.13	BRL	—	0.13	BRL	—	0.13	BRL	—	0.13	BRL	—
5-W-4	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
MW-23	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
MW-26	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
MW-37	0.10	**0.20**	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
MW-39	0.10	**0.47**	**0.32**	0.10	BRL	BRL	0.10	**0.16**	**0.34**	0.10	BRL	**0.30**	0.10	BRL	**0.16**
MW-42	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
R-3	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
Rail Yard															
2A-W-10	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—
2A-W-11	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—
2A-W-3	0.10	**0.35**	**0.28**	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
2A-W-4	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—
2A-W-5	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
2A-W-7	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
2A-W-9	0.10	**0.83**	BRL	0.10	**0.11**	BRL	0.10	**0.20**	BRL	0.10	BRL	BRL	0.10	BRL	BRL
2A-W-9	0.21	**0.77**	—	0.21	BRL	—	0.21	**0.17** J	—	0.21	BRL	—	0.21	BRL	—
MW-11	0.10	**4.60**	**3.62**	0.10	**0.64**	**0.62**	0.10	**0.53**	BRL	0.10	BRL	BRL	0.10	BRL	BRL
MW-13	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
MW-31	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
MW-5	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
MW-7	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
MW-9	0.10	**0.16**	**0.15**	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL

Note:
BRL – Below reporting limit
RL – Reporting limit.
J – Estimated concentration.
UJ – Estimated detection limit.
"—" – No data available.

Table 3-3 PAH Concentrations in Groundwater

Chemical Name:	Benzo(b)fluoranthene (µg/L)			Benzo(g,h,i)perylene (µg/L)			Benzo(k)fluoranthene (µg/L)			Chrysene (µg/L)			Dibenz(a,h)anthracene (µg/L)		
Location ID	**RL**	**Result 1/2002**	**Result 8/2002**	**RL**	**Result 1/2002**	**Result 8/2002**	**RL**	**Result 1/2002**	**Result 8/2002**	**RL**	**Result 1/2002**	**Result 8/2002**	**RL**	**Result 1/2002**	**Result 8/2002**
Outside Rail Yard															
1A-W-1	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL
1A-W-2	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL
1A-W-3	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
1A-W-4	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
1A-W-4	0.13	BRL	—	0.13	BRL	—	0.13	BRL	—	0.13	BRL	—	0.13	BRL	—
1B-W-2	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
1B-W-3	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
1C-W-2	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
2A-W-1	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
2A-W-2	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL
2A-W-6	0.13	BRL	—	0.13	BRL	—	0.13	BRL	—	0.13	BRL	—	0.13	BRL	—
2B-W-4	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
5-W-1	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL
5-W-2	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—
5-W-2	0.13	BRL	—	0.13	BRL	—	0.13	BRL	—	0.13	BRL	—	0.13	BRL	—
5-W-4	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
MW-23	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
MW-26	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
MW-37	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
MW-39	0.10	BRL	BRL	0.10	BRL	**0.28**	0.10	BRL	BRL	0.10	BRL	**0.50**	0.10	BRL	BRL
MW-42	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
R-3	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
Rail Yard															
2A-W-10	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—
2A-W-11	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—
2A-W-3	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
2A-W-4	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—
2A-W-5	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
2A-W-7	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
2A-W-9	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
2A-W-9	0.21	BRL	—	0.21	BRL	—	0.21	BRL	—	0.21	**0.04** J	—	0.21	BRL	—
MW-11	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
MW-13	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
MW-31	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
MW-5	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
MW-7	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL
MW-9	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL

Note:
BRL – Below reporting limit
RL – Reporting limit.
J – Estimated concentration.
UJ – Estimated detection limit.
"—" – No data available.

Table 3-3 PAH Concentrations in Groundwater

Chemical Name:	Fluoranthene (µg/L)			Fluorene (µg/L)			Indeno(1,2,3-cd)pyrene (µg/L)			Naphthalene (µg/L)			Phenanthrene (µg/L)			Pyrene (µg/L)	
Location ID	**RL**	**Result 1/2002**	**Result 8/2002**	**RL**	**Result 1/2002**	**Result 8/2002**	**RL**	**Result 1/2002**	**Result 8/2002**	**RL**	**Result 1/2002**	**Result 8/2002**	**RL**	**Result 1/2002**	**Result 8/2002**	**RL**	**Result 1/2002**
Outside Rail Yard																	
1A-W-1	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL	0.10	—
1A-W-2	0.10	—	BRL	0.10	—	**0.74** J	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL	0.10	—
1A-W-3	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL
1A-W-4	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL
1A-W-4	0.13	BRL	—	0.13	BRL	—	0.13	BRL	—	0.13	BRL	—	0.13	BRL	—	0.13	BRL
1B-W-2	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL
1B-W-3	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL
1C-W-2	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL
2A-W-1	0.10	BRL	BRL	0.10	**2.30**	**1.72**	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL
2A-W-2	0.10	—	BRL	0.10	—	**0.77**	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL	0.10	—
2A-W-6	0.13	0.09 J	—	0.13	**4.00**	—	0.13	BRL	—	0.13	BRL	—	0.13	2.70	—	0.13	0.07 J
2B-W-4	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL
5-W-1	0.10	—	BRL	0.10	—	**0.41**	0.10	—	BRL	0.10	—	BRL	0.10	—	BRL	0.10	—
5-W-2	0.10	BRL	—	0.10	**0.53**	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL
5-W-2	0.13	BRL	—	0.13	**0.63**	—	0.13	BRL	—	0.13	BRL	—	0.13	BRL	—	0.13	0.03 J
5-W-4	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL
MW-23	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL
MW-26	0.10	BRL	BRL	0.10	**0.12**	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL
MW-37	0.10	BRL	BRL	0.10	**0.41**	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL
MW-39	0.10	BRL	**0.20**	0.10	**0.55**	**0.46**	0.10	BRL	BRL	0.10	BRL	BRL	0.10	**0.20**	**0.38**	0.10	**0.17**
MW-42	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL
R-3	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL
Rail Yard																	
2A-W-10	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL
2A-W-11	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL
2A-W-3	0.10	BRL	BRL	0.10	**1.20**	**1.23**	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	**0.21**	0.10	BRL
2A-W-4	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL	—	0.10	BRL
2A-W-5	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL
2A-W-7	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL
2A-W-9	0.10	BRL	BRL	0.10	**1.30**	**0.20**	0.10	BRL	BRL	0.10	**0.20**	BRL	0.10	**0.92**	**0.20**	0.10	**0.10**
2A-W-9	0.21	**0.03** J	—	0.21	**1.50**	—	0.21	BRL	—	0.21	BRL	—	0.21	**1.30**	—	0.21	**0.08** J
MW-11	0.10	BRL	BRL	0.10	**7.20**	**6.55**	0.10	BRL	BRL	0.50	**8.70**	**2.13**	0.10	**8.20**	**7.57**	0.10	BRL
MW-13	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL
MW-31	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL
MW-5	0.10	BRL	BRL	0.10	BRL	**0.11**	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL
MW-7	0.10	BRL	BRL	0.10	BRL	**0.48**	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL
MW-9	0.10	BRL	BRL	0.10	**0.12**	**0.17**	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL	BRL	0.10	BRL

Note:
BRL – Below reporting limit
RL – Reporting limit.
J – Estimated concentration.
UJ – Estimated detection limit.
"—" – No data available.

Table 3-3 PAH Concentrations in Groundwater

Chemical Name:	
Location ID	**Result 8/2002**
Outside Rail Yard	
1A-W-1	BRL
1A-W-2	BRL
1A-W-3	—
1A-W-4	BRL
1A-W-4	—
1B-W-2	BRL
1B-W-3	BRL
1C-W-2	—
2A-W-1	BRL
2A-W-2	BRL
2A-W-6	—
2B-W-4	BRL
5-W-1	BRL
5-W-2	—
5-W-2	—
5-W-4	BRL
MW-23	BRL
MW-26	BRL
MW-37	BRL
MW-39	**1.20**
MW-42	BRL
R-3	BRL
Rail Yard	
2A-W-10	—
2A-W-11	—
2A-W-3	BRL
2A-W-4	—
2A-W-5	BRL
2A-W-7	BRL
2A-W-9	BRL
2A-W-9	—
MW-11	BRL
MW-13	BRL
MW-31	BRL
MW-5	BRL
MW-7	BRL
MW-9	BRL

Note:
BRL – Below reporting limit
RL – Reporting limit.
J – Estimated concentration.
UJ – Estimated detection limit.
"—" – No data available.

Table 3-4 BTEX Concentrations in Groundwater

Chemical Name:	Benzene (µg/L)				Ethylbenzene (µg/L)				m,p-Xylenes (µg/L)		o-Xylene (µg/L)		Total Xylenes (µg/L)		Toluene (µg/L)			
Location ID	**RL**	**Result 1/2002**	**RL**	**Result 8/2002**	**RL**	**Result 1/2002**	**RL**	**Result 8/2002**	**RL**	**Result 1/2002**	**RL**	**Result 1/2002**	**RL**	**Result 8/2002**	**RL**	**Result 1/2002**	**RL**	**Result 8/2002**
Outside Rail Yard																		
1A-W-3	5.00	BRL	0.500	BRL	5.00	BRL	0.500	BRL	5.00	BRL	5.00	BRL	1.00	BRL	5.00	BRL	0.500	BRL
1A-W-4	5.00	BRL	0.500	BRL	5.00	BRL	0.500	BRL	5.00	BRL	5.00	BRL	1.00	BRL	5.00	BRL	0.500	BRL
1A-W-4	1.00	BRL	—	—	1.00	BRL	—	—	2.00	BRL	1.00	BRL	—	—	1.00	BRL	—	—
1B-W-2	5.00	BRL	0.500	BRL	5.00	BRL	0.500	BRL	5.00	BRL	5.00	BRL	1.00	BRL	5.00	BRL	0.500	BRL
1B-W-3	1.00	BRL	0.500	BRL	1.00	BRL	0.500	BRL	1.00	BRL	1.00	BRL	1.00	BRL	1.00	BRL	0.500	BRL
1C-W-2	5.00	BRL	0.500	BRL	5.00	BRL	0.500	BRL	5.00	BRL	5.00	BRL	1.00	BRL	5.00	BRL	0.500	BRL
2A-W-1	5.00	BRL	0.500	BRL	5.00	BRL	0.500	BRL	5.00	BRL	5.00	BRL	1.00	**1.12 J**	5.00	BRL	0.500	BRL
2A-W-6	1.00	BRL	—	—	1.00	BRL	—	—	2.00	BRL	1.00	BRL	—	—	1.00	BRL	—	—
2B-W-4	1.00	BRL	0.500	BRL	1.00	BRL	0.500	BRL	1.00	BRL	1.00	BRL	1.00	BRL	1.00	BRL	0.500	BRL
5-W-2	5.00	BRL	—	—	5.00	BRL	—	—	5.00	BRL	5.00	BRL	—	—	5.00	BRL	—	—
5-W-2	1.00	BRL	—	—	1.00	BRL	—	—	2.00	BRL	1.00	BRL	—	—	1.00	BRL	—	—
5-W-4	1.00	BRL	0.500	BRL	1.00	BRL	0.500	BRL	1.00	BRL	1.00	BRL	1.00	BRL	1.00	BRL	0.500	BRL
MW-23	1.00	BRL	0.500	BRL	1.00	BRL	0.500	BRL	1.00	BRL	1.00	BRL	1.00	BRL	1.00	BRL	0.500	BRL
MW-26	1.00	BRL	0.500	BRL	1.00	BRL	0.500	BRL	1.00	BRL	1.00	BRL	1.00	BRL	1.00	BRL	0.500	BRL
MW-37	1.00	BRL	0.500	BRL	1.00	BRL	0.500	BRL	1.00	BRL	1.00	BRL	1.00	BRL	1.00	BRL	0.500	BRL
MW-39	5.00	BRL	0.500	**0.73**	5.00	BRL	0.500	BRL	5.00	BRL	5.00	BRL	1.00	BRL	5.00	BRL	0.500	**<.82 U**
MW-42	1.00	BRL	0.500	BRL	1.00	BRL	0.500	BRL	1.00	BRL	1.00	BRL	1.00	BRL	1.00	BRL	0.500	BRL
R-3	5.00	BRL	0.500	BRL	5.00	BRL	0.500	BRL	5.00	BRL	5.00	BRL	1.00	BRL	5.00	BRL	0.500	BRL
Rail Yard																		
2A-W-10	5.00	BRL	—	—	5.00	BRL	—	—	5.00	BRL	5.00	BRL	—	—	5.00	BRL	—	—
2A-W-11	5.00	BRL	—	—	5.00	BRL	—	—	5.00	BRL	5.00	BRL	—	—	5.00	BRL	—	—
2A-W-3	5.00	BRL	0.500	BRL	5.00	BRL	0.500	BRL	5.00	BRL	5.00	BRL	1.00	BRL	5.00	BRL	0.500	BRL
2A-W-4	5.00	BRL	—	—	5.00	BRL	—	—	5.00	BRL	5.00	BRL	—	—	5.00	BRL	—	—
2A-W-5	5.00	BRL	0.500	BRL	5.00	BRL	0.500	BRL	5.00	BRL	5.00	BRL	1.00	BRL	5.00	BRL	0.500	BRL
2A-W-7	5.00	BRL	—	—	5.00	BRL	—	—	5.00	BRL	5.00	BRL	—	—	5.00	BRL	—	—
2A-W-9	5.00	BRL	0.500	BRL	5.00	BRL	0.500	BRL	5.00	BRL	5.00	BRL	1.00	BRL	5.00	BRL	0.500	BRL
2A-W-9	1.00	BRL	—	—	1.00	BRL	—	—	2.00	BRL	1.00	BRL	—	—	1.00	BRL	—	—
MW-11	1.00	BRL	0.500	BRL	1.00	**1.80**	0.500	BRL	1.00	BRL	1.00	BRL	1.00	BRL	1.00	BRL	0.500	BRL
MW-13	1.00	BRL	0.500	BRL	1.00	BRL	0.500	BRL	1.00	BRL	1.00	BRL	1.00	BRL	1.00	BRL	0.500	BRL
MW-31	1.00	BRL	0.500	BRL	1.00	BRL	0.500	BRL	1.00	BRL	1.00	BRL	1.00	BRL	1.00	BRL	0.500	BRL
MW-5	1.00	BRL	0.500	BRL	1.00	BRL	0.500	BRL	1.00	BRL	1.00	BRL	1.00	BRL	1.00	BRL	0.500	BRL
MW-7	1.00	BRL	0.500	BRL	1.00	BRL	0.500	BRL	1.00	BRL	1.00	BRL	1.00	BRL	1.00	BRL	0.500	BRL
MW-9	1.00	BRL	0.500	BRL	1.00	BRL	0.500	BRL	1.00	BRL	1.00	BRL	1.00	BRL	1.00	BRL	0.500	BRL

Note:
BRL – Below reporting limit
RL – Reporting limit
"—" – No data available.

Table 3-5 Summary of Final Indicator Hazardous Substances

Chemical Name	CAS No	Soil (8 IHSs)	Sediment (4 IHSs)	Groundwater (4 IHSs)	Surface Water (0 IHSs)
Inorganics					
Arsenic	7440-38-2	X			
Lead	7439-92-1	X	X		
Semi-Volatile Organics					
Benzo(a)anthracene	56-55-3	X	X	X	
Benzo(a)pyrene	50-32-8	X			
Benzo(b)fluoranthene	205-99-2	X	X		
Benzo(k)fluoranthene	207-08-9	X			
Chrysene	218-01-9	X	X	X	
Fluoranthene	206-44-0			X	
Indeno(1,2,3-cd)pyrene	193-39-5	X			
Total Petroleum Hydrocarbons					
	NA	X	X	X	X

NA = Not applicable

Table 4-1 Indicator Hazardous Substances and Media

Constituent	Surface Soil (0-2 ft)	Subsurface Soil	Groundwater	Surface Water	Sediment
TPH	✓	✓	✓	✓	✓
Select PAHs	✓	✓	✓		✓
Arsenic	✓				
Lead	✓				✓

Table 4-2 Selected Physical Properties of Skykomish Free Product Samples

Sample	Specific Gravity (g/cc)	Viscosity (cp @ 50F)	Viscosity (cp @ 100F)
Free Product (R1)	0.965	5,100	590
Free Product (R2)	0.973	5,900	710

Comparative values for fuels:

Material	Specific Gravity (g/cc)	Viscosity (cp @ 68F)
Diesel	0.81-0.86	2.5
Bunker C	0.97-0.98	485-2,400

Table 5-1 Proposed Cleanup Levels

				Petroleum				cPAHs						ncPAHs	Metals	
Environmental Medium	**MTCA Regulation Cite**	**Basis**	**Units**	**Total Petroleum Hydrocarbon based on Fraction Composition *BNSF***	**Total Petroleum Hydrocarbon based on Fraction Composition *Ecology***	**diesel range organics**	**heavy oil**	**benzo[a]anthracene**	**benzo[a]pyrene**	**benzo[b]fluoranthene**	**benzo[k]fluoranthene**	**chrysene**	**indeno[1,2,3-cd]pyrene**	**fluoranthene**	**Arsenic**	**Lead**
Surface Water	-730(3)(b)(i)(A)	Ch. 173-201A WAC	µg/L	na		na	na	na				na		na		
Surface Water	-730(3)(b)(i)(B) & (C)	Natl. Rec. WQC, fw acute	µg/L	na		na	na	na				na		na		
Surface Water	-730(3)(b)(i)(B) & (C)	Natl. Rec. WQC, fw chronic	µg/L	na		na	na	na				na		na		
Surface Water	-730(3)(b)(i)(B) & (C)	Natl. Rec. WQC, hh, w&o	µg/L	na		na	na	0.0038				0.0038		130		
Surface Water	-730(3)(b)(i)(B) & (C)	Natl. Rec. WQC, hh, org. only	µg/L	na		na	na	0.0180				0.0180		140		
Surface Water	-730(3)(b)(ii)	Environmental Effects	µg/L	700	700	na	na	na	not COC	not COC	not COC	na	not COC	na	not COC	not COC
Surface Water	-730(3)(b)(iii)(A)	HH, fish consumpt'n, nc	µg/L	na		na	na	na				na		90.2		
Surface Water	-730(3)(b)(iii)(B)	HH, fish consumpt'n, c	µg/L	na		na	na	0.0296				0.0296		na		
Surface Water	-730(3)(b)(iii)(C)	HH, fish con, petrol mixt	µg/L	500		500	500	na				na		na		
Surface Water	-730(3)(b)(iv)	DW, -720 Method B	µg/L	477	477	na	na	0.0120				0.0120		na		
Surface Water	*-700(6)(d)*	*PQLs*	*µg/L*	*40-100[1]*	*40-100[1]*	*250*	*500*	*0.1*				*0.1*		*0.3*		
Surface Water	**-730**	**Minimum of above[2]**	**µg/L**	**477**	**477**	**500**	**500**	**0.1 [3]**				**0.1 [3]**		**90.2**		
Sediment	-760	Environmental Effects [4]	mg/kg	91 [7]	23.7 [7]			na[6]	not COC	na	not COC	na[6]	na	not COC	not COC	na[6]
Ground Water	-720(4)(b)(I)	MCL, SDWA	µg/L	na		na	na	na				na		na		
Ground Water	-720(4)(b)(I)	MCLG for nc, SDWA	µg/L	na		na	na	na				na		na		
Ground Water	-720(4)(b)(I)	MCL, WDOH	µg/L	na		na	na	na				na		na		
Ground Water	-720(4)(b)(ii)	Protect SW, from above	µg/L	477	477	na	na	0.1 [3]				0.1 [3]		90.2		
Ground Water	-729(8)(d)(I)(F)	Protect Sed, from above	µg/L	477	64	na	na	na	not COC	not COC	not COC	na	not COC	na	not COC	not COC
Ground Water	-720(4)(b)(iii)(A)	HH, nc	µg/L	na		na	na	na				na		640		
Ground Water	-720(4)(b)(iii)(B)	HH, c	µg/L	na		na	na	0.012				0.012		na		
Ground Water	-720(4)(b)(iii)(C)	HH, petrol mixt	µg/L	477	477	500	500	na				na		na		
Ground Water	*700(6)(d)*	*PQLs*	*µg/L*	*40-100[1]*	*40-100[1]*	*250*	*500*	*0.1*				*0.1*		*0.3*		
Ground Water	**-720**	**Minimum of above[2]**	**µg/L**	**477**	**480-600[3, 8]**	**500**	**500**	**0.1 [3]**				**0.1 [3]**		**90.2**		
Soil	-740(3)b)(i)	ARARs	mg/kg	na	na	na	na	na	na	na	na	na	na	not COC	na	na
Soil	-740(3)b)(ii)	Environmental Protection	mg/kg	TEE pending												
Soil - Vadose	-740(3)b)(iii)(A)	HH, GW protection	mg/kg	res satr	res satr	na	na	na[6]	na[6]	na[6]	na[6]	na[6]	na[6]	na[6]	na	na
Soil - Smear	-740(3)b)(iii)(A)	HH, GW protection	mg/kg	res satr	7.70E+01	na	na	na	na	na	na	na	na		na	na
Soil - Off RY	-740(3)b)(iii)(B)(I)	Direct Contact, nc	mg/kg	na	na	na	na	na	na	na	na	na	na		24	250
Soil - Off RY	-740(3)b)(iii)(B)II)	Direct Contact, c	mg/kg	na	na	na	na	0.137	0.137	0.137	0.137	0.137	0.137	not COC	20	na
Soil - RY	-745(5)(b)(iii)(B)(I), (II) & (III)	Direct Contact	mg/kg	TBD	na	na	na	18	18	18	18	18	18		88	1000
Soil - Vadose	-740(3)(b)(iii)(B)(III)	Direct Con, petrol mixt	mg/kg	2130	2130	na	na	na	na	na	na	na	na		na	na
Soil - Smear	-740(3)(b)(iii)(B)(III)	Direct Con, petrol mixt	mg/kg	2765	2765	na	na	na	na	na	na	na	na			
Soil	-740(3)(b)(iii)(C)	Soil vapors	mg/kg	na[5]	2900	na	na	na	na	na	na	na	na	not COC		
Soil	**-740**	**Minimum of above**	**mg/kg**	**2.13E+03**	**7.70E+01**	**na**	**na**	**0.137**	**0.137**	**0.137**	**0.137**	**0.137**	**0.137**	**not IHS**	**20**	**250**

Notes:

[1] Range of PQLs for individual fractions.

[2] Minimum of above values, not including PQLs. PQLs are selected as cleanup levels only if minimum of above values is less than the PQL. PQL estimated based on survey of local laboratories.

[3] Selected cleanup level based on PQL.

[4] Environmental effects levels for all IHSs other than TPH obtained from McDonald, 2000. Threshold effect and probable effect levels are provided as the lower and upper range of potential cleanup levels.

[5] Empirical data shows pathway is insignificant and existing site conditions pose no risk to vapor pathway.

[6] TPH is surrogate for other compounds.

[7] These values are not used per se to define sediment areas requiring cleanup. Bioassay pass/fails are used to delineate seiment cleanup zones. Rather, these values are used to evaluate the potential for groundwater recontamination of sediments.

[8] Sum of PQLs for 12 individual TPH fractions, each with a PQL range.

TBD - To be determined: na - not applicable

Table 5-2 Comparison of Product Headspace Analytical Results to Proposed Ambient Air Cleanup Levels

Compound	MTCA-Defined VOC?[3]	Standard MTCA Mthd B CLARC V 3.1 (Nov 2001) Carcinogenic (μg/m³)	Standard MTCA Mthd B CLARC V 3.1 (Nov 2001) Noncarcinogenic (μg/m³)	Product Headspace[1] (μg/m³)	Is Product Headspace > Mthd B Scrn Level?
Benzene	YES	3.21E-01	2.72E+00	ND	NO – not detected
Toluene	YES		1.83E+02	71.7	NO
Ethylbenzene	YES		4.57E+03	ND	NO – not detected
m,p-Xylene	YES		3.20E+02	103.2	NO
o-Xylene	YES		3.20E+02	46.6	NO
1,3,5-Trimethylbenzene	YES			113.6	NO
1,2,4-Trimethylbenzene	YES			269.6	NO
Propylene	YES			ND	NO – not detected
1,3-Butadiene	YES	8.93E-03		ND	NO – not detected
Hexane	YES		9.14E+01	ND	NO – not detected
Cyclohexane	YES			ND	NO – not detected
4-Ethyltoluene	YES			134.5	NO – no SL
Heptane	YES			ND	NO – not detected
Naphthalene	YES		1.37E+00	35.92B	YES[2]
Total TPH				**775.12**	**NO**

NOTE-Cannot calculate TPH Method B air cleanup level because composition of the petroleum mixture in air cannot be determined as: (1) product headspace value is based on the maximum detected concentration detected from any sample. Therefore, the maximum detected concentration may not be from the same sample. (2) aliphatic and aromatic hydrocarbons were not quantified. Therefore, their contribution to the petroleum mixture is unknown.

[1] Maximum concentration detected in any sample, at any sampling time.

[2] Maximum detected concentration also detected in the blank. This introduces uncertainty regarding the detected concentration. Napthalene was not detected in headspace sample from R-1, and was qualified as "UB" at a detection limit of 3.83 μg/m³ in headspace sample from MW-36. Also, napthalene was not detected above the Method B value of 1.37 μg/m³ in any indoor air sample collected at the site.

[3] Ecology's CLARC v3.1 (November 2001) defines "VOC" for petroleum fractions as EC 12 and less, plus naphthalenes. Non-volatile fractions are not a potential concern from soil volatilization to air.

[4] Although a TPH Method B air cleanup level cannot be calculated using existing product headspace concentrations, a TPH air cleanup level of 1350 ug/m³ was calculated using the *MTCATPH workbook, A.4-Worksheet for Calculating Soil Cleanup Level for the Protection of Method B-Air Cleanup Level* as presented in Figure 6 of Ecology's February 24, 2003 Memo, *Evaluation of Method B Soil TPH Cleanup Levels for Unrestricted Land Use at BNSF Site* . This value is compared to the cumulative product headspace concentrations.

SL - Method B Screening Level
ND - Not detected
B - This compound was also detected in the blank

NQ - Not quantified. Although VOC and SVOC analyses were performed using EPA Compendium Methods IP-1A and -7 (mass spectrometry analysis), analytical results were not integrated over the carbon ranges specified.

Table 5-3 Potentially Applicable Requirements – Cleanup Levels

Medium	Standard/Criterion	Citation	Comments
Groundwater Surface Water	Requirements for establishing numeric or risk-based goals and selecting cleanup actions.	Model Toxics Control Act (WAC 173-340, Sections 720 and 730)	Relevant and appropriate to site remediation. Groundwater and surface water cleanup levels are reported in Table 5-1.
Sediment	Criteria used to identify sediments that have no adverse effects on biological resources and correspond to no significant health risk to humans.	Sediment Management Standards (WAC 173-204)	SMS cleanup levels have not been promulgated for fresh-water sediments. Site-specific cleanup levels are developed on a case-by-case basis, as are cleanup levels for other deleterious substances (WAC 173-204-100(3)).
Surface Water	Ambient water quality criteria for the protection of aquatic organisms and human health.	Federal Water Pollution Control Act/ Clean Water Act (CWA) (33 USC 1251–1376; 40 CFR 100–149) 40 CFR 131	MTCA requires the attainment of water quality criteria where relevant to the circumstances of the release. Ambient water criteria and Water Quality Standards for the human consumption of organisms at 1 ´ 10^{-6} risk is anticipated to be relevant for groundwater (Table 5-1).
Drinking Water	SDWA National Primary Drinking Water Standards: Maximum Contaminant Levels (MCLs), Maximum Contaminant Level Goals (MCLGs), Proposed MCLs and MCLGs.	Safe Drinking Water Act (SDWA) 40 CFR 141 and WAC 246-290	Drinking water is a potential beneficial use of groundwater and surface water at the site.
Surface Water	State water quality standards; conventional water quality parameters and toxic criteria.	Washington Water Pollution Control Act - State Water Quality Standards for Surface Water (RCW 90.48) WAC 173-201A-130	Applicable. The Skykomish River is designated Class AA.
Soil	Requirements for establishing numeric or risk-based goals and selecting cleanup actions.	Model Toxics Control Act (WAC 173-340, Sections 740 and 745); TSCA 40CFR (Part 761)	Relevant and appropriate to site remediation. Soil cleanup levels are reported in Table 5-1.

Table 5-4 Potentially Applicable Requirements – Treatment and Disposal

Activity	Requirement	Citation	Comments
Discharge to Surface Water	Point-source standards for discharges into surface water bodies. Applicable to point-source discharge or site runoff directed to surface water body. Federal criteria for water quality to protect human health and aquatic life. Enforced under state water quality laws and MTCA. State Water Quality Standards for Surface Water.	National Pollutant Discharge Elimination System (NPDES) (40 CFR 122, 125) State Discharge Permit Program; NPDES Program (WAC 173-216, -220) Federal Water Quality Criteria (40 CFR 131) WAC 173-201-045, -047	Anticipated to be relevant if discharged to on-site water body. Discharges must comply with substantive requirements of the NPDES permit. Applicable for off-site discharges; a permit would be required. Anticipated to be relevant for remedial measures involving this activity. Implementation of federal requirement to develop state water quality control plan. Narrative and quantitative limitations for surface and groundwater protection based on beneficial uses. Anticipated as relevant.
Point Source or Other Defined Emission Source	State implementation of ambient air quality standards. PSAPCA ambient and emission standards.	Washington State Clean Air Act (70.94 RCW) General Requirements for Air Pollution Sources (WAC 173-400) PSAPCA Regulations I and III	Potentially applicable to remedial actions.
Storage or Disposal of Solid Wastes	Requirements for solid waste management.	Solid Waste Disposal (Act 42 USC Sec. 3251-3259, 6901-6991), as administered under 40 CFR 257, 258 Minimum Functional Standards for Solid Waste Handling (WAC 173-304)	Applicable to non-hazardous waste generated during remedial activities.
General Remediation	Requirement for use of all known available and reasonable technologies for treating wastewater from industrial sources prior to discharge to waters of the state.	State Water Pollution Control Act (RCW 90.48); Water Resources Act (RCW 90.54); Water Quality Standards for Surface Water (WAC 173-201A); Clean Water Act (Sect. 401)	Anticipated to be applicable to remedial technologies involving discharges to surface water or groundwater.

Table 5-4 Potentially Applicable Requirements – Treatment and Disposal

Activity	Requirement	Citation	Comments
Discharge to POTWs (Publicly Owned Treatment Works)	Contaminated water must be pretreated to certain limits prior to discharge.	National Pretreatment Standards (40 CFR 403);	Not applicable as there is no existing POTW near the site that could receive pretreated water generated during remedial activities
Excavation/ Disposal of Solid Wastes	Requirements for solid waste management.	Solid Waste Disposal Act (42 USC Sec. 325103259, 6901-6991), as administered under 40 CFR 257, 258; WAC 173-304, Minimum Functional Standards for Solid Waste Handling; TSCA 40CFR (Part 761)	Applicable to non-hazardous waste generated during remedial activities and disposed off site.

Table 5-5 Potentially Applicable Requirements – Other Remediation Activities

Location/Activity	Requirement/Prerequisite	Citation	Comments
Within 200 Feet of Shoreline	Construction near shorelines of statewide significance, including marine waters and wetlands.	Shoreline Management Act (RCW 90.58), Coastal Zone Management Act (16 USC 1451 et seq.)	Anticipated to be applicable.
Within Floodplain	Actions that will occur in a floodplain (i.e., lowlands) and relatively flat areas adjoining inland and coastal waters must be performed so as to avoid impacts.	Executive Order 11988, Protection of Flood Plains (40 CFR 6, Appendix A)	Anticipated to be relevant as site is located in floodplain.
Disturbance of Greater than 5 Acres	NPDES Stormwater Permit for construction activity.	WAC 173-226 RCW 90.48	Anticipated to be applicable.
Within/Adjacent to Wetlands	Actions must be performed so as to minimize the destruction, loss, or degradation of wetlands as defined by Executive Order 11990 Section 7. Requirement for no net loss of remaining wetlands.	Executive Order 11990, Protection of Wetlands (40 CFR 6, Appendix A) EPA Wetland Actions Plan. (January 1989, OWWP)	Potentially applicable requirement; wetlands removed by cleanup activities will be replaced at 1.5 to 1 ratio and shoreline revegetation will be performed.
Critical Habitat upon Which Endangered or Threatened Species Depend	Actions must be performed so as to conserve endangered or threatened species, including consultation with the Department of the Interior.	Clean Water Act (Sect. 404); Endangered Species Act of 1973 (16 USC 1531 et seq.) (50 CFR Part 200) (50 CFR Part 402)	Various anadromous fish listed as threatened or endangered species, relevant.
Within State Siting Criteria for Waste Management Facilities	Siting criteria to be used as initial screen for consideration of solid or dangerous waste facility sites.	WAC 173-304	No new solid waste management facilities are anticipated.
Construction in State Waters	Requirements for construction and development projects for the protection of fish and shellfish in state waters.	Construction in State Waters, Hydraulic Code Rules (RCW 75.20; WAC 220-1101), Clean Water Act (Sect. 404)	U.S. Army Corps of Engineers Nationwide 38 Permit anticipated as relevant to any sediment removal below the mean high-water line.
Pump and Treat	Specifications for the extraction of groundwater or surface water that are waters of the state.	State Water Code and Water Rights (RCW 90.03, 90.14)	Anticipated to be relevant for cleanup actions involving groundwater extraction.
	Reporting requirements for new water treatment facilities.	Submission of plans and reports for construction of wastewater facilities (WAC 173-240)	Potentially relevant if cleanup action involves groundwater extraction and treatment.
Extraction/	Regulations and standards	Underground Injection	Potentially relevant if

Table 5-5 Potentially Applicable Requirements – Other Remediation Activities

Location/Activity	Requirement/Prerequisite	Citation	Comments
Reinjection	for the underground injection of treated groundwater. State standards for discharges to surface water or reinjection.	Control Regulations (40 CFR 144-147; WAC 173-216, -218, -220; RCW 90.03, 90.14) WAC 173-154 Protection of Upper Aquifer Zone State Water Code and Water Rights	cleanup action involves groundwater extraction and treatment and discharge.
Air Emissions	National Primary and Secondary Ambient Air Quality Standards (NAAQS) for carbon monoxides, lead, nitrogen dioxide, particulate matter (PM_{10}), ozone, and sulfur oxides emissions from a "major" source.	Clean Air Act, Section 109; 40 CFR 50	Emissions from site not expected to qualify as major source unless: a) emissions are greater than 100 tons/year; or b) emissions of a specified air contaminant occur.
	Regional ambient air quality standards applicable to regulated air contaminant.	Puget Sound Air Pollution Control Agency (PSAPCA) Regulation III	Emissions from site not expected to qualify as major source unless: a) emissions are greater than 100 tons/yr; or b) emissions of a specified air contaminant occur.
	National Emissions Standards for Hazardous Air Pollutants (NESHAPs) for Industrial Emissions.	Clean Air Act National Emissions Standards for Hazardous Air Pollutants (NESHAPs), 40 CFR 61; WAC 173-400-075 State Emission Standards for Hazardous Air Pollutants	Not anticipated to be relevant.
	New Source Pretreatment Standards applicable to new source of hazardous air pollutants.	40 CFR 60	Potentially applicable to releases from remedial actions.
	Controls for New Sources of Toxic Air Pollutants for emission of any Class A or Class B toxic air pollutant (identified in WAC 173-460-150 through -160) into ambient air.	WAC 173-460	Potentially applicable to releases from remedial actions.
	Regional Emission Standards for Toxic Air Pollutants. Source of toxic air contaminant requires a notice of construction.	PSAPCA Regulation III	Potentially applicable depending on remedial technology used.

Table 5-5 Potentially Applicable Requirements – Other Remediation Activities

Location/Activity	Requirement/Prerequisite	Citation	Comments
	Regional Emission Standards for fugitive dust. BACT to control dust.	PSAPCA Regulation I	Potentially applicable to releases from remedial actions.
Monitoring/ Extraction/ Recharge Wells	Standards for construction, testing, and abandonment of water and resource protection wells.	WAC 173-160-010 through -303, -050 through -060	Anticipated to be applicable requirement for cleanup activities.
Noise Control	Maximum noise levels	Noise Control Act of 1974 (RCW 70.107; WAC 173-60)	Potentially relevant depending on remedial activities selected.
Habitat for Fish, Plants, or Birds Subject to State Fish and Game Department	Prohibits water pollution with any substance deleterious to fish, plant life, or bird life.	U.S. Fish and Wildlife Coordination Act (16 USC 661 et seq.)	Relevant requirement. The Skykomish River is a Class AA river and a salmonid migratory route.
General Remediation	Site worker health and safety.	WISHA (WAC 296-62) OSHA (29 CFR 1910.120)	Relevant requirement for environmental remediation operations.
	Erosion and sedimentation controls.	Puget Sound Water Quality Management Plan (RCW 90.70.070)	Relevant requirement.

Table 6-1 Technologies Identified and Screened for Use in Developing Remedial Alternatives

Medium/ Contaminant	Response Action	Technology Identified For Screening	Technology Retained for Further Consideration
Metals (AS, Pb) in Soil	Containment	Capping	X
	Removal	Excavation	X
	Ex Situ Treatment	Soil Stabilization	X
		Cement Incorporation	X
		Asphalt Incorporation	
	Disposal	Commercial Landfill	X
Petroleum Hydrocarbons in Soil	Containment	Capping	X
	Removal	Excavation	X
	In Situ Treatment	Bioventing	X
	Ex Situ Treatment	*Biological*	
		Biopile	
		Landfarming	
		Physical/Chemical	
		Soil Washing	
		Asphalt incorporation	
		Thermal	
		Incineration	
		Thermal Desorption	X
		Cement Incorporation	X
	Disposal	Commercial Landfills	X

Table 6-1 Technologies Identified and Screened for Use in Developing Remedial Alternatives

Medium/ Contaminant	Response Action	Technology Identified For Screening	Technology Retained for Further Consideration
LNAPL	Containment	Slurry Wall	X
		Permeation Grouting	X
		Displacement Barriers (e.g. sheet piles)	
		Injected or Mix-in-Place Barriers	
	Extraction	Excavation	X
		Bioslurping	
		Skimming	X
		Drawdown Pumping in Wells or Trenches	
	In Situ Treatment	*In Situ* Flushing	X
		Hot Water/Steam Flushing	X
		Thermally Enhanced Soil Vapor Extraction	
		In Situ Oxidation	X
	Reuse	Recycling as Off-Specification Fuel	X
Dissolved Petroleum Hydrocarbons in Groundwater	Containment	Slurry Wall	X
		Displacement Barriers (e.g. sheet piles)	
		Injected or Mix-in-Place Barriers	
	Extraction	Pumping	X
	In Situ Treatment	Enhanced Aerobic Biodegradation	X
	Natural Attenuation	Natural Attenuation	X
	In Situ Treatment	Chemical Oxidation	X
	Ex Situ Treatment	*Biological*	X
		Bioreactors	X
		Constructed Wetlands	
		Physical/Chemical	
		Phase Separation	X
		Precipitation	X
		Filtration	X
		Carbon Adsorption	X
		Oxidation	X
	Discharge	NPDES Discharge	X
		Reinjection	X

Table 6-2 Points of Compliance for Site Media

Media and Criteria	Standard Point of Compliance	Conditional Points of Compliance
Soil		
Protection of Groundwater	Throughout the site	None
Protect from Vapors	Not Applicable	None
Direct Contact	Throughout the site to 15 feet below ground surface	None
Terrestrial Ecological Considerations	Throughout the site to 15 feet below ground surface	To the depth of the biologically active zone (a default of 6 feet) or to a site-specific depth based on: • Depth to which soil macro-invertebrates occur • Depth to which soil bioturbation occurs due to the activity of soil invertebrates • Depth to which animals are expected to burrow • Depth to which plant roots extend
Groundwater		
Protection of Potable Groundwater	Throughout the site	As close as practicable to the source, not to exceed the property boundary
Protection of Surface Water	None	As close as practicable to the source, not to exceed the points of discharge to surface water. Must also protect sediment quality.
Surface Water		
All	Points of discharge to surface water	None
Sediment		
Protect Aquatic Resources, Surface Water and Direct Contact	Site-specific biologically active zone (assume upper 10 centimeters)	None

Table 6-3 Remedial Alternative Points of Compliance and Remediation Levels

Medium	SW1	SW2	SW3	SW4	PB1	PB2	PB3	PB4	STD
Points of Compliance									
Surface Water	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard
Sediment	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard
Groundwater	Points of Discharge to Surface Water	Points of Discharge to Surface Water	Points of Discharge to Surface Water	Points of Discharge to Surface Water	Downgradient property boundary	Downgradient property boundary	Downgradient property boundary	Downgradient property boundary	Standard
Soil	Standard or site-specific biologically active zone soil depth	Standard or site-specific biologically active zone soil depth	Standard or site-specific biologically active zone soil depth	Standard or site-specific biologically active zone soil depth	Standard or site-specific biologically active zone soil depth	Standard or site-specific biologically active zone soil depth	Standard or site-specific biologically active zone soil depth	Standard or site-specific biologically active zone soil depth	Standard
Remediation Levels									
Sediment	Protect environmental receptors by achieving cleanup levels in the former Maloney Creek Channel in a manner that will not significantly impact wetland habitat	Protect environmental receptors by achieving cleanup levels in the former Maloney Creek Channel in a manner that will not significantly impact wetland habitat	Protect environmental receptors by achieving cleanup levels in the former Maloney Creek Channel in a manner that will not significantly impact wetland and shoreline habitat	Protect environmental receptors by achieving cleanup levels in the former Maloney Creek Channel in a manner that will not significantly impact wetland habitat	Protect environmental receptors by achieving cleanup levels in the former Maloney Creek Channel in a manner that will not significantly impact wetland habitat	Protect environmental receptors by achieving cleanup levels in the former Maloney Creek Channel in a manner that will not significantly impact wetland and shoreline habitat	Protect environmental receptors by achieving cleanup levels in the former Maloney Creek Channel in a manner that will not significantly impact wetland habitat	Not Applicable	Not Applicable
Soil	Provide additional protection to people by achieving direct contact cleanup levels for metals in the upper 2 feet in Railyard Zone and NW and Developed Zones where soil is accessible and TPH in the South Developed Zone.	Provide additional protection to people by achieving direct contact cleanup levels for metals in the upper 2 feet in Railyard Zone and NW and Developed Zones where soil is accessible and TPH in the South Developed Zone.	Provide additional protection to people by achieving direct contact cleanup levels for metals in the upper 2 feet in Railyard Zone and NW and Developed Zones where soil is accessible and TPH in the South Developed Zone.	Provide additional protection to people by achieving direct contact cleanup levels for TPH and metals in the upper 2 feet in Railyard Zone and NW and Developed Zones where soil is accessible.	Provide additional protection to people by achieving direct contact cleanup levels for metals in the upper 2 feet in Railyard Zone and NW and Developed Zones where soil is accessible.	Provide additional protection to people by achieving direct contact cleanup levels for metals in the upper 2 feet in Railyard Zone and NW and Developed Zones where soil is accessible.	Provide additional protection to people by achieving direct contact cleanup levels for TPH and metals in the upper 2 feet in Railyard Zone and NW and Developed Zones where soil is accessible.	Remove all free and residual product from soil in the NW Developed Zone.	Not applicable.
				Provide additional protection to people by achieving Direct Contact cleanup levels in the upper 4 feet of the NW Developed Zone where accessible.			Provide additional protection to people by achieving Direct Contact cleanup levels in the upper 4 feet of the NW Developed Zone where accessible.	Provide additional protection to people by achieving Direct Contact cleanup levels in the upper 4 feet of the NW Developed Zone where accessible.	

Table 6-3 Remedial Alternative Points of Compliance and Remediation Levels

Medium	SW1	SW2	SW3	SW4	PB1	PB2	PB3	PB4	STD
Points of Compliance									
Surface Water	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard
Sediment	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard
Groundwater	Points of Discharge to Surface Water	Points of Discharge to Surface Water	Points of Discharge to Surface Water	Points of Discharge to Surface Water	Downgradient property boundary	Downgradient property boundary	Downgradient property boundary	Downgradient property boundary	Standard
Soil	Standard or site-specific biologically active zone soil depth	Standard or site-specific biologically active zone soil depth	Standard or site-specific biologically active zone soil depth	Standard or site-specific biologically active zone soil depth	Standard or site-specific biologically active zone soil depth	Standard or site-specific biologically active zone soil depth	Standard or site-specific biologically active zone soil depth	Standard or site-specific biologically active zone soil depth	Standard
Remediation Levels									
Soil			Remove surface sediment associated with seeps in the Skykomish River	Remove accessible surface sediment above CUL from the Former Maloney Creek Channel without impacting wetland habitat		Remove surface sediment associated with seeps in the Skykomish River	Remove accessible surface sediment above CUL from the Former Maloney Creek Channel without impacting wetland habitat		
	Achieve soil concentrations protective of groundwater in the Former Maloney Creek.	Achieve soil concentrations protective of groundwater in the Former Maloney Creek.	Achieve soil concentrations protective of groundwater in the Former Maloney Creek.	Achieve soil concentrations protective of groundwater in the Former Maloney Creek.	Achieve soil concentrations protective of groundwater in the Former Maloney Creek.	Achieve soil concentrations protective of groundwater in the Levee and Former Maloney Creek.	Achieve soil concentrations protective of groundwater in the Former Maloney Creek.	Achieve soil concentrations protective of groundwater in the Former Maloney Creek.	
Groundwater	Remove free product from the NE, South, and NW Developed Zones and Railyard.	Remove free product from the NE, South, and NW Developed Zones and Railyard.	Remove free product from the Levee, South and NW Developed Zones and Railyard.	Remove free product from the NW Developed Zone and Railyard.	Remove free product from the NE and NW Developed Zones and Railyard.	Remove free product from the Levee, Railyard and NW Developed Zones.	Remove free product from the NW Developed Zone and Railyard.	Remove free product from the Railyard.	Not applicable.

Table 6-4 Remedial Alternatives Matrix

Site Cleanup Zone	Medium	Remedial Technology	SW1	SW2	SW3	SW4	PB1	PB2	PB3	PB4	STD
Skykomish River and Levee (Ecological Risk)	Free Product	Excavate or Pressure Grout			X			X			
	Smear Zone	Ozone Sparge or Flush				X			X		
		Excavate								X	X
	Sediment	Excavate to RL			X			X			
		Excavate to CUL				X			X	X	X
	Groundwater	Biosparge	X	X	X	X	X	X	X	X	
Former Maloney Creek (Ecological Risk)	Smear Zone/ Groundwater	Natural Attenuation	X	X	X		X	X			
		Enhanced Bio				X			X	X	
		Excavate									X
	Sediment	Excavate to RL				X			X		
		Excavate to CUL								X	X
NE Developed Zone (Diesel)	Free Product	Enhanced Bio			X	X		X	X		
		Excavate								X	X
	Smear Zone	Enhanced Bio			X	X		X	X	X	
		Excavate									X
	Groundwater	Natural Attenuation	X	X			X				
		Enhanced Bio			X	X		X	X	X	
South Developed Zone (Oil and Diesel)	Free Product	Excavate	X	X	X	X	X	X	X	X	X
	Surface TPH	Excavate	X	X	X	X	X	X	X	X	X
	Smear Zone	Excavate				X	X	X	X	X	X
	Groundwater	Natural Attenuation	X	X	X						
NW Developed Zone (Oil and Diesel)	Free Product	Existing System	X								
		Trenches		X							
		Excavate Where Accessible			X		X				
		Excavate and/or Flush				X		X	X	X	X
	Surface Metals	Excavate	X	X	X	X	X	X	X	X	X
	Shallow Smear Zone	Excavate				X			X	X	X
	Smear Zone	Enhanced Bio					X	X	X	X	
		Excavate Residual Product								X	
		Excavate to CUL									X
	Groundwater	Natural Attenuation	X	X	X	X					
		Enhanced Bio					X	X	X	X	
Railyard Zone (Surface Soil - Higher Risk)	Vadose Zone	Excavate Surface Metals & Cap	X	X	X	X	X	X	X	X	X
		Excavate Surface TPH & Cap				X			X	X	X
		Excavate									X
	Free Product	Skimming	X	X	X	X	X	X			
		Trenches		X	X	X	X	X	X		
		Flush							X	X	
		Excavate								X	
		Enhanced Bio								X	X
	Smear Zone	Excavate									X
	Groundwater	Natural Attenuation	X	X	X	X	X				
		Enhanced Bio - Containment						X	X	X	

Table 6-5 Summary Description of Remedial Alternatives

	SW1	SW2	SW3	SW4	PB1	PB2	PB3	PB4	STD
GW POC	Surface Water	Surface Water	Surface Water	Surface Water	Railyard Boundary	Railyard Boundary	Railyard Boundary	Railyard Boundary	Throughout
Levee	Enhanced Bio to gw CUL	Enhanced Bio to gw CUL	Excavate or pressure grout free product Enhanced Bio to gw CUL Remove surface sediment to RL (seeps)	Ozone sparge, flush, or excavate to soil RL/gw CUL Enhanced Bio to gw CUL Remove surface sediment to CUL	Enhanced Bio to gw CUL	Excavate or pressure grout free product Enhanced Bio to gw CUL Remove surface sediment to RL (seeps)	Ozone sparge, flush, or excavate to soil RL/gw CUL Enhanced Bio to gw CUL Remove surface sediment to CUL	Excavate to soil RL/gw CUL Enhanced Bio to gw CUL Remove surface sediment to CUL	Excavate to CUL Remove surface sediment to CUL
Former Maloney Creek Channel	Natural Attenuation to RL	Natural Attenuation to RL	Natural Attenuation to RL	Enhanced Bio to soil RL/gw CUL Remove surface sediment to RL	Natural Attenuation to RL	Natural Attenuation to RL	Enh Bio to soil RL/gw CUL Remove surface sediment to RL	Enh Bio to soil RL/gw CUL Remove surface sediment to CUL	Excavate to CUL Remove surface sediment to CUL
NE Developed Zone	Natural Attenuation to RL	Natural Attenuation to RL	Enhanced Bio to CUL	Enhanced Bio to CUL	Natural Attenuation to RL	Enhanced Bio to CUL	Enhanced Bio to CUL	Excavate Free Product plus Enhanced Bio to CUL	Excavate to CUL
South Developed Zone	Excavate free product plus natural attenuation Excavate surface soil to CULs	Excavate free product plus natural attenuation Excavate surface soil to CULs	Excavate free product plus natural attenuation Excavate surface soil to CULs	Excavate to CUL Excavate surface soil to CULs	Excavate to CUL Excavate surface soil to CULs	Excavate to CUL Excavate surface soil to CULs	Excavate to CUL Excavate surface soil to CULs	Excavate to CUL Excavate surface soil to CULs	Excavate to CUL Excavate surface soil to CULs
NW Developed Zone	Existing Barrier Wall and Skimming System Excavate surface metals to CUL	Free product recovery trenches plus natural attenuation & inst controls Excavate surface metals to CUL	Excavate free product where accessible & natural attenuation & inst controls Excavate surface metals to CUL	Excavate or flush all free product plus natural attenuation & institional controls Excavate surface metals to CUL Excavate shallow smear zone where accessible to CUL (outside free product areas)	Excavate free product where accessible plus enhanced bio to RL/CUL & inst controls Excavate surface metals to CUL	Excavate or flush all free product plus enhanced bio & instit controls Excavate surface metals to CUL	Excavate or flush all free product plus enhanced bio & instit controls Excavate surface metals to CUL Excavate shallow smear zone where accessible to CUL (outside free product areas)	Excav. &/or flush free & resid product (~10,000 mg/kg) plus zone-wide enhanced bio to RL/CUL & instit controls Excavate surface metals to CUL Excavate shallow smear zone to CUL (outside free and residual product areas)	Excavate to CUL Excavate surface metals to CUL
Railyard	Free product recovery skimming at property boundary and natural attenuation Excavate surface metals impacts (2 feet) to CULs	Free product recovery trenches at property bdry, skim free product interior areas, and natural attenuation Excavate surface metals impacts (2 feet) to CULs	Free product recovery trenches at property bdry, skim free product interior areas, and natural attenuation Excavate surface metals impacts (2 feet) to CULs	Free product recovery trenches at property bdry, skim free product interior areas, and natural attenuation Excavate surface metals & TPH impacts (2 feet) to CULs	Free product recovery trenches at property bdry, skim free product interior areas, and natural attenuation Excavate surface metals impacts (2 feet) to CULs	Free Product Recovery trenches at all plumes, plus enhanced bio at property boundary to gw CUL Excavate surface metals impacts (2 feet) to CULs	Flush free product at 2 n'western plumes, trenches elsewhere, enhanced bio at ppty boundary and NE free product area to gw CUL Excavate surface metals & TPH impacts (2 feet) to CULs	Excav. 2 S'ern, flush 2 N'western and eastern free product areas, enhanced bio at ppty. Bdry. & at NE free product area Excavate surface metals & TPH impacts (2 feet) to CULs	Excavate to CUL Excavate Surface Impacts (2 feet) to CULs

Table 7-1 Remedial Alternatives and Cleanup Standards

Criteria	No Action	Alternative SW1	Alternative SW2	Alternative SW3	Alternative SW4	Alternative PB1	Alternative PB2	Alternative PB3	Alternative PB4	Standard Alternative
Groundwater	• Free product discharge to river is stopped in the long-term • Groundwater discharging to river exceeds CUL	• Free product discharge to Skykomish River is stopped • Groundwater discharging to river meets CUL • Passive free product recovery at Barrier Wall and railyard property boundary locations • Free product excavated in S Developed Zone • Natural Attenuation in NE Developed Zone	• Free product discharge to Skykomish River is stopped • Groundwater discharging to river meets CUL • Passive free product recovery at Barrier Wall, in NW Developed Zone, on railyard and at railyard property boundary • Free product excavated in S Developed Zone • Natural Attenuation in NE Developed Zone	• Free product discharge to Skykomish River is stopped • Groundwater discharging to river meets CUL • Passive free product recovery at Barrier Wall, on railyard and at railyard property boundary • Free product in NW Developed Zone and Levee excavated where accessible • Free product excavated in S Developed Zone • Free product removed and groundwater meets CUL in NE Developed Zone	• Free product discharge to Skykomish River is stopped • Groundwater discharging to river meets CUL • Passive free product recovery on railyard and at railyard property boundary • Excavation or surfactant flushing of free product in NW Developed Zone and Levee • Free product excavated in S Developed Zone • Free product removed and groundwater meets CUL in NE Developed Zone	• Free product discharge to Skykomish River is stopped • Passive free product recovery on railyard and at railyard property boundary • Excavation of free product in NW Developed Zone where accessible • Excavation of free product in S Developed Zone • Natural attenuation and enhanced bioremediation achieve groundwater CULs site wide	• Free product discharge to Skykomish River is stopped • Passive free product recovery on railyard and at railyard property boundary • Excavation of free product in NW Developed Zone where accessible • Excavation of free product in S Developed Zone • Enhanced bioreme-diation and natural attenuation achieve groundwater CULs site wide	• Free product discharge to Skykomish River is stopped • Passive free product recovery on railyard • Excavation or surfactant flushing of free product in NW Developed Zone • Excavation of free product in S Developed Zone • Enhanced bioreme-diation and natural attenuation achieve groundwater CULs site wide	• Free product discharge to Skykomish River is stopped • Excavation or surfactant flushing of free product site wide • Enhanced bioreme-diation and natural attenuation achieve groundwater CULs site wide	• Free product discharge to Skykomish River is stopped • Excavation of free product site wide • Natural attenuation achieve groundwater CULs site wide
Soil	• Surface soil containing metals (Rail yard and off rail yard locations) and hydrocarbons (Rail yard only) exceed CULs • Clean overburden soil off the rail yard separates ecological receptors and humans from exposures. Exposure occurs only as a result of excavation below clean soil depth	• Accessible surface soil meets CULs site wide for metals • Subsurface soil site wide and near surface soil on rail yard that exceeds CUL for TPH is contained by clean overburden or rail yard ballast	• Accessible surface soil meets CULs site wide for metals • Subsurface soil site wide and near surface soil on rail yard that exceeds CUL for TPH and is contained by clean overburden or rail yard ballast	• Accessible surface soil meets CULs site wide for metals • Subsurface soil site wide and near surface soil on rail yard that exceeds CUL for TPH and is contained by clean overburden or rail yard ballast	• Accessible surface soil meets CULs site wide for TPH and metals • Shallow soil in NW Developed Zone excavated to CUL where accessible • Soil in S Developed Zone excavated to CUL • Subsurface soil site wide that exceeds CUL for TPH is contained by clean overburden or rail yard ballast	• Accessible surface soil meets CULs site wide for metals • Soil in S Developed Zone excavated to CUL • Subsurface soil site wide and near surface soil on rail yard that exceeds CUL for TPH and is contained by clean overburden or rail yard ballast	• Accessible surface soil meets CULs site wide for metals • Shallow soil in NW Developed Zone excavated to CUL where accessible • Soil in S Developed Zone excavated to CUL • Subsurface soil site wide and near surface soil on rail yard that exceeds CUL for TPH and is contained by clean overburden or rail yard ballast	• Accessible surface soil meets CULs site wide for metals and TPH • Shallow soil in NW Developed Zone excavated to CUL where accessible • Soil in S Developed Zone excavated to CUL • Subsurface soil site wide and near surface soil on rail yard that exceeds CUL for TPH and is contained by clean overburden or rail yard ballast		• Excavation or surfactant flushing of all soil to CULs
Surface water	Groundwater discharging to Skykomish River exceeds surface water CUL	Groundwater discharging to Skykomish River meets surface water CUL.[1]	Groundwater discharging to Skykomish River meets surface water CUL.[1]	Groundwater discharging to Skykomish River meets surface water CUL.[1]	Groundwater discharging to Skykomish River meets surface water CUL.[1]	Groundwater discharging to river meets surface water CUL.[1]	Groundwater discharging to river meets surface water CUL.[1]	Groundwater discharging to river meets surface water CUL.[1]	Groundwater discharging to river meets surface water CUL.[1]	Groundwater discharging to river meets surface water CUL.[1]
Sediment in Skykomish River	Groundwater discharging to river exceeds CUL. Natural recovery may restore sediment quality to CUL.	Groundwater discharging to river meets CUL. Natural recovery restores sediment quality to CUL.	Groundwater discharging to river meets CUL. Natural recovery restores sediment quality to CUL.	Groundwater discharging to river meets CUL. Selective removal and natural recovery restores sediment quality to CUL.	Groundwater discharging to river meets CUL. Selective removal and natural recovery restores sediment quality to CUL.	Groundwater discharging to river meets CUL. Natural recovery restores sediment quality to CUL.	Contaminant discharge to river is discontinued. Selective removal and natural recovery restores sediment quality to CUL	Contaminant discharge to river is discontinued. Selective removal, ozonation and natural recovery restore sediment quality to CUL	Contaminant discharge to river is discontinued. Selective removal, ozonation and natural recovery restore sediment quality to CUL	Complete removal to CUL

Table 7-1 Remedial Alternatives and Cleanup Standards

Criteria	No Action	Alternative SW1	Alternative SW2	Alternative SW3	Alternative SW4	Alternative PB1	Alternative PB2	Alternative PB3	Alternative PB4	Standard Alternative
Sediment in Former Maloney Creek	Natural recovery restores sediment quality to CUL. [1]	Natural recovery restores sediment quality to CUL. [1]	Natural recovery restores sediment quality to CUL. [1]	Natural recovery restores sediment quality to CUL. [1]	Sediment quality restored through excavation. Recontamination potential addressed by enhanced bioremediation.	Natural recovery restores sediment quality to CUL. [1]	Natural recovery restores sediment quality to CUL. [1]	Enhanced Bio prevents sediment recontamination. Selective removal minimizes damage to ecological habitat. Natural recovery restores sediment quality to CUL.	Enhanced Bio prevents sediment recontamination. Complete removal re-stores sediment quality to CUL.	Excavation of Subsurface Soil eliminates potential for recontamination. Complete removal re-stores sediment quality to CUL.
Protects Human Health and the Environment	• Exposure risks to metals and hydrocarbons in surface soil are unchanged; dust suppressant is used to minimize exposure • Exposure to subsurface TPH contaminated soil can occur with excavation. Otherwise, potential for exposures is limited by existence of clean soil overburden • Existing ordinances and regulations preclude use of groundwater for drinking water. • Risks to human and ecological receptors in the river persist as a result of groundwater discharges to the river • Sediments may naturally recover to protective levels long-term	• Exposure risks to metals in surface soil are eliminated through removal and disposal. • Exposure risks to TPH contaminated soil remaining on site are managed by containment and institutional controls. • Exposure risks to contaminated groundwater remaining on site are managed by institutional controls. • Human and ecological receptors in the river are protected by eliminating upland discharges of free product and contaminated groundwater. • Sediments naturally recover to protective levels.	• Exposure risks to metals in surface soil are eliminated through removal and disposal. • Exposure risks to TPH contaminated soil remaining on site are managed by containment and institutional controls. • Exposure risks to contaminated groundwater remaining on site are managed by institutional controls. • Human and ecological receptors in the river are protected by eliminating upland discharges of free product and contaminated groundwater. • Sediments naturally recover to protective levels.	• Exposure risks to metals in surface soil are eliminated through removal and disposal. • Exposure risks to TPH contaminated soil remaining on site are managed by containment and institutional controls. • Exposure risks to contaminated groundwater remaining on site are managed by institutional controls. • Human and ecological receptors in the river are protected by eliminating upland discharges of free product and contaminated groundwater. • Sediments naturally recover to protective levels.	• Exposure risks to metals and TPH in surface soil are eliminated through removal and disposal. • Exposure risks to TPH contaminated soil remaining on site are managed by containment and institutional controls. • Exposure risks to contaminated groundwater remaining on site are managed by institutional controls. • Human and ecological receptors in the river are protected by eliminating upland discharges of free product and contaminated groundwater. • Sediment quality restored through excavation	• Exposure risks to metals in surface soil are eliminated through removal and disposal. • Exposure risks to TPH contaminated soil remaining on site are managed by containment and institutional controls. • Groundwater CULs are achieved off the railyard property • Human and ecological receptors in the river are protected by eliminating upland discharges of free product and contaminated groundwater. • Sediment quality restored through selective removal and natural recovery	• Exposure risks to metals in surface soil are eliminated through removal and disposal. • Exposure risks to TPH contaminated soil remaining on site are managed by containment and institutional controls. • Groundwater CULs are achieved off the railyard property • Human and ecological receptors in the river are protected by eliminating upland discharges of free band contaminated groundwater. • Sediment quality restored through selective removal and natural recovery	• Exposure risks to metals and TPH in surface soil are eliminated through removal and disposal. • Exposure risks to TPH contaminated soil remaining on site are managed by containment and institutional controls. • Groundwater CULs are achieved off the railyard property • Human and ecological receptors in the river are protected by eliminating upland discharges of free product and contaminated groundwater. • Sediment quality restored through selective removal *in situ* treatment and natural recovery	• Exposure risks to metals and TPH in surface soil are eliminated through removal and disposal. • Exposure risks to TPH contaminated soil remaining on site are managed by containment and institutional controls. • Groundwater CULs are achieved off the railyard property • Human and ecological receptors in the river are protected by eliminating upland discharges of free product and contaminated groundwater. • Sediment quality restored through selective removal *in situ* treatment and natural recovery	• Protection achieved by attaining CULs at the standard point of compliance for all media

Table 7-2 SEPA and MTCA "Other Requirements"

Criteria	No Action	Alternative SW1	Alternative SW2	Alternative SW3	Alternative SW4	Alternative PB1	Alternative PB2	Alternative PB3	Alternative PB4	Standard Alternative
Permanence	• Upland soil and groundwater remain in excess of cleanup levels. • Free product discharges to the river will cease long-term • Natural recovery permanently reduces impacts to sediments in the long-term once discharges of free product to surface water are eliminated	• Removal and disposal of contaminated surface soil and free product is permanent. • Upland soil and groundwater remain in excess of cleanup levels. • Natural recovery permanently protects sediments in the long-term once discharges to surface water are eliminated	Similar to SW1	• Increased permanence over SW1 from, • Excavation of accessible free product in the NW Developed Zone and Seep bearing material in the Levee • Enhanced Bioremediation in the NE developed zone	• Increased permanence over SW3 from, • Complete free product removal in the NW Developed Zone • Excavation of shallow soil in NW Developed Zone and S Developed Zone • Soil and sediment cleanup activities	• Removal and disposal of contaminated surface soil and free product is permanent. • Upland soil remains in excess of CUL. • GW?? • Natural recovery permanently protects sediments in the long-term once discharges to surface water are eliminated	• Increased permanence over PB1 from, • Greater enhanced bioremediation capacity • Removal or stabilization of Hot Spot soil and sediment in the Levee	• Increased permanence over PB2 from, • More aggressive free product and soil removal actions in the Levee • Removal of shallow soil in the NW Developed Zone • Sediment removal and enhanced bioremediation at Former Maloney Creek	• Increased permanence over PB3 primarily from, • Expanded excavation and surfactant flushing in the NW Developed Zone	• Maximum permanence achieved by treating or removing contaminants to CULs throughout the site
Equivalent Volume of Soil/Sediment Treated or Removed (cy)	NA	220,000	230,000	430,000	510,000	400,000	470,000	580,000	650,000	770,000
Cost ($M)	$1.5M	$4.4M	$7.7M	$10.4M to $10.9M	$19.4M to $29.5M	$10.5M	$16.2M to $22.8M	$20.9M to $31.6M	$31.7M to $48.7M	$49.6M
Effectiveness Over the Long Term	• Existing ordnances and regulations limit risks from consumption of groundwater • Existing barrier wall and free product recovery systems eliminate free product discharges to the river long term. • Surface soil contamination is not addressed	• Excavation and treatment/disposal are routine and reliable • Testing required to determine the effectiveness and reliability of enhanced bioremediation • Isolation and institutional controls prevent exposures to contaminated soil and groundwater remaining on site after remediation but rank low in long term effectiveness compared to removal or treatment.	Same as SW1	Same as SW1	• Similar to SW1 plus, • Testing required to determine the effectiveness and reliability of ozonation or surfactant flushing for the Levee.	• Excavation and treatment/disposal are routine and reliable • Testing required to ensure the effectiveness and reliability of enhanced bioremediation • Isolation and institutional controls prevent exposures to contaminated soil and groundwater remaining on site during and after remediation but rank low in long-term effectiveness compared to removal or treatment.	• Same as PB1	• Similar to PB1 • Testing required to determine the effectiveness of surfactant flushing and ozonation	• Increased effectiveness over PB3 from • Removal of all free product by excavation or surfactant flushing (effectiveness of surfactant flushing to be confirmed by testing) • Excavation likely to be more effective for soil and sediment removal at levee than *in situ* methods	Similar to PB3. Heavy reliance on excavation and treatment/disposal for hydrocarbon contaminated soil in developed areas.
Management of Short Term Risks	• The short-term risks from no action are limited to existing and immediate exposures • Surface soil exposures to workers may occur as a result of work on the rail yard. • Residents of the community may be exposed to metals that exist off the rail yard or as a result of wind-borne transport of soil containing metals. • Residents, recreational users of the Skykomish River, and ecological receptors are exposed to free product and contaminated sediment at the River's edge.	• Engineering controls and standard worker health and safety practices minimize human and ecological risks during implementation. • Engineering controls prevent the spread of particulate (e.g., dust) and liquid contaminants during removal operations. • Air monitoring determines whether controls are preventing potential exposures by air transport of contaminants	Same as SW1	• Similar to SW1 plus, • Increased risks to general public during excavation in residential area	• Similar to SW3 plus, • Surfactant flushing at the Levee requires careful hydraulic controls to ensure no chemical releases to the river	• Engineering controls and standard worker health and safety practices minimize human and ecological risks during implementation. • Engineering controls prevent the spread of particulate (e.g., dust) and liquid contaminants during removal operations. • Precautions necessary to protect general public during cleanup actions in residential areas • Air monitoring determines whether controls are preventing potential exposures by air transport of contaminants	• Same as PB1	• Similar to PB1 • Precautions necessary to protect natural resources (river and wetlands) during sediment removal and installation/operation of *in situ* treatment equipment	• Similar to PB1 • Sediment removal poses ecological risks from disruption of existing habitat and contaminated sediment suspension/transport. • Precautions necessary to protect natural resources (river and wetlands) during sediment removal and installation/operation of *in situ* treatment equipment	
Technical and Administrative Implementability	• Does not meet MTCA threshold requirements.	• No significant technical aspects that preclude implementation of this alternative • State rules exempt the cleanup action from state and local permitting requirements • The alternative can be implemented in substantial compliance with provisions of state and local permit requirements. • No federal permits required • Conditional POC for groundwater at point of discharge to river requires community acceptance of restrictive covenants	Same as SW1	• Same as SW1 plus • Residents must be temporarily relocated during free product removal operations in the NW Developed Zone. • Excavation work in the NW Developed Zone may cause disruptions to road and utility services	• Similar to SW3 plus, • ACOE Permit 38 required for sediment removal. • Excavation near the school should occur during the summer.	• No significant technical aspects that preclude implementation of this alternative • State rules exempt the cleanup action from state and local permitting requirements • The alternative can be implemented in substantial compliance with provisions of state and local permit requirements. • No federal permits required • Residents must be temporarily relocated during free product removal operations in the NW Developed Zone. • Excavation work in the NW Developed Zone may cause disruptions to road and utility services	• Similar to PB1. Nationwide 38 permit required for excavation work below high water mark along river bank	• Similar to PB2. May not require Nationwide 38 Permit depending on technology implemented at levee	• Similar to PB1. Nationwide 38 permit required for excavation work below high water mark along river bank • Greater disruption to community due to expanded area of cleanup operations in the NW Developed Zone.	
Restoration Timeframe[1] Surface Soil (Rail Yard and NW Zone) Levee Former Maloney Creek NE Developed Zone South Developed Zone NW Developed Zone Rail yard	FP / GW / S/S NA / NA / >30 10 to 20 / >30 / >30 NA / 10 to 20 / 5 to 10 10 to 20 / 20 to 30 / 20 to 30 >30 / >30 / >30 >30 / >30 / >30 >30 / >30 / >30	FP / GW / S/S NA / NA / 1 5 to 10 / 5 to 10 / 5 to 10 NA / 5 to 10 / 5 to 10 10 to 20 / 0 / 0 1 / 0 / 0 20 to 30 / 0 / 0 20 to 30 / 0 / 0	FP / GW / S/S NA / NA / 1 5 to 10 / 5 to 10 / 5 to 10 NA / 5 to 10 / 5 to 10 10 to 20 / 0 / 0 1 / 0 / 0 20 to 30 / 0 / 0 20 to 30 / 0 / 0	FP / GW / S/S NA / NA / 1 1 / 3 to 5 / 3 to 5 NA / 5 to 10 / 5 to 10 3 to 5 / 0 / 0 1 / 0 / 0 5 to 10 / 0 / 0 20 to 30 / 0 / 0	FP / GW / S/S NA / NA / 1 1 / 2 / 1 NA / 3 to 5 / 3 to 5 3 to 5 / 0 / 0 1 / 0 / 0 3 to 5 / 0 / 0 20 to 30 / 0 / 0	FP / GW / S/S NA / NA / 1 5 to 10 / 5 to 10 / 5 to 10 NA / 5 to 10 / 5 to 10 10 to 20 / 20 to 30 / 20 to 30 1 / 2 / 1 5 to 10 / 10 to 20 / 10 to 30 20 to 30 / 0 / 0	FP / GW / S/S NA / NA / 1 1 / 3 to 5 / 3 to 5 NA / 5 to 10 / 5 to 10 5 to 10 / 5 to 10 / 5 to 10 1 / 2 / 1 1 / 2 / 2 20 to 30 / 0 / 0	FP / GW / S/S NA / NA / 1 1 / 2 / 1 NA / 3 to 5 / 3 to 5 5 to 10 / 5 to 10 / 5 to 10 1 / 2 / 1 1 / 2 / 2 10 to 20 / 0 / 0	FP / GW / S/S NA / NA / 1 1 / 2 / 1 NA / 3 to 5 / 3 to 5 1 / 3 to 5 / 3 to 5 1 / 2 / 1 1 / 2 / 2 3 to 5 / 0 / 0	FP / GW / S/S NA / NA / 1 1 / 2 / 1 NA / 2 / 1 1 / 2 / 1 1 / 2 / 1 1 / 2 / 1 1 / 2 / 1
Public Concerns[2]	• Does not address community concerns about site contamination • Prevents any physical disruption to the community	• Removes most immediate threat to human health (surface soil containing metals). • Minimizes physical disruption to community. • Institutional controls require property owners to notify city of planned construction at depths that may expose contaminated soil • Long restoration time frame. Access to property required for monitoring	Similar to SW1. Free product recovery in NW Developed Zone increases community disruption slightly and requires periodic access to for equipment servicing.	Significant disruption to community from excavation in the NW Developed Zone. Roads, septic systems and some utilities are taken out of service and repaired or replaced following excavation. Residents may be displaced temporarily during excavation. Odors and noise. Institutional controls still required. Enhanced bioremediation in NE Developed Zone likely of limited concern to community as equipment and operations are below grade.	Similar to SW3. Institutional controls required.	Similar to SW3. Institutional controls required for soil. Groundwater meets CUL in the long-term (<20 yrs).	Similar to SW3. Institutional controls required for soil. Groundwater meets CUL in the long-term (<20 yrs).	Similar to SW3. Institutional controls required for soil. Groundwater meets CUL in <10 yrs.	Similar to SW3 but with much greater physical impacts – greater excavation and surfactant flushing footprint. Institutional controls required for soil. Groundwater meets CUL in <10 yrs.	Greatest disruption to community. Houses need to be moved. Residents are displaced during excavation. No institutional controls required.

[1] FP=Free product, GW= groundwater, S/S = soil and sediment. These restoration timeframes are rough estimates based on best professional judgement.

[2] Community concerns will be formally addressed through the Public Notice and Participation provisions of WAC 173-340-600.

Table 7-3 Summary of Impact Analysis Relative to No Action Alternative

Legend: + = minor or temporary adverse impacts; ++ =moderate adverse impacts; +++ = major adverse impacts; 0 = no impact or inapplicable	No Action Alternative (site-wide[5])	SW1						SW2						SW3						SW4					
		Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard	Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard	Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard	Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard
Comments	*These are ongoing (long-term) impacts in the absence of cleanup. Impacts for the alternatives are relative to this baseline*							*Impacts same as SW1*	*Impact same as SW1*	*Impacts same as SW1*	*Impacts similar to SW1 plus additional*	*Impacts same as SW1*	*Impacts similar to SW1*	*Impacts include SW1 plus additional*	*Impacts same as SW1*		*Impacts similar to SW1 plus additional*	*Impacts same as for SW1*	*Impacts same as for SW2*		*Impacts represent a worst-case scenario*	*Impacts same as SW3*	*Impacts similar to SW1 plus additional*		*Impacts similar to SW2 plus additional*
Natural Environment																									
Earth																									
E1 Soil	++	0[1]	0	0[1]	++[1]	+[1]	0[1]	0[1]	0	0[1]	++[1]	+[1]	0[1]	+[1]	0	0[1]	++[1]	+[1]	0[1]	0[1]	0	0[1]	+++[1]	+[1]	0[1]
E2 Topography	0	0	0	0	+	+	+	0	0	0	+	+	+	+	0	0	+	+	+	+	+	0	+	+	+
E3 Sediment	+++	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	++	++	0	0	0	0
Air Quality																									
A1 Emissions	0[2]	0	0	0	+	+	+	0	0	0	+	+	+	+	0	0	+	+	+	+	0	0	+	+	+
A2 Vapor Intrusion	0[2]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3 Odors	++	0	0	0	0	+	+	0	0	0	+	+	+	+	0	0	+	+	+	+	0	0	+	+	+
Groundwater																									
G1 Quantity	0	0	0	0	0	+	0	0	0	0	0	+	0	0	0	0	+	+	0	0	0	0	+	+	0
G2 Quality	+++	0[1]	0[1]	0[1]	0	+[1]	0[1]	0[1]	0[1]	0[1]	0[1]	+[1]	0[1]	0[1]	0[1]	0[1]	+1	+[1]	0[1]	+[1]	0[1]	0[1]	+[1]	+[1]	0[1]
Surface Water																									
S1 Hydrology	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	+	+	0	0	0	0
S2 Floods	0	0	0	0	.+	+	0	0	0	0	+	+	0	+	0	0	+	+	0	+	+	0	+	+	0
S3 Runoff/Infiltration	0	0	0	0	+	+	+	0	0	0	+	+	+	+	0	0	+	+	+	+	+	0	++	+	+
S4 Quality	+	0[1]	0[1]	0	0	0	0	0[1]	0[1]	0	0	0	0	+[1]	0[1]	0	0	0	0	+[1]	+[1]	0	0	0	0
Natural Environment																									
N1 Habitat, Wetland and Wildlife	0	+	0	0	+	+	+	+	0	0	+	+	+	+	0	+	+	+	+	+	+++[3]	+	+	+	+
N2 Aquatic Resources	++	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	++	++	0	0	0	0
Built Environment																									
Land Use																									
L1 Zoning and Land Use	+[6]	+[6]	+[6]	+	+	+	+[6]	+[6]	+[6]	+	+	+	+[6]	+[6]	+[6]	+	+	+	+[6]	+[6]	+[6]	+	+	+	+[6]
L2 Housing and Demographics	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	++	0	0	0	0	0	++	++	0
L3 Aesthetics and Historical Structures	+	0	0	0	+	+	0	0	0	0	+	+	0	+	0	++	++	+	0	+	+	++	+++	++	0
Environmental Health																									
H1 Noise and Vibrations	0	+	0	0	++	++	++	+	0	0	++	++	++	++	0	++	++	++	++	++	++	++	++	++	+
H2 Hazardous Substances	++	0	0	0	0	+	0	0	0	0	0	+	0	+	0	0	+	+	0	+	0	0	++	+	0
Transportation and Services																									
T1 Roads and Transportation Systems	0	0	0	0	0	0	+	0	0	0	+	0	+	++	0	+	++	0	+	++	0	+	++	+	+
T2 Traffic[4]	0	+	0	0	++	++	+	+	0	0	++	++	+	++	0	+	+++	++	+	+	+	+	+++	+++	+
T3 Public Services	0	0	0	0	+	+	0	0	0	0	+	+	0	0	0	++	++	+	0	0	0	++	+++	+	0

	PB1						PB2						PB3						PB4						STD					
	Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard	Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard	Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard	Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard	Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard
Comments	*Impacts same as SW1*	*Impacts same as SW1*	*Impacts same as SW1*		*Impacts same as SW4*	*Impacts same as SW4*	*Impacts same as SW3*	*Impacts same as SW1*	*Impacts same as SW3*	*Impacts same as for PB1*	*Impacts same as for SW4*		*Impacts as for SW4 plus additional*	*Impacts same as SW4*	*Impacts same as SW3*		*Impacts same as for SW4*		*Impacts represent a worst case scenario*	*Impacts represent a worst case scenario*		*Impacts similar to SW4 but more extensive*	*Impacts same as for SW4*		*Impacts similar to PB4 but more extensive*	*Impacts similar to PB4 but more extensive*		*Impacts similar to SW2 plus additional*	*Impacts same as for SW2 (except L1)*	
Natural Environment																														
Earth																														
E1 Soil	0[1]	0	0[1]	++[1]	+[1]	0[1]	+[1]	0	0[1]	++[1]	+[1]	0[1]	++[1]	0	0[1]	++[1]	+[1]	0[1]	++[1]	0	+[1]	+++[1]	+[1]	0[1]	++[1]	0	++[1]	+++[1]	+[1]	0[1]
E2 Topography	0	0	0	+	+	+	+	0	0	+	+	+	+	+	0	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
E3 Sediment	0	0	0	0	0	0	+	0	0	0	0	0	++	++	0	0	0	0	++	++	0	0	0	0	+	++	0	0	0	0
Air Quality																														
A1 Emissions	0	0	0	+	+	+	+	0	0	+	+	+	+	0	0	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
A2 Vapor Intrusion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3 Odors	0	0	0	+	+	+	+	0	0	+	+	+	+	0	0	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Groundwater																														
G1 Quantity	0	0	0	+	+	0	0	0	0	+	+	0	+	0	0	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
G2 Quality	0[1]	0[1]	0[1]	+[1]	+[1]	0[1]	0[1]	0[1]	0[1]	+[1]	+[1]	0[1]	+[1]	0[1]	0[1]	+[1]	+[1]	+[1]	+[1]	+[1]	+[1]	+[1]	+[1]	+[1]	+[1]	+[1]	+[1]	+[1]	+[1]	+[1]
Surface Water																														
S1 Hydrology	0	0	0	0	0	0	+	0	0	0	0	0	+	+	0	0	0	0	+	+	0	0	0	0	+	+	0	0	0	0
S2 Floods	0	0	0	+	+	0	+	0	0	+	+	0	++	+	0	+	+	0	++	+	+	+	+	0	++	+	+	+	+	0
S3 Runoff/Infiltration	0	0	0	+	+	+	+	0	0	+	+	+	++	+	0	.++	+	+	++	++	+	++	+	++	++	++	++	++	+	++
S4 Quality	0[1]	0[1]	0	0	0	0	+[1]	0[1]	0	0	0	0	+[1]	+[1]	0	0	0	0	+[1]	++[1]	0	0	0	0	+[1]	+[1]	0	0	0	0
Natural Environment																														
N1 Habitat, Wetland and Wildlife	+	0	0	+	+	+	+	0	+	+	+	+	+	+++[3]	+	+	+	+	+	+++[3]	+	+	+	+	+	+++[3]	+	+	+	+
N2 Aquatic Resources	0	0	0	0	0	0	+	0	0	0	0	0	++	++	0	0	0	0	++	+++	0	0	0	0	++	+++	0	0	0	0
Built Environment																														
Land Use																														
L1 Zoning and Land Use	+[6]	+[6]	+	+	+	+[6]	+[6]	+[6]	+	+	+	+[6]	+[6]	+[6]	+	+	+	+[6]	+[6]	+[6]	+	+	+	+[6]	0	0	0	0	0	0
L2 Housing and Demographics	0	0	0	++	++	0	0	0	0	++	++	0	+	0	0	++	++	0	+	0	+	+++	++	0	+	0	+++	+++	++	0
L3 Aesthetics and Historical Structures	0	0	0	++	++	0	+	0	++	++	++	0	++	+	++	++	++	+	++	+++	++	+++	++	+	++	+++	+++	+++	++	+
Environmental Health																														
H1 Noise and Vibrations	+	0	0	++	++	++	++	0	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++
H2 Hazardous Substances	0	0	0	+	+	0	+	0	0	+	+	0	+	0	0	+	+	+	+	+	+	++	+	+	+	+	+	++	+	+
Transportation and Services																														
T1 Roads and Transportation Systems	0	0	0	++	+	+	++	0	+	++	+	0	+++	0	+	++	+	+	+++	0	+	+++	+	++	+++	0	+	+++	+	+++
T2 Traffic[4]	+	0	0	+++	+++	+	++	0	+	+++	+++	+	++	+	+	+++	+++	+	++	++	+	+++	+++	+++	+++	++	+++	+++	+++	+++
T3 Public Services	0	0	0	++	+	0	0	0	++	++	+	0	0	0	++	++	+	0	0	0	++	+++	+	++	0	0	++	+++	+	+++

Comments

[1] The listed value represents short-term (construction phase) impacts. Long-term impacts, by the nature of the clean-up project, are always positive (beneficial) compared to the no action alternative.

[2] Emissions and vapor intrusion are not significant under current conditions

[3] Compensatory wetland mitigation will be provided per WDOE and Town of Skykomish CAO requirements

[4] Traffic impacts assume that removed material will be hauled via U.S. 2 to either Everett or beyond. Use of trains to transport removed material would reduce impacts.

[5] The no action alternative represents a baselin, long-term impact in the absence of cleanup. The impacts reflect site-wide impacts and are not limited to any cleanup zone. All impcats from alternatives represent a comparison relative to the no-action alternative.

[6] Institutional controls will be imposed on all zones under all alternatives (including the no action alternative) except the standard alternative. These excavation restrictions to land use are primarily of concern to private landowners in the NE, NW, and S zones, and have been assigned a "minor" classification. In the public areas and the reailyard, the restriction on excavation is considered less of an impact.. This footnote has been attached to these areas.

Table 7-4 Definitions of "Adverse Impacts" Relative to No Action Alternative

	Basis for Definition	Minor or temporary impact (+)	Moderate Impact (++)	Major Impact (+++)
Natural Environment				
Earth				
E1 Soil	Short-term removal of valuable topsoil (long-term soil conditions will improve as a result of cleanup	Temporary loss of small volumes of topsoil	Temporary loss of garden or public landscaping soil	Loss of large volumes of cultivated or garden topsoil
E2 Topography	Temporary or permanent changes in topography	Temporary presence of storage piles	Some regrading of existing contours	Major changes in contours
E3 Sediment	Changes in ecologically relevant sediment resource	Disturbances or minor loss of existing sediment, replaced naturally	Loss of existing sediment resource, replaced naturally	Loss of existing resource, including valuable benthic habitat
Air Quality				
A1 Emissions	Increase in emissions which may be detrimental to human health or safety, injure plants or animals.	Short-term increase in emissions below ambient source impact levels.	Quantifiable increases in toxic or criteria pollutants with potential health risk	Significant deterioration of ambient air quality with potential for human, plant, or animal health effects
A2 Vapor Intrusion	Increases in ambient or indoor VOCs to potentially hazardous levels	Short-term increase in VOC vapors as a result of excavations	Longer-term increase in VOC vapors, with potential for health risk	Clear potential for release of harmful amounts of VOC vapors
A3 Odors	Noxious hydrocarbon odors (professional judgement)	Minor or short-term nuisance odors	Longer-term hydrocarbon odors	Permanent odor nuisance created
Groundwater				
G1 Quantity	Removals of groundwater, or blockage to natural flow (professional judgement)	Temporary removal of small volumes for treatment	Changes in future flow patterns of impacted groundwater	Reduced volumes of groundwater used for a beneficial use
G2 Quality	Short term decline in quality (long-term there is improvement due to cleanup)	Minor and temporary degradation possible due to treatment chemicals	Major degradation of impacted groundwater possible	Degradation of unimpacted groundwater possible
Surface Water				
S1 Hydrology	Changes in natural flows (professional judgement)	Minor construction in watercourses, no restriction of flow	Construction in watercourses, minor restrictions of flow	Reductions in water flow, water allocation, or navigability
S2 Floods	Likelihood and severity of flooding events (professional judgement)	Minor flooding during storm events possible	Temporary increased potental for unlikely yet catastrophic flooding	Permanent increase in flooding potential in urban areas
S3 Runoff/Infiltration	Changes in stormwater management	Temporary blockage or interruption in stormwater runoff	Temporary blockage of stormwater system requiring diversions or bypasses	Permanent loss of stormwater drainage, potentially leading to flooding
S4 Quality	Short term decline in quality (long-term there is improvement due to cleanup)	Minor impacts due to construction activities (silting)	Potential violation of non-degradation statutes	Loss of attainable use
Fish and Wildlife				
N1 Habitat, Wetland and Wildlife	Loss of habitat (wetlands, upland natural areas, developed residential and industrial lands)	Temporary loss of developed residential and industrial habitats	Short-term loss of wetlands and wetland values; temporary loss of wildlife use	Long-term loss of wetlands and wetland values, including wildlife use
N2 Aquatic Resources	Loss of salmonid habitat	Temporary loss of salmonid habitat	Minor loss of salmonid habitat; temporary loss of access to salmonid habitat	Permanent or long-term loss of salmonid habitat
Built Environment				
Land Use				
L1 Zoning and Land Use	Changes in current zoning; or institutional control affecting full property use	Institutional control affecting excavation rights; temporary loss of access to public areas	Changes in zoning required; Critical Areas affected	Loss of valuable land use
L2 Housing and Demographics	Housing units temporarily or permanently unusable	Restriction in access to existing housing;	Major excavation around existing structures	Demolition of existing housing units
L3 Aesthetics and Historical Structures	Changes in town character (professional judgement)	Nuisance in developed or natural areas due to construction	Destruction (temporary) of structures and landscaping; temporary change in overall town character	Destruction of historical structures; permanent change in town character
Environmental Health				
H1 Noise and Vibrations	dBA levels and time of day	< 45 dBA and any level of noise or vibrations during daytime hours	> 60 dBA and any vibrations during working hours	>45 dBA or any vibrations during nighttime hours
H2 Hazardous Substances	Hazardous substances in hazardous amounts (Professional Judgement)	Small potential for release or exposure to hazardous substances	Increased probability of accidental exposure to hazardous chemicals in hazardous amounts	Widespread or likely exposure to hazardous chemicals in hazardous amounts
Transportation and Services				
T1 Roads and Transportation Systems	Train traffic and roads	Road closure up to a month; a train per week added	Road closure lasting less than 2 months; up to 2 trains per week for up to 2 months	Construction of major access roads; permanent closure of roads; more than 2 trains per week for more than 2 months
T2 Traffic [4]	Increase in Highway 2 traffic	Increased traffic lasting less than 2 weeks	Increased traffic lasting less than 2 months	Increased traffic lasting more than 2 months
T3 Public Services	Interruption in utilities or services	Nuisances due to closures of roads, interruptions in leachfield use	Some interruptions in services; effects on leachfields	Excavation activities resulting in major interruptions in utility services

Comments
[1] Top value represents long-term
[2] Emissions and vapor intrusion are not significant under current conditions
[3] Compensatory wetland mitigation
[4] Traffic impacts assume that removed material will be hauled via U.S. 2 to either Everett or beyond. Use of trains to transport removed material would reduce impacts.

Table 7-5 Summary of Significant Unavoidable Impacts Relative to No Action Alternative (by alternative)

	Alternative								
	SW1	SW2	SW3	SW4	PB1	PB2	PB3	PB4	STD
Natural Environment [1]									
Earth									
E1 Soil	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected
E2 Topography	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected
E3 Sediment	None expected	None expected	None expected	Sediment removal with natural recovery over time (levee and former Maloney Creek)	None expected	None expected	Sediment removal with natural recovery over time (levee and former Maloney Creek)	Sediment removal with natural recovery over time (levee and former Maloney Creek)	Sediment removal with natural recovery over time (levee and former Maloney Creek)
Air Quality									
A1 Emissions	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected
A2 Vapor Intrusion	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected
A3 Odors	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected
Groundwater									
G1 Quantity	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected
G2 Quality	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected
Surface Water									
S1 Hydrology	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected
S2 Floods	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected
S3 Runoff/Infiltration	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected
S4 Quality	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected
Natural Environment									
N1 Habitat, Wetland and Wildlife	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected
N2 Aquatic Resources	None expected	None expected	None expected	Loss of salmon habitat with recovery over time	None expected	None expected	Loss of salmon habitat with recovery over time	Loss of salmon habitat with recovery over time	Loss of salmon habitat with recovery over time

Table 7-5 Summary of Significant Unavoidable Impacts Relative to No Action Alternative (by alternative)

	SW1	SW2	SW3	SW4	PB1	PB2	PB3	PB4	STD
Built Environment [2]									
Land Use									
L1 Zoning and Land Use	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected	None expected
L2 Housing and Demographics	None expected	None expected	Nuisance and disturbance near homes	Demolition or moving of housing over free product needed	Nuisance and disturbance near homes	Nuisance and disturbance near homes	Nuisance and disturbance near homes	Demolition or moving of housing needed over free product	Demolition or moving of housing needed throughout downtown area
L3 Aesthetics and Historical Structures	None expected	None expected	Nuisance and disturbance in historic district	Nuisance and disturbance in historic district	Nuisance and disturbance in historic district	Nuisance and disturbance in historic district	Nuisance and disturbance in historic district. Impacts to former Maloney Creek wetland	Demolition in hsitoric district required. Changes in town character likely.	Demolition of most of historic district required. Major changes in town character.
Environmental Health									
H1 Noise and Vibrations	Loud activities during working hours in developed zones and railyard	Loud activities during working hours in developed zones and railyard	Loud activities during working hours in aquatic and developed zones and railyard	Loud activities during working hours in aquatic and developed zones and railyard	Loud activities during working hours in developed zonees	Loud activities during working hours in aquatic and developed zones and railyard	Loud activities during working hours in aquatic and developed zones and railyard	Loud activities during working hours in aquatic and developed zones and railyard	Loud activities during working hours in aquatic and developed zones and railyard
H2 Hazardous Substances	None expected	None expected	None expected	Increased risk of exposure to hazardous substances	None expected	None expected	None expected	Increased risk of exposure to hazardous substances	Increased risk of exposure to hazardous substances
Transportation and Services									
T1 Roads and Transportation Systems	None expected	None expected	Road closures in developed zones, access roads in aquatic zones	Heavy use of roads, access road construction	Temporary road closures in developed zones	Heavy use of roads, temporary road closures	Heavy use of roads, temporary road closures	Heavy use of roads, temporary road closures	Heavy use of roads, temporary road closures, construction of access roads
T2 Traffic	Increased traffic in town and on U.S. 2 (excavations in developed zones)	Increased traffic in town and on U.S. 2 (excavations in developed zones)	Increased traffic in town and on U.S. 2 (excavations in developed and aquatic zones)	Increased traffic in town and on U.S. 2 (excavations in developed zones)	Increased traffic in town and on U.S. 2 (excavations in developed zones)	Increased traffic in town and on U.S. 2 (excavations in developed and aquatic zones)	Increased traffic in town and on U.S. 2 (excavations in developed and aquatic zones)	Large increases in traffic in town and on U.S.2 (excavations in all zones)	Very large increases in traffic in town and on U.S.2 (excavations in all zones)
T3 Public Services	None expected	None expected	Temporary impacts to utilities (e.g. water)	Temporary impacts to utilities (e.g.water)	Some temporary effects on utilities likely	Temporary impacts to utilities (e.g. water)	Impacts to utilities	Impacts to utilities	Impacts to utilities throughout the site

[1] Proposed mitigation measures for the natural environment include timing of work to minimize impacts, compensatory mitigation for wetland loss, and construction best management practices

[2] Proposed mitigation measures for the built environment inclusde construction best management practices, and installation of a community system to replace leachfields impacted by alternatives

Table 7-6 Summary Costs of Remedial Alternatives

	No Action	SW1	SW2	SW3	SW4	PB1	PB2	PB3	PB4	STD
Levee	Boom Maintenance	Boom Maintenance	Boom Maintenance	Excavate or pressure grout free product	Excavate, ozone sparge, or flush to soil RL/gw CUL	Boom Maintenance	Excavate or pressure grout free product	Excavate, ozone sparge, or flush to soil RL/gw CUL	Excavate, ozone sparge, or flush to soil RL/gw CUL	Excavate to CUL
		Enhanced Bio to gw CUL	Enhanced Bio to gw CUL	Enhanced Bio to gw CUL	Enhanced Bio to gw CUL	Enhanced Bio to gw CUL	Enhanced Bio to gw CUL	Enhanced Bio to gw CUL	Enhanced Bio to gw CUL	
				Remove surface sediment to RL (seeps)	Remove surface sediment to CUL		Remove surface sediment to RL (seeps)	Remove surface sediment to CUL	Remove surface sediment to CUL	Remove surface sediment to CUL
Cost	$230,000	$900,000	$900,000	$1,180,000	$2,708,100	$900,000	$1,184,700	$2,708,100	$2,708,100	$3,166,500
					$4,480,000			$4,480,000	$4,480,000	
				$1,690,500	$6,480,000		$1,690,500	$6,480,000	$6,480,000	
Fmr Maloney Creek		Natural Attenuation to RL	Natural Attenuation to RL	Natural Attenuation to RL	Enhanced Bio to soil RL/gw CUL	Natural Attenuation to RL	Natural Attenuation to RL	Enh Bio to soil RL/gw CUL	Enh Bio to soil RL/gw CUL	Excavate to CUL
					Remove surface sediment to RL			Remove surface sediment to RL	Remove surface sediment to CUL	Remove surface sediment to CUL
Cost		$220,000	$220,000	$220,000	$1,060,000	$220,000	$220,000	$1,060,000	$1,480,000	$1,710,000
NE Developed Zone		Natural Attenuation to RL	Natural Attenuation to RL	Enhanced Bio to CUL	Enhanced Bio to CUL	Natural Attenuation to RL	Enhanced Bio to CUL	Enhanced Bio to CUL	Excavate Free Product plus Enhanced Bio to CUL	Excavate to CUL
Cost		$220,000	$220,000	$600,000	$600,000	$220,000	$600,000	$600,000	$990,000	$3,640,000
South Developed Zone		Excavate free product plus natural attenuation	Excavate free product plus natural attenuation	Excavate free product plus natural attenuation	Excavate to CUL	Excavate to CUL	Excavate to CUL	Excavate to CUL	Excavate to CUL	Excavate to CUL
		Excavate surface soil to CULs	Excavate surface soil to CULs	Excavate surface soil to CULs	Excavate surface soil to CULs	Excavate surface soil to CULs	Excavate surface soil to CULs	Excavate surface soil to CULs	Excavate surface soil to CULs	Excavate surface soil to CULs
Cost		$340,000	$340,000	$340,000	$380,000	$380,000	$380,000	$380,000	$380,000	$380,000
NW Developed Zone	Existing Barrier Wall and Skimming System	Existing Barrier Wall and Skimming System	Free product recovery trenches where accessible plus natural attenuation & inst controls	Excavate free product where accessible & natural attenuation & inst controls	Excavate or flush all free product plus natural attenuation & institional controls	Excavate free product where accessible plus enhanced bio to RL/CUL & inst controls	Excavate or flush all free product plus enhanced bio & instit controls	Excavate or flush all free product plus enhanced bio & instit controls	Excav. &/or flush free & resid product (~10,000 mg/kg) plus zone-wide enhanced bio to RL/CUL & instit controls	Excavate to CUL
		Excavate surface metals to CUL	Excavate surface metals to CUL	Excavate surface metals to CUL	Excavate surface metals to CUL	Excavate surface metals to CUL	Excavate surface metals to CUL	Excavate surface metals to CUL	Excavate surface metals to CUL	Excavate surface metals to CUL
					Excavate shallow smear zone where accessible to CUL (outside free product areas)			Excavate shallow smear zone where accessible to CUL (outside free product areas)	Excavate shallow smear zone to CUL (outside free and residual product areas)	
Cost	$870,000	$980,000	$3,110,000	$5,180,000	$11,100,000	$5,870,000	$10,140,000	$11,630,000	$22,040,000	$23,480,000
					$13,040,000		$12,650,000	$14,150,000	$28,780,000	
Railyard	Dust Suppressant Application	Free product recovery skimming at property boundary and natural attenuation	Free product recovery trenches at property bdry, skim free product interior areas, and natural attenuation	Free product recovery trenches at property bdry, skim free product interior areas, and natural attenuation	Free product recovery trenches at property bdry, skim free product interior areas, and natural attenuation	Free product recovery trenches at property bdry, skim free product interior areas, and natural attenuation	Free Product Recovery trenches at all plumes, plus enhanced bio at property boundary to gw CUL	Flush free product at 2 n'western plumes, trenches elsewhere, enhanced bio at ppty boundary and NE free product area to gw CUL	Excav. 2 S'ern, flush 2 N'western and eastern free product areas, enhanced bio at ppty. Bdry. & at NE free product area	Excavate to CUL
		Excavate surface metals impacts (2 feet) to CULs	Excavate surface metals impacts (2 feet) to CULs	Excavate surface metals impacts (2 feet) to CULs	Excavate surface metals & TPH impacts (2 feet) to CULs	Excavate surface metals impacts (2 feet) to CULs	Excavate surface metals impacts (2 feet) to CULs	Excavate surface metals & TPH impacts (2 feet) to CULs	Excavate surface metals & TPH impacts (2 feet) to CULs	Excavate Surface Impacts (2 feet) to CULs
Cost	$70,000	$1,510,000	$2,610,000	$2,610,000	$3,330,000	$2,610,000	$3,430,000	$4,270,000	$3,820,000	$16,930,000
Flusing Water Treatment		$0	$0	$0	$4,390,000	$0	$3,550,000	$4,390,000	$6,510,000	$0
Long Term Monitoring	$310,000	$260,000	$260,000	$260,000	$260,000	$260,000	$260,000	$260,000	$260,000	$260,000
TOTAL COST	$1,500,000	$4,400,000	$7,700,000	$10,400,000	$19,400,000	$10,500,000	$16,200,000	$20,900,000	$31,700,000	$49,600,000
				$10,900,000	$29,500,000		$22,800,000	$31,600,000	$48,700,000	

Table 8-1 Benefit Analysis for Disproportionate Cost Analysis

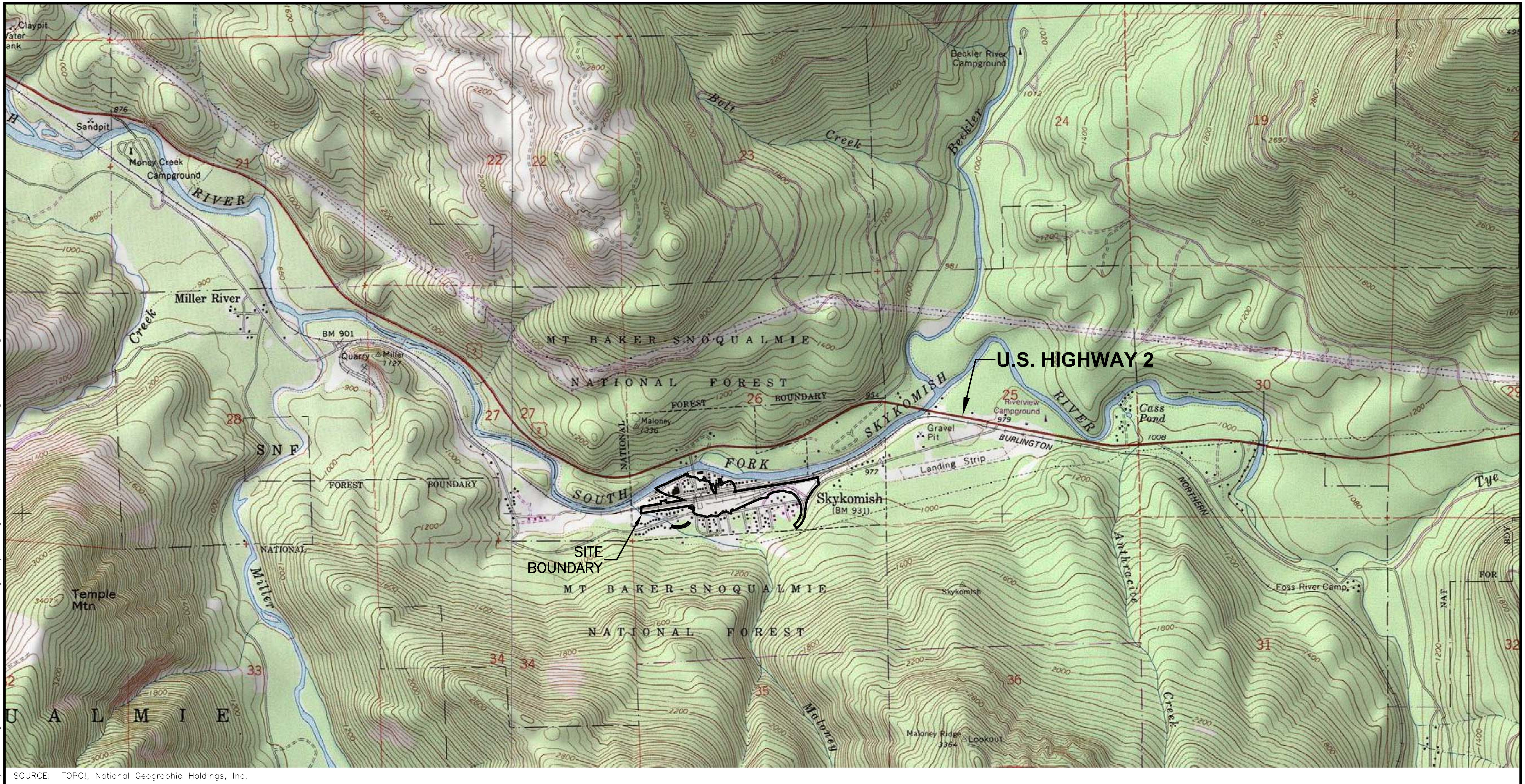
	No Action	SW1	SW2	SW3	SW4	PB1	PB2	PB3	PB4	STD
Protectiveness	2	4	4	7	10	5	7	10	10	10
Permanence	0	3	3	6	7	5	6	7	8	10
Effectiveness over the long-term	5	9	10	9	9	9	9	10	9	8
Management of Short-Term Risks	10	7	7	4	3	5	4	3	2	0
Technical and Administrative Implementability	8	6	6	4	3	6	5	4	3	3
Total Benefit	25	29	30	30	32	30	31	34	32	31

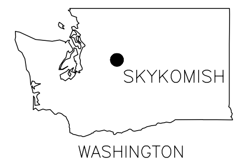
Notes: 1. Ratings are based on a point system where a maximum score of 10 is possible for each benefit evaluation category.

2. For protectiveness, human health is protected from direct contact if: contaminated soil is contained (1 pt), surface soil is excavated (1 pt) or shallow smear zone is excavated in the NW Zone (1 pt). Human health is protected from ingestion of groundwater if: free product is excavated in the NW Developed Zone(1 pt), and groundwater is not consumed (1 pt). The environment is protected if: sediment is removed from the Levee (1 pt), sediment is removed from the former Maloney Creek (1 pt), there is active groundwater remediation at the levee (1 pt), there is active groundwater remediation in the former Maloney Creek (1 pt), or if free product is removed from the levee (1 pt).

3. Permanence was calculated by calculating equivalent soil volume as described in Section 7.1.2.1 and normalizing to a scale of 10.
4. Effectiveness over the long-term was calculated by dividing the equivalent soil volume for each technology by it's place in the hierarchy given in Section 8.2.4, summing up these numbers by remedial alternative, then dividing by the total equivalent soil volume to be treated, and normalizing to a scale of 10.
5. Management of short term risks was calculated as 10 minus Permanence score.

6. Technical implementability is calculated as (10 minus Permanence)/2 (up to 5 points), Administrative implementability is scored as follows starting with a score of 5 pts: soil institutional controls (-1 pt), groundwater institutional controls (-1 pt), Section 404 permit for levee (-1 pt), Section 404 permit for Maloney Creek (-1 pt).





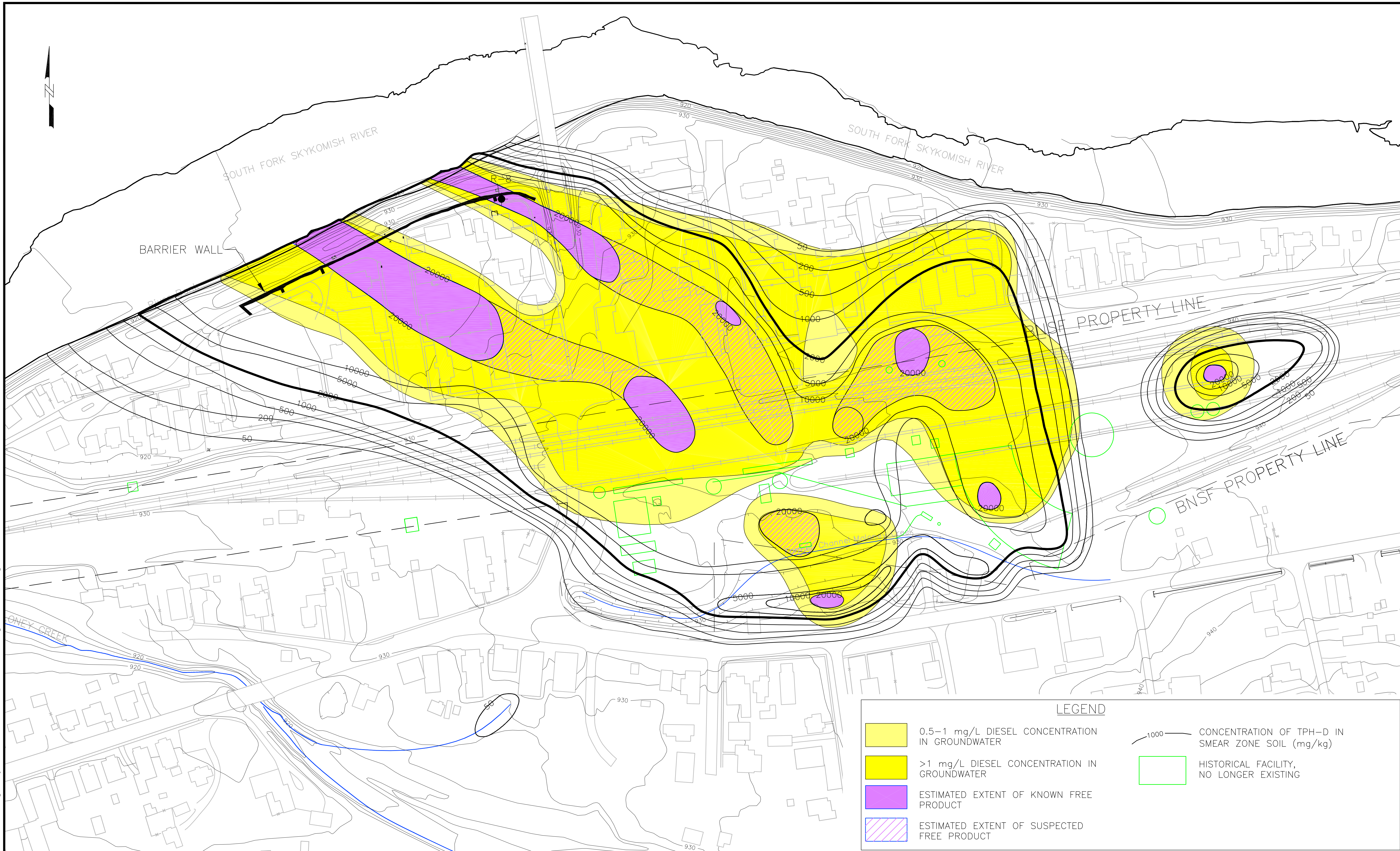
SCALE IN FEET: 1000 0 2000

RETEC

DRAFT

FS/EIS BNSF - SKYKOMISH, WASHINGTON BN050-16423-230	**REGIONAL LOCATION MAP**
DATE: 05/09/03 DRWN: CJL/FTC	**FIGURE 1-1**

File: H:\16423\SKYKOMISH from Fort Collins\skykomish figures2\FC-16423-230-1-1.dwg Layout: Figure 1-1 User: astenberg Plotted: Aug 26, 2003 - 5:19pm Xref's:



LEGEND

- 0.5–1 mg/L DIESEL CONCENTRATION IN GROUNDWATER
- >1 mg/L DIESEL CONCENTRATION IN GROUNDWATER
- ESTIMATED EXTENT OF KNOWN FREE PRODUCT
- ESTIMATED EXTENT OF SUSPECTED FREE PRODUCT
- 1000 — CONCENTRATION OF TPH–D IN SMEAR ZONE SOIL (mg/kg)
- HISTORICAL FACILITY, NO LONGER EXISTING

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BNSF - SKYKOMISH, WASHINGTON

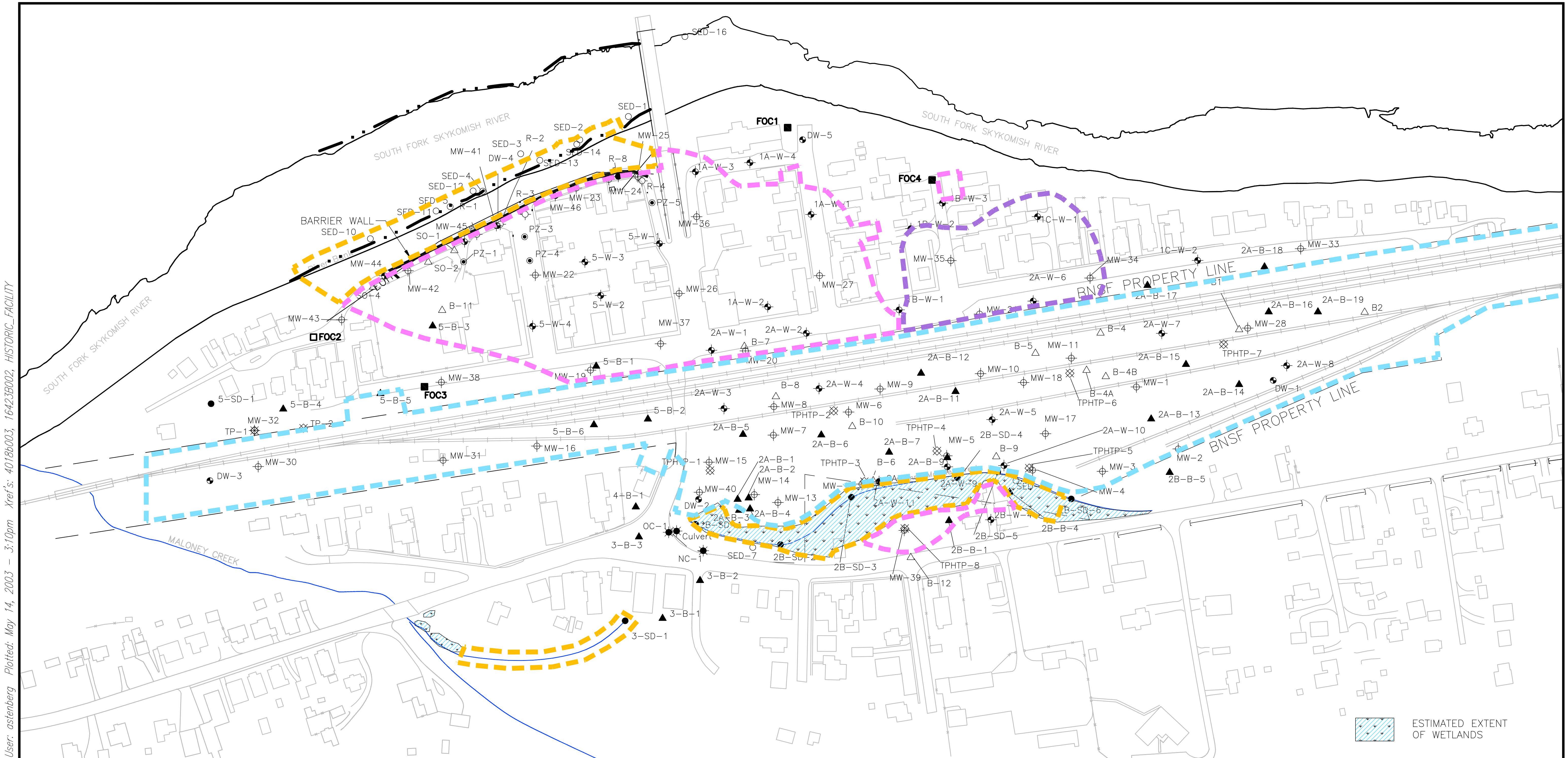
BN050-16423-250

DATE: 08/20/03 DRWN: A.S./SEA

EXTENT OF TPH THROUGHOUT SITE

FIGURE

File: H:\16423\16423S166.dwg Layout: ANSI_BI-LJ User: astenberg Plotted: Aug 20, 2003 - 9:48am Xref's: 4018b003, 16423B002, HISTORIC_FACILITY



SITE CLEANUP ZONES

AQUATIC RESOURCE ZONES – SKYKOMISH RIVER AND LEVEE & FORMER MALONEY CREEK

NE DEVELOPED ZONE

NW & SOUTH DEVELOPED ZONES

RAILYARD

100 0 200
SCALE IN FEET

RETEC

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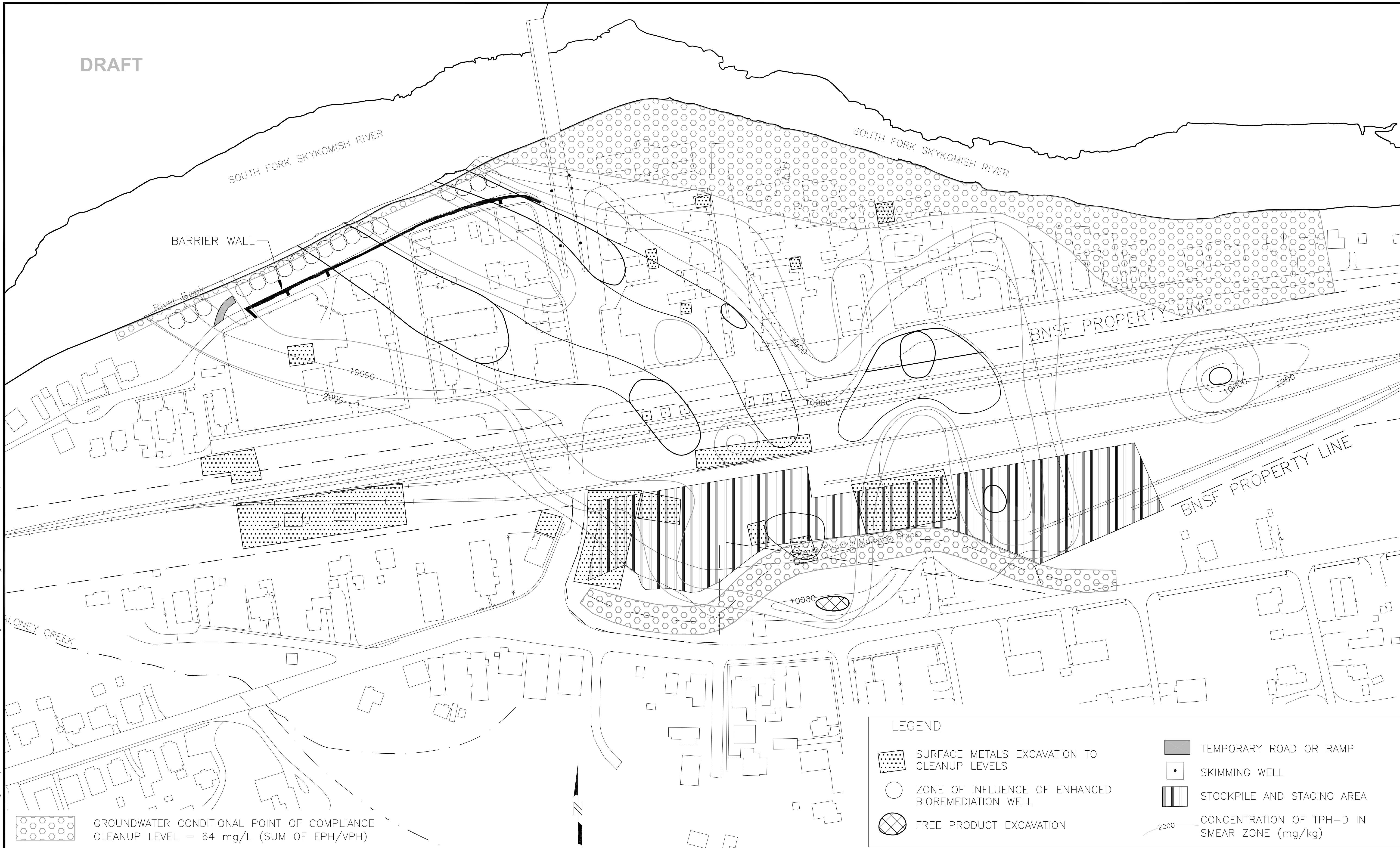
BNSF - SKYKOMISH, WASHINGTON
BN050-16423-510

DATE: 05/14/03 DRWN: A.S./SEA

SITE CLEANUP ZONES

FIGURE 6-1



LEGEND

- SURFACE METALS EXCAVATION TO CLEANUP LEVELS
- ZONE OF INFLUENCE OF ENHANCED BIOREMEDIATION WELL
- FREE PRODUCT EXCAVATION
- TEMPORARY ROAD OR RAMP
- SKIMMING WELL
- STOCKPILE AND STAGING AREA
- 2000 CONCENTRATION OF TPH-D IN SMEAR ZONE (mg/kg)

GROUNDWATER CONDITIONAL POINT OF COMPLIANCE CLEANUP LEVEL = 64 mg/L (SUM OF EPH/VPH)

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BN050-16423-222

SITE-WIDE REMEDIAL ALTERNATIVE
SW1 LAYOUT

DATE: 08/08/03 | DRWN: A.S./SEA

FIGURE 6-25

File: H:\16423\16423S053.dwg Layout: ANSI_BI-LJ User: astenberg Plotted: Aug 13, 2003 - 5:23pm Xref's: 4018b003, GW-CONDIONAL-POINT-COMPLIANCE

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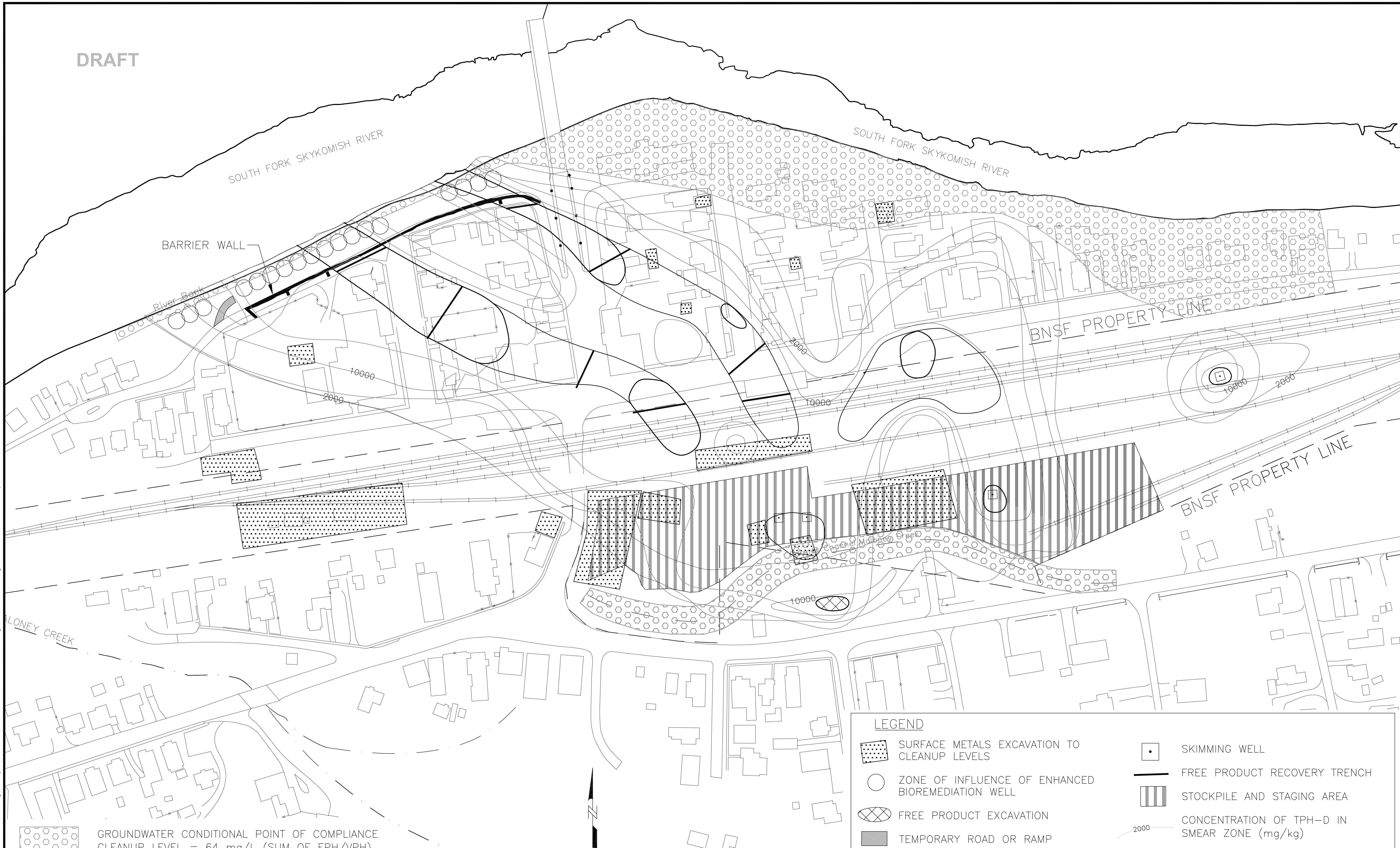

LEGEND

- SURFACE METALS EXCAVATION TO CLEANUP LEVELS
- ZONE OF INFLUENCE OF ENHANCED BIOREMEDIATION WELL
- FREE PRODUCT EXCAVATION
- TEMPORARY ROAD OR RAMP
- SKIMMING WELL
- FREE PRODUCT RECOVERY TRENCH
- STOCKPILE AND STAGING AREA
- 2000 CONCENTRATION OF TPH-D IN SMEAR ZONE (mg/kg)

GROUNDWATER CONDITIONAL POINT OF COMPLIANCE CLEANUP LEVEL = 64 mg/L (SUM OF EPH/VPH)

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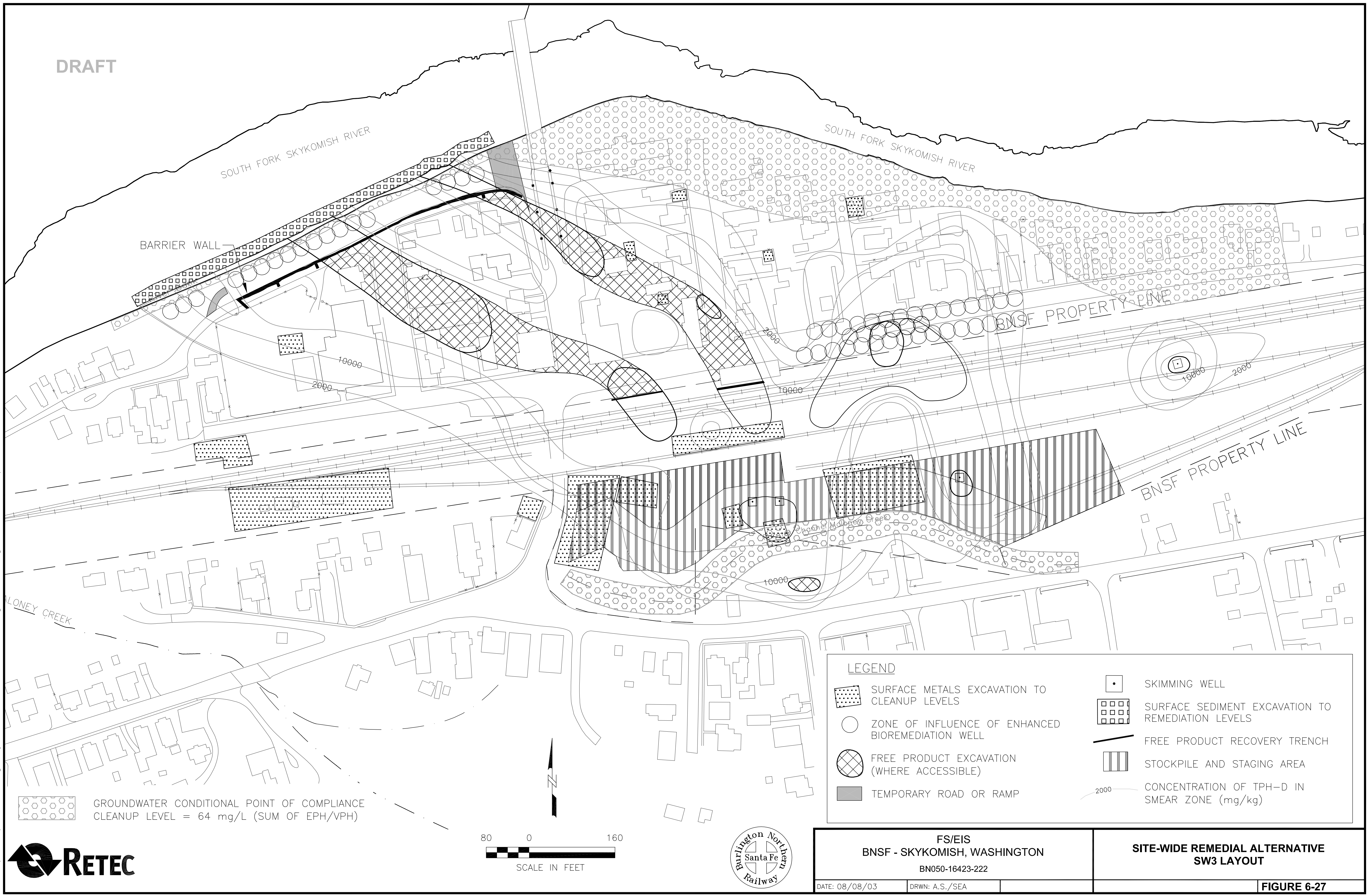
BNSF - SKYKOMISH, WASHINGTON
BN050-16423-222

DATE: 08/08/03 DRWN: A.S./SEA

SITE-WIDE REMEDIAL ALTERNATIVE SW2 LAYOUT

FIGURE 6-26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DRAFT
SOUTH FORK SKYKOMISH RIVER
SOUTH FORK SKYKOMISH RIVER
BARRIER WALL
BNSF PROPERTY LINE
BNSF PROPERTY LINE
MALONEY CREEK
10000
2000
LEGEND
SURFACE METALS EXCAVATION TO CLEANUP LEVELS
ZONE OF INFLUENCE OF ENHANCED BIOREMEDIATION WELL
FREE PRODUCT EXCAVATION (WHERE ACCESSIBLE)
TEMPORARY ROAD OR RAMP
SKIMMING WELL
SURFACE SEDIMENT EXCAVATION TO REMEDIATION LEVELS
FREE PRODUCT RECOVERY TRENCH
STOCKPILE AND STAGING AREA
CONCENTRATION OF TPH-D IN SMEAR ZONE (mg/kg)
GROUNDWATER CONDITIONAL POINT OF COMPLIANCE CLEANUP LEVEL = 64 mg/L (SUM OF EPH/VPH)
80 0 160
SCALE IN FEET
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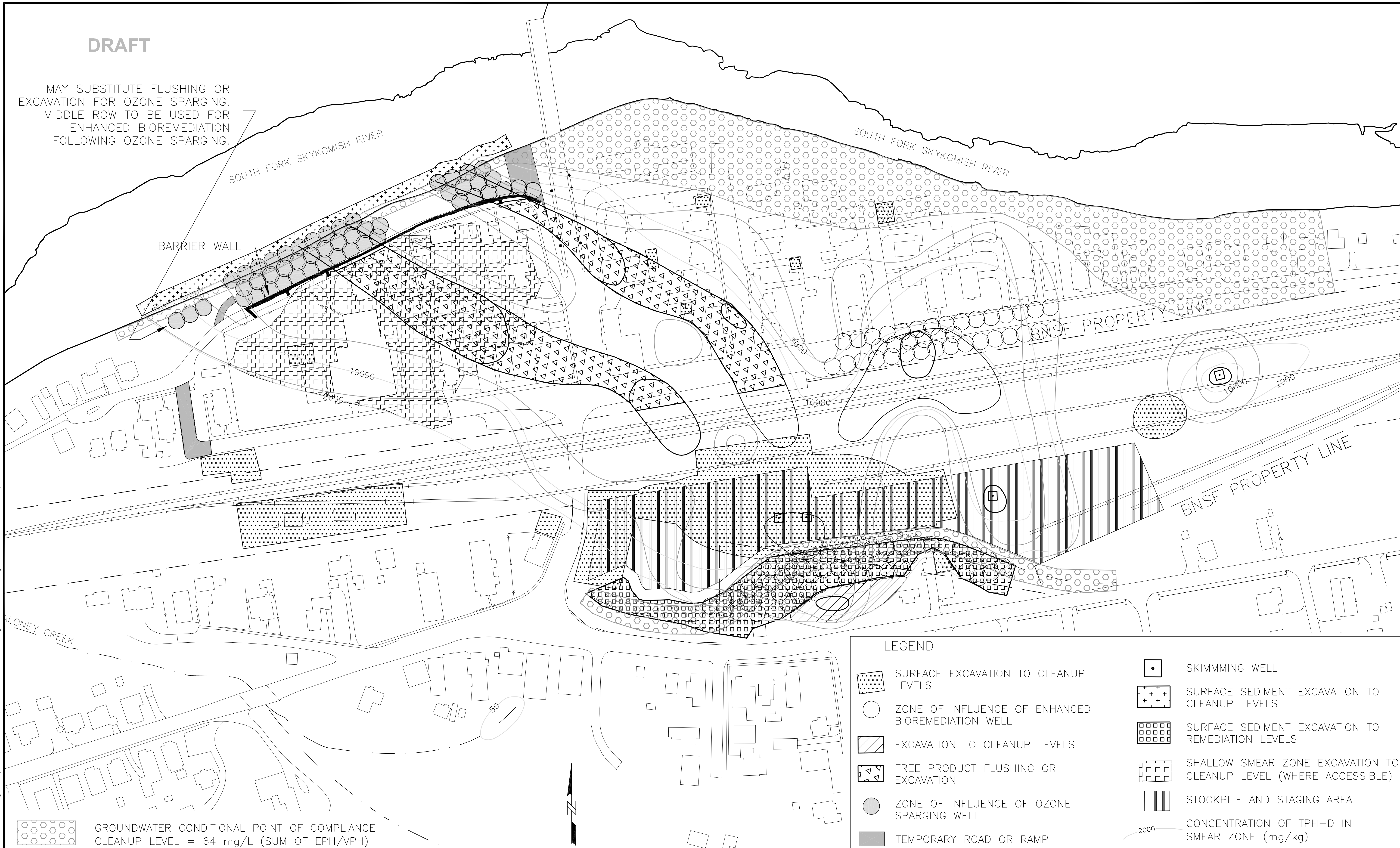
BNSF - SKYKOMISH, WASHINGTON
BN050-16423-222
DATE: 08/08/03
DRWN: A.S./SEA
SITE-WIDE REMEDIAL ALTERNATIVE SW3 LAYOUT
FIGURE 6-27

File: H:\16423\16423S055.dwg Layout: ANSI_BI-LJ User: astenberg Plotted: Aug 27, 2003 - 5:09pm Xref's: 4018b003, GW-CONDIONAL-POINT-COMPLIANCE



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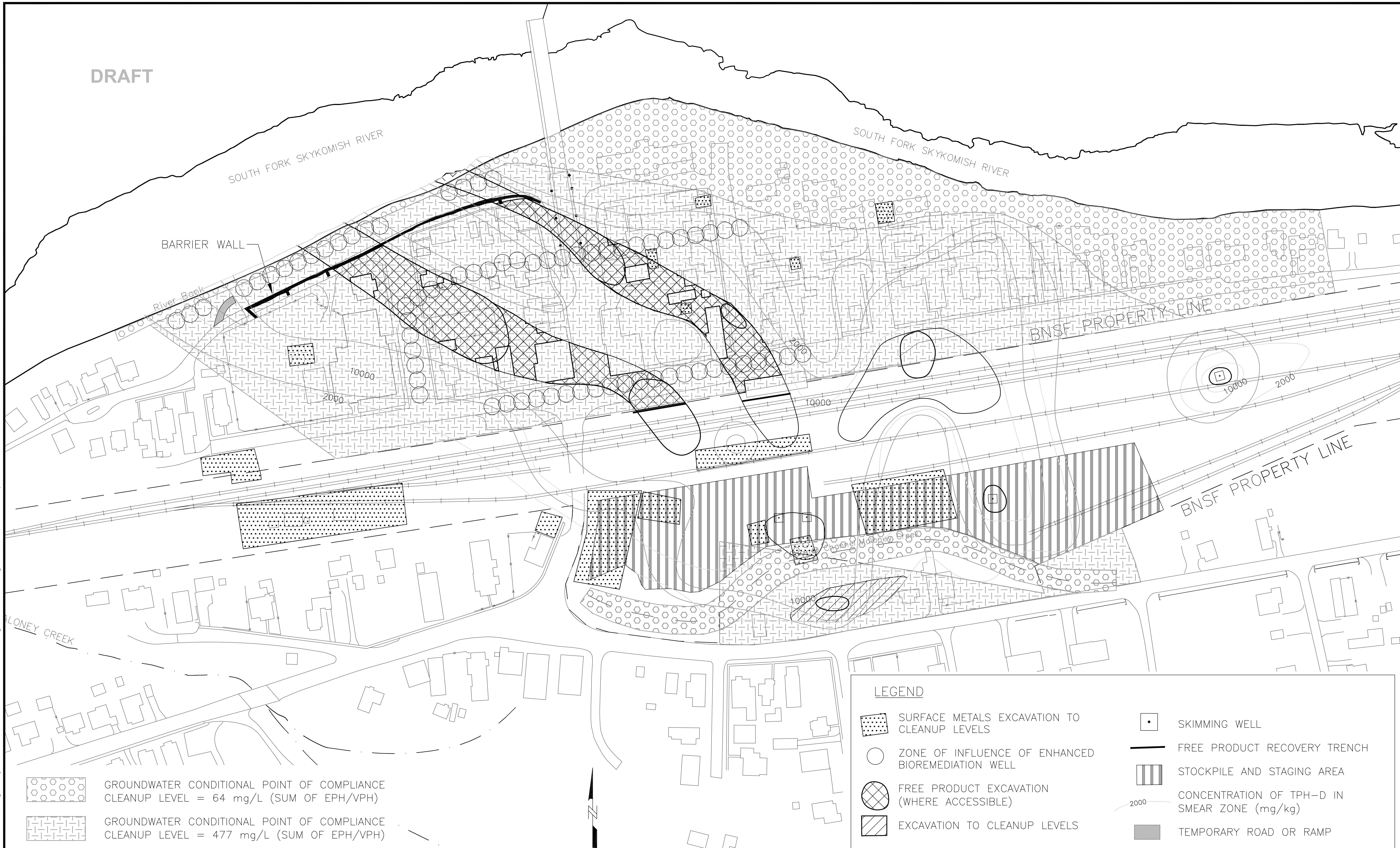
BN050-16423-222

DATE: 08/08/03 DRWN: A.S./SEA

SITE-WIDE REMEDIAL ALTERNATIVE SW4 LAYOUT

FIGURE 6-28



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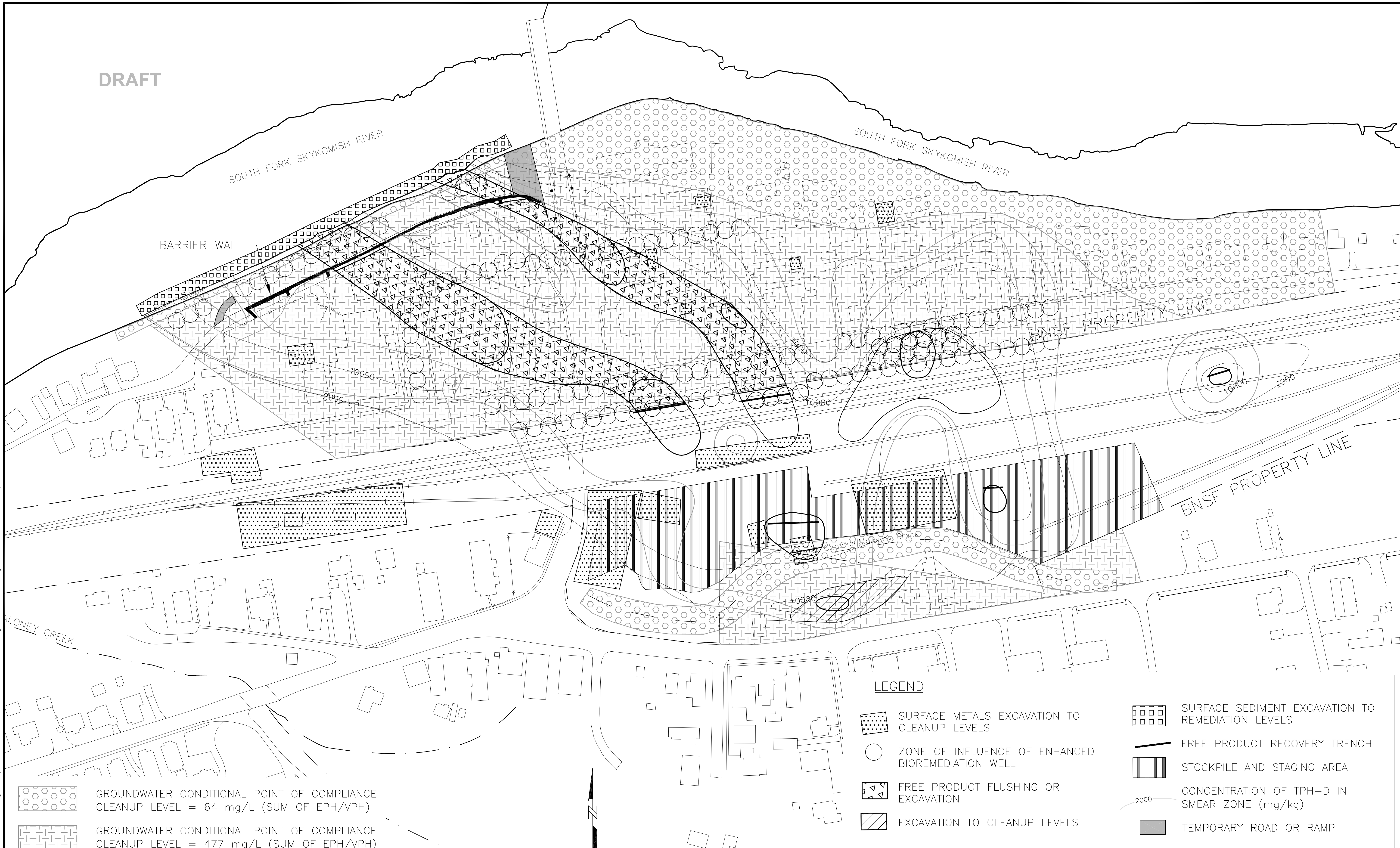
RETEC

FS/EIS BNSF - SKYKOMISH, WASHINGTON BN050-16423-222	SITE WIDE REMEDIAL ALTERNATIVE PB1 LAYOUT
DATE: 08/08/03 DRWN: A.S./SEA	FIGURE 6-29



LEGEND

- SURFACE METALS EXCAVATION TO CLEANUP LEVELS
- ZONE OF INFLUENCE OF ENHANCED BIOREMEDIATION WELL
- FREE PRODUCT FLUSHING OR EXCAVATION
- EXCAVATION TO CLEANUP LEVELS
- SURFACE SEDIMENT EXCAVATION TO REMEDIATION LEVELS
- FREE PRODUCT RECOVERY TRENCH
- STOCKPILE AND STAGING AREA
- 2000 CONCENTRATION OF TPH-D IN SMEAR ZONE (mg/kg)
- TEMPORARY ROAD OR RAMP

GROUNDWATER CONDITIONAL POINT OF COMPLIANCE CLEANUP LEVEL = 64 mg/L (SUM OF EPH/VPH)

GROUNDWATER CONDITIONAL POINT OF COMPLIANCE CLEANUP LEVEL = 477 mg/L (SUM OF EPH/VPH)

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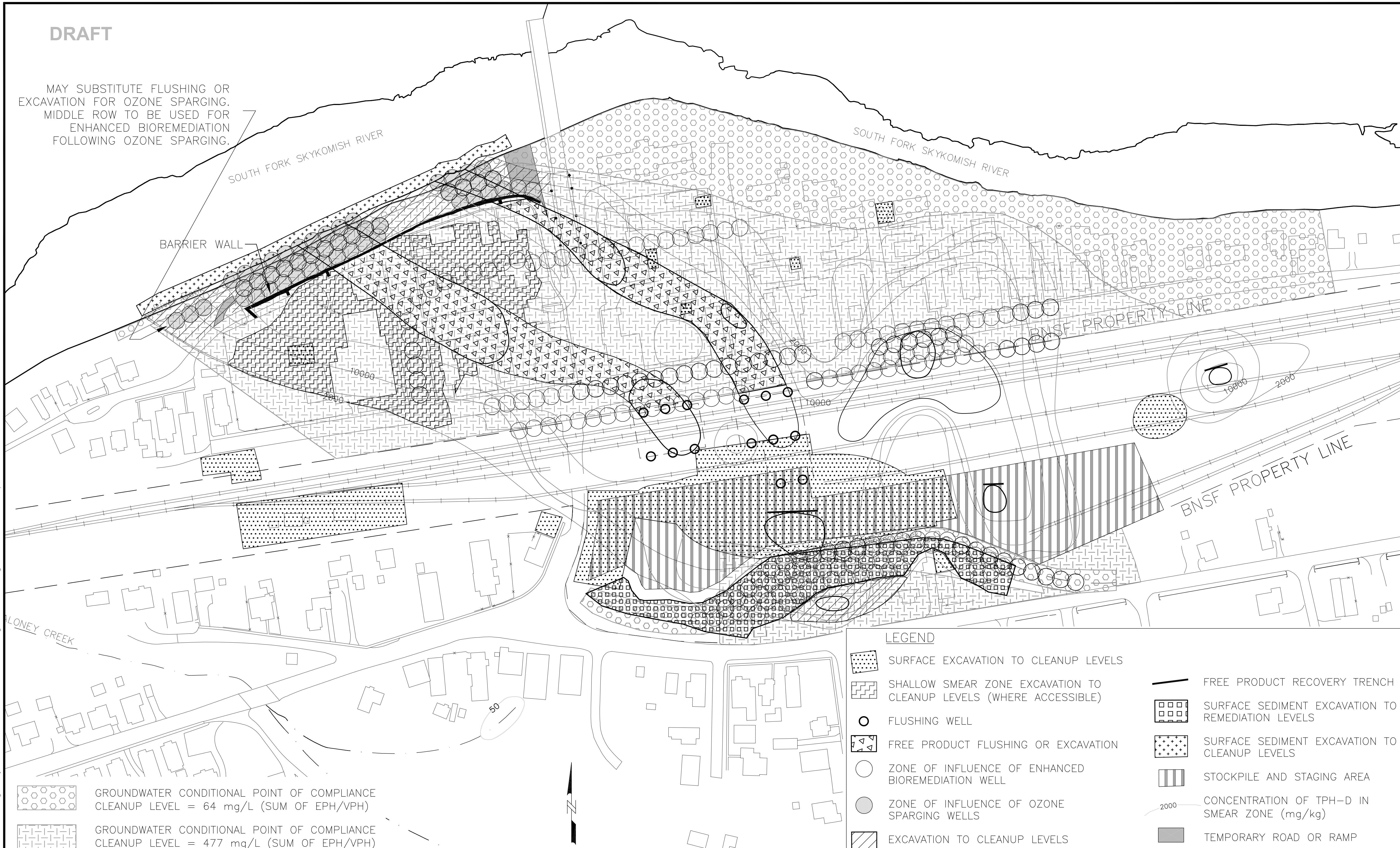
BN050-16423-222

DATE: 08/08/03 DRWN: A.S./SEA

SITE-WIDE REMEDIAL ALTERNATIVE PB2 LAYOUT

FIGURE 6-30

File: H:\16423\16423S040.dwg Layout: ANSI_BI-LJ User: astenberg Plotted: Aug 27, 2003 - 5:08pm Xref's: 4018b003, GW-CONDIONAL-POINT-COMPLIANCE



GROUNDWATER CONDITIONAL POINT OF COMPLIANCE CLEANUP LEVEL = 64 mg/L (SUM OF EPH/VPH)

GROUNDWATER CONDITIONAL POINT OF COMPLIANCE CLEANUP LEVEL = 477 mg/L (SUM OF EPH/VPH)

LEGEND

- SURFACE EXCAVATION TO CLEANUP LEVELS
- SHALLOW SMEAR ZONE EXCAVATION TO CLEANUP LEVELS (WHERE ACCESSIBLE)
- FLUSHING WELL
- FREE PRODUCT FLUSHING OR EXCAVATION
- ZONE OF INFLUENCE OF ENHANCED BIOREMEDIATION WELL
- ZONE OF INFLUENCE OF OZONE SPARGING WELLS
- EXCAVATION TO CLEANUP LEVELS
- FREE PRODUCT RECOVERY TRENCH
- SURFACE SEDIMENT EXCAVATION TO REMEDIATION LEVELS
- SURFACE SEDIMENT EXCAVATION TO CLEANUP LEVELS
- STOCKPILE AND STAGING AREA
- 2000 CONCENTRATION OF TPH-D IN SMEAR ZONE (mg/kg)
- TEMPORARY ROAD OR RAMP

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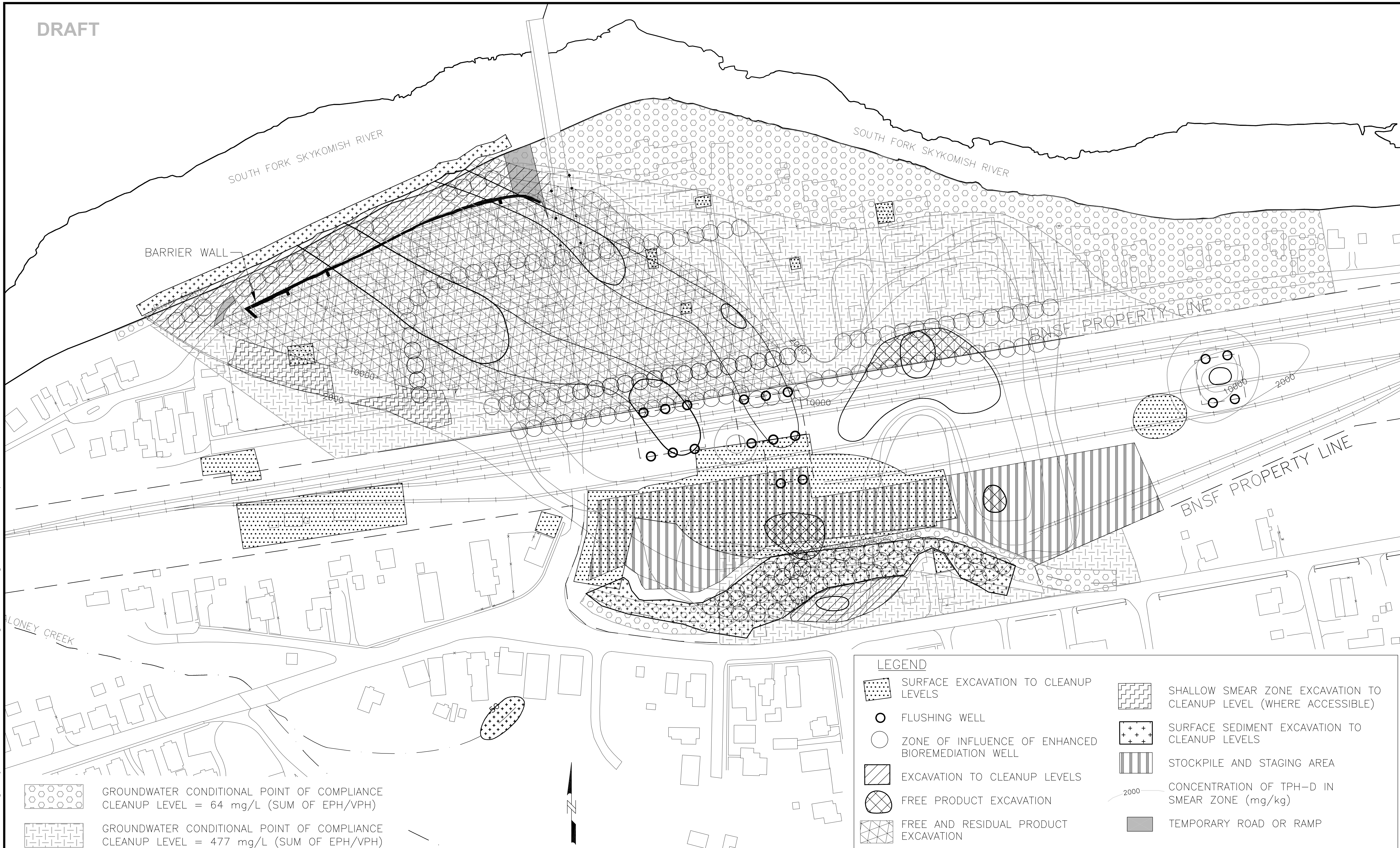
FS/EIS BNSF - SKYKOMISH, WASHINGTON BN050-16423-222	SITE-WIDE REMEDIAL ALTERNATIVE PB3 LAYOUT
DATE: 08/08/03 DRWN: A.S./SEA	FIGURE 6-31



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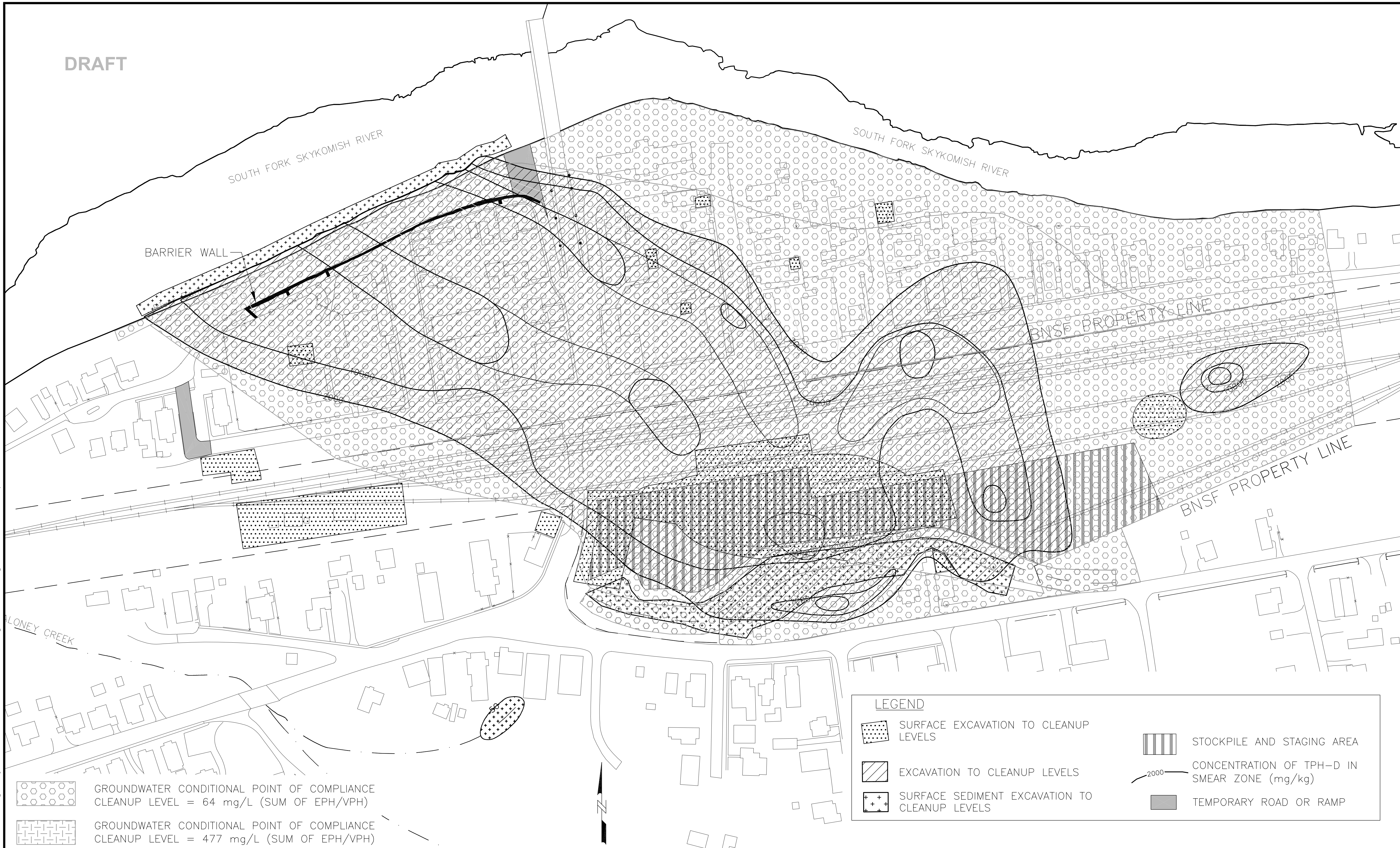
DATE: 08/08/03 DRWN: A.S./SEA

SITE-WIDE REMEDIAL ALTERNATIVE PB4 LAYOUT

FIGURE 6-32



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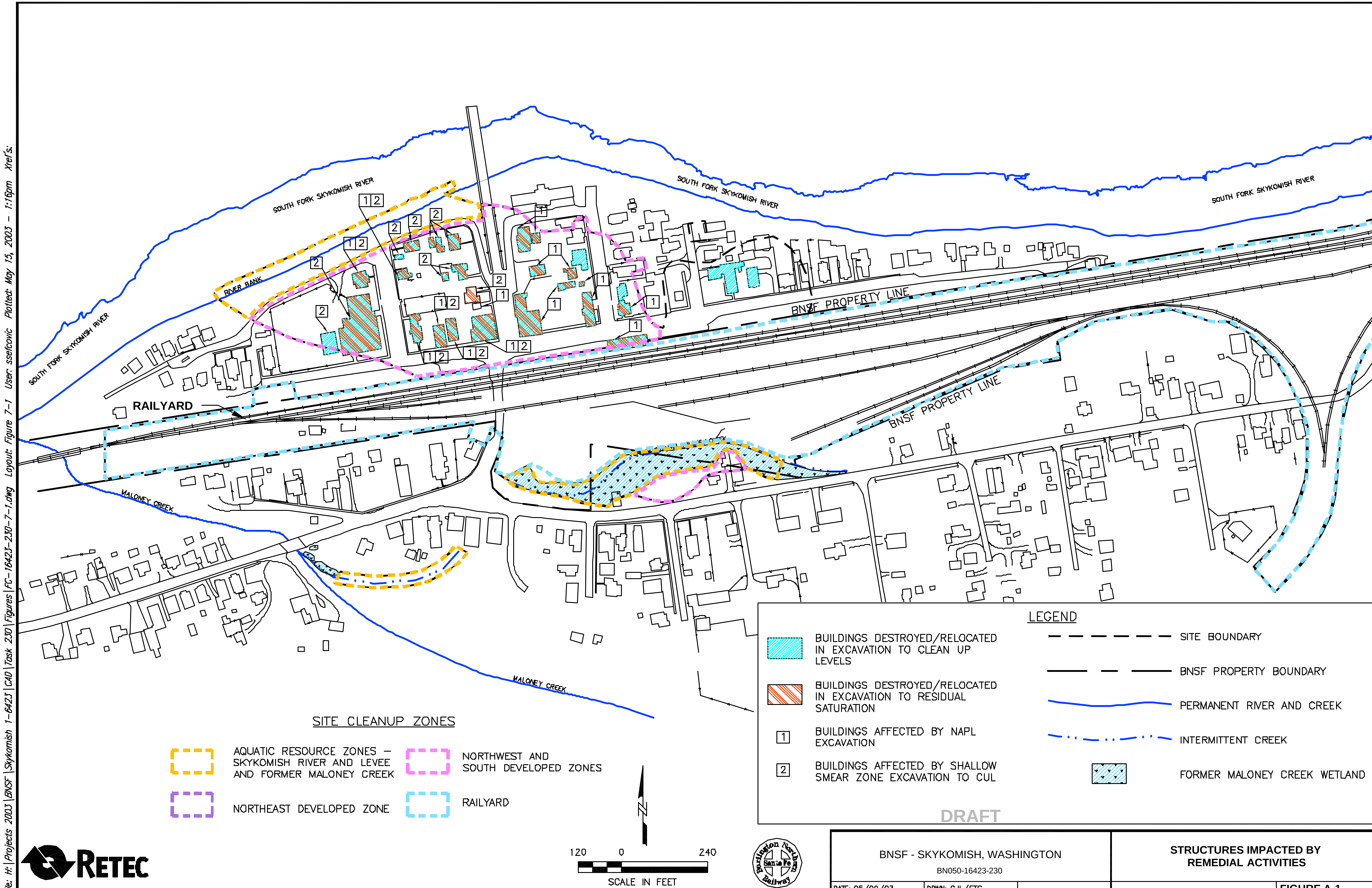
DATE: 08/08/03 | DRWN: A.S./SEA

SITE-WIDE REMEDIAL ALTERNATIVE STD LAYOUT

FIGURE 6-33

File: H:\16423\16423S042.dwg Layout: ANSI_BI-LJ User: astenberg Plotted: Aug 27, 2003 - 5:06pm Xref's: 4018b003


File: H:\Projects 2003\BNSF\Skykomish 1-6423\CAD\Task 230\Figures\FC-16423-230-7-1.dwg Layout: Figure 7-1 User: ssefcovic Plotted: May 15, 2003 - 1:16pm Xref's:
SOUTH FORK SKYKOMISH RIVER
SOUTH FORK SKYKOMISH RIVER
SOUTH FORK SKYKOMISH RIVER
SOUTH FORK SKYKOMISH RIVER
RIVER BANK
RAILYARD
BNSF PROPERTY LINE
BNSF PROPERTY LINE
MALONEY CREEK
MALONEY CREEK
SITE CLEANUP ZONES
AQUATIC RESOURCE ZONES – SKYKOMISH RIVER AND LEVEE AND FORMER MALONEY CREEK
NORTHWEST AND SOUTH DEVELOPED ZONES
NORTHEAST DEVELOPED ZONE
RAILYARD
LEGEND
BUILDINGS DESTROYED/RELOCATED IN EXCAVATION TO CLEAN UP LEVELS
BUILDINGS DESTROYED/RELOCATED IN EXCAVATION TO RESIDUAL SATURATION
1 BUILDINGS AFFECTED BY NAPL EXCAVATION
2 BUILDINGS AFFECTED BY SHALLOW SMEAR ZONE EXCAVATION TO CUL
SITE BOUNDARY
BNSF PROPERTY BOUNDARY
PERMANENT RIVER AND CREEK
INTERMITTENT CREEK
FORMER MALONEY CREEK WETLAND
DRAFT
N
120 0 240
SCALE IN FEET
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Burlington Northern Santa Fe Railway
BNSF - SKYKOMISH, WASHINGTON
BN050-16423-230
DATE: 05/09/03
DRWN: CJL/FTC
STRUCTURES IMPACTED BY REMEDIAL ACTIVITIES
FIGURE A-1

Table A-1   Results of Scoping: Potential Significant Adverse Impacts

	SEPA Scoping Element	Issue addressed under MTCA	Issue identified in Determination of Significance	Significant Adverse Impacts	Section Discussed	Comments
Natural Environment						
Earth						
Geology	YES	YES		NO		Introduced in Section 2.2.1 but no impact expected
Soils	YES	YES	YES	YES	7.2.1	
Topography	YES	YES		YES	7.2.1	
Unique Physical Features	YES	NO		NO		No unique physical feature identified
Erosion/Enlargement	YES	NO		NO		No impacts to steep or undeveloped areas
Air						
Air Quality	YES	YES	YES	YES	7.2.2	
Odor	YES	NO	YES	YES	7.2.2	Discussed jointly with Air Quality
Climate	YES	YES		NO		No impacts expected
Water						
Surface Water Quality/Quantity/Movement	YES	YES	YES	YES	7.2.4	
Runoff/Absorption	YES	YES		YES	7.2.4	
Floods	YES	YES		YES	7.2.4	
Ground Water	YES	YES	YES	YES	7.2.3	
Public Water Supplies	YES	YES		NO		Introduced in Section 2.2.3 but no impact expected
Sediments	NO	NO	YES	YES	7.2.6	
Plants and Animals						
Habitat and Diversity of Plants/Wildlife	YES	YES	NO	YES	7.2.6	
Fish or Wildlife Migration	YES	YES	YES	YES	7.2.6	
Energy and Natural Resources						
Amount required/rate of use/efficiency	YES	NO		NO		No energy concerns anticipated
Source/availability	YES	NO		NO		No energy concerns anticipated
Nonrenewable resources	YES	NO		NO		No energy concerns anticipated
Conservation	YES	NO		NO		No resource concerns anticipated
Scenic Resources	YES	NO		YES	7.2.5	Discussed as "Aesthetics"

Table A-1 Results of Scoping: Potential Significant Adverse Impacts

	SEPA Scoping Element	Issue addressed under MTCA	Issue identified in Determination of Significance	Significant Adverse Impacts	Section Discussed	Comments
Built Environment						
Environmental Health						
Noise	YES	NO	YES	YES	7.2.7	
Risk of Explosion	YES	YES		NO		
Releases to the Environment	YES	YES	YES	YES	7.2.7	Includes Exposure to Hazardous Substances from the D.S.
Vibrations	NO	NO	YES	YES	7.2.7	Discussed jointly with Noise
Land and Shoreline Use						
Relationship to Land Use Plans	YES	YES		YES	7.2.4	
Housing and Businesses	YES	NO	YES	YES	7.2.4	
Light and Glare	YES	NO		NO		No permanent changes in lighting and little night work
Aesthetics	YES	NO	YES	YES	7.2.5	
Agricultural Crops	YES	NO		NO		No agriculture in this area
Transportation						
Transportation Systems	YES	NO	YES	NO		No changes
Vehicular Traffic	YES	NO		YES	7.2.8	Covers transportation systems
Waterborne, rail, and air traffic	YES	NO		NO		Only minimal rail traffic impact
Parking	YES	NO		NO		No issues
Movement of People and Goods	YES	NO		NO		No issues
Traffic Hazards	YES	NO		NO		Not expected to be a local issue
Public Services and Utilities						
Fire	YES	NO		NO		No effect
Police	YES	NO		NO		No effect
Schools	YES	NO	YES	YES	7.2.8	Discussed as needed in noise, land use, and traffic
Parks and Recreation	YES	NO		NO		No parks or recreation in or near site
Maintenance	YES	NO		NO		No impact expected
Communications	YES	NO		NO		No impact expected
Water/Storm Water	YES	NO	YES	YES	7.2.4	Covers "Natural Resources" from D.S. Discussed under Runoff/ Infiltration
Sewer/Solid Waste	YES	NO	YES	YES	7.2.8	
Other Government Services	YES	NO		NO		No impacts expected

Table A-3 Definitions of "Adverse Impacts"

	Basis for Definition	Minor or temporary impact (+)	Moderate Impact (++)	Major Impact (+++)
Natural Environment				
Earth				
E1 Soil	Short-term removal of valuable topsoil (long-term soil conditions will improve as a result of cleanup	Temporary loss of small volumes of topsoil	Temporary loss of garden or public landscaping soil	Loss of large volumes of cultivated or garden topsoil
E2 Topography	Temporary or permanent changes in topography	Temporary presence of storage piles	Some regrading of existing contours	Major changes in contours
E3 Sediment	Changes in ecologically relevant sediment resource	Disturbances or minor loss of existing sediment, replaced naturally	Loss of existing sediment resource, replaced naturally	Loss of existing resource, including valuable benthic habitat
Air Quality				
A1 Emissions	Increase in emissions which may be detrimental to human health or safety, injure plants or animals.	Short-term increase in emissions below ambient source impact levels.	Quantifiable increases in toxic or criteria pollutants with potential health risk	Significant deterioration of ambient air quality with potential for human, plant, or animal health effects
A2 Vapor Intrusion	Increases in ambient or indoor VOCs to potentially hazardous levels	Short-term increase in VOC vapors as a result of excavations	Longer-term increase in VOC vapors, with potential for health risk	Clear potential for release of harmful amounts of VOC vapors
A3 Odors	Noxious hydrocarbon odors (professional judgement)	Minor or short-term nuisance odors	Longer-term hydrocarbon odors	Permanent odor nuisance created
Groundwater				
G1 Quantity	Removals of groundwater, or blockage to natural flow (professional judgement)	Temporary removal of small volumes for treatment	Changes in future flow patterns of impacted groundwater	Reduced volumes of groundwater used for a beneficial use
G2 Quality	Short term decline in quality (long term there is improvement due to cleanup)	Minor and temporary degradation possible due to treatment chemicals	Major degradation of impacted groundwater possible	Degradation of unimpacted groundwater possible
Surface Water				
S1 Hydrology	Changes in natural flows (professional judgement)	Minor construction in watercourses, no restriction of flow	Construction in watercourses, minor restrictions of flow	Reductions in water flow, water allocation, or navigabiltiy
S2 Floods	Likelihood and severity of flooding events (professional judgement)	Minor flooding during storm events possible	Temporary increased potental for unlikely yet catastrophic flooding	Permanent increase in flooding potential in urban areas
S3 Runoff/Infiltration	Changes in stormwater management	Temporary blockage or interruption in stormwater runoff	Temporary blockage of stormwater system requiring diversions or bypasses	Permanent loss of stormwater drainage, potentially leading to flooding
S4 Quality	Short term decline in quality (long term there is improvement due to cleanup)	Minor impacts due to construction activities (silting)	Potential violation of non-degradation statutes	Loss of attainable use
Fish and Wildlife				
N1 Habitat, Wetland and Wildlife	Loss of habitat (wetlands, upland natural areas, developed residential and industrial lands)	Temporary loss of developed residential and industrial habitats	Short-term loss of wetlands and wetland values; temporary loss of wildlife use	Long-term loss of wetlands and wetland values, including wildlife use
N2 Aquatic Resources	Loss of salmonid habitat	Temporary loss of salmonid habitat	Minor loss of salmonid habitat; temporary loss of access to salmonid habitat	Permanent or long-term loss of salmonid habitat
Built Environment				
Land Use				
L1 Zoning and Land Use	Changes in current zoning; or institutional control affecting full property use	Institutional control affecting excavation rights; temporary loss of access to public areas	Changes in zoning required; Critical Areas affected	Loss of valuable land use
L2 Housing and Demographics	Housing units temproarily or permanently unusable	Restriction in access to existing housing;	Major excavation around existing structures	Demolition of existing housing units
L3 Aesthetics and Historical Structures	Changes in town character (professional judgement)	Nuisance in developed or natural areas due to construction	Destruction (temporary) of structures and landscaping; temporary change in overall town character	Destruction of historical structures; permanent change in town character
Environmental Health				
H1 Noise and Vibrations	dBA levels and time of day	< 45 dBA and any level of noise or vibrations during daytime hours	> 60 dBA and any vibrations during working hours	>45 dBA or any vibrations during nighttime hours
H2 Hazardous Substances	Hazardous substrances in hazardous amounts (Professional Judgement)	Small potential for release or exposure to hazardous subsances	Increased probability of accidental exposure to hazardous chemicals in hazardous amounts	Widespread or likely exposure to hazardous chemicals in hazardous amounts
Transportation and Services				
T1 Roads and Transportation Systems	Train traffic and roads	Road closure up to a month; a train per week added	Road closure lasting less than 2 months; up to 2 trains per week for up to 2 months	Construction of major access roads; permanent closure of roads; more than 2 trains per week for more than 2 months
T2 Traffic [4]	Increase in Highway 2 traffic	Up to 24 trucks per day (2-3 trucks/hour) or increased traffic lasting less than 1 week	Up to 48 trucks per day (1 every 10 minutes) or increased traffic lasting less than 2 months	Over 48 trucks per day or increased traffic lasting more than 2 months
T3 Public Services	Interruption in utilities or services	Nuisances due to closures of roads, interruptions in leachfield use	Some interruptions in services; effects on leachfields	Excavation activities resulting in major interruptions in utility services

Comments
[1] Top value represents long-term
[2] Emissions and vapor intrusion are not significant under current conditions
[3]Compensatory wetland mitigation
[4] Traffic impacts assume that removed material will be hauled via U.S. 2 to either Everett or beyond. Use of trains to transport removed material would reduce impacts.

Table A-2 Summary of Impact Analysis

	No Action Alternative (site-wide[5])	SW1						SW2						SW3						SW4					
Legend: **+ = minor or temporary adverse impacts** **++ =moderate adverse impacts** **+++ = major adverse impacts** **0 = no impact or inapplicable**		**Levee and River Sediments**	**Former Maloney Creek Channel**	**NE Developed Zone**	**NW Developed Zone**	**South Developed Zone**	**Railyard**	**Levee and River Sediments**	**Former Maloney Creek Channel**	**NE Developed Zone**	**NW Developed Zone**	**South Developed Zone**	**Railyard**	**Levee and River Sediments**	**Former Maloney Creek Channel**	**NE Developed Zone**	**NW Developed Zone**	**South Developed Zone**	**Railyard**	**Levee and River Sediments**	**Former Maloney Creek Channel**	**NE Developed Zone**	**NW Developed Zone**	**South Developed Zone**	**Railyard**
Comments	*These are ongoing (long-term) impacts in the absence of cleanup. Impacts for the alternatives are relative to this baseline*							*Impacts same as SW1*	*Impact same as SW1*	*Impacts same as SW1*	*Impacts similar to SW1 plus additional*	*Impacts same as SW1*	*Impacts similar to SW1*	*Impacts include SW1 plus additional*	*Impacts same as SW1*		*Impacts similar to SW1 plus additional*	*Impacts same as for SW1*	*Impacts same as for SW2*		*Impacts represent a worst-case scenario*	*Impacts same as SW3*	*Impacts similar to SW1 plus additional*		*Impacts similar to SW2 plus additional*
Natural Environment																									
Earth																									
E1 Soil	++	0[1]	0	0[1]	++[1]	+[1]	0[1]	0[1]	0	0[1]	++[1]	+[1]	0[1]	+[1]	0	0[1]	++[1]	+[1]	0[1]	0[1]	0	0[1]	+++[1]	+[1]	0[1]
E2 Topography	0	0	0	0	+	+	+	0	0	0	+	+	+	+	0	0	+	+	+	+	+	0	+	+	+
E3 Sediment	+++	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	+	++	0	0	0	0
Air Quality																									
A1 Emissions	0 [2]	0	0	0	+	+	+	0	0	0	+	+	+	+	0	0	+	+	+	+	0	0	+	+	+
A2 Vapor Intrusion	0 [2]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3 Odors	++	0	0	0	0	+	+	0	0	0	+	+	+	+	0	0	+	+	+	+	0	0	+	+	+
Groundwater																									
G1 Quantity	0	0	0	0	0	+	0	0	0	0	0	+	0	0	0	0	+	+	0	0	0	0	+	+	0
G2 Quality	+++	0[1]	0[1]	0[1]	0	+[1]	0[1]	0[1]	0[1]	0[1]	0[1]	+[1]	0[1]	0[1]	0[1]	0[1]	+1	+[1]	0[1]	+[1]	0[1]	0[1]	+[1]	+[1]	0[1]
Surface Water																									
S1 Hydrology	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	+	+	0	0	0	0
S2 Floods	0	0	0	0	.+	+	0	0	0	0	+	+	0	+	0	0	+	+	0	+	+	0	+	+	0
S3 Runoff/Infiltration	0	0	0	0	+	+	+	0	0	0	+	+	+	+	0	0	+	+	+	+	+	0	++	+	+
S4 Quality	+	0[1]	0[1]	0	0	0	0	0[1]	0[1]	0	0	0	0	+[1]	0[1]	0	0	0	0	+[1]	+[1]	0	0	0	0
Natural Environment																									
N1 Habitat, Wetland and Wildlife	0	+	0	0	+	+	+	+	0	+	+	+	+	+	0	+	+	+	+	+	+++[3]	+	+	+	+
N2 Aquatic Resources	++	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	++	++	0	0	0	0

Table A-2 Summary of Impact Analysis

Legend: + = minor or temporary adverse impacts ++ =moderate adverse impacts +++ = major adverse impacts 0 = no impact or inapplicable	No Action Alternative (site-wide[5])	SW1						SW2						SW3						SW4					
		Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard	Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard	Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard	Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard
Comments	*These are ongoing (long-term) impacts in the absence of cleanup. Impacts for the alternatives are relative to this baseline*							*Impacts same as SW1*	*Impact same as SW1*	*Impacts same as SW1*	*Impacts similar to SW1 plus additional*	*Impacts same as SW1*	*Impacts similar to SW1*	*Impacts include SW1 plus additional*	*Impacts same as SW1*		*Impacts similar to SW1 plus additional*	*Impacts same as for SW1*	*Impacts same as for SW2*		*Impacts represent a worst-case scenario*	*Impacts same as SW3*	*Impacts similar to SW1 plus additional*		*Impacts similar to SW2 plus additional*
Built Environment																									
Land Use																									
L1 Zoning and Land Use	+[6]	+[6]	+[6]	+	+	+	+[6]	+[6]	+[6]	+	+	+	+[6]	+[6]	+[6]	+	+	+	+[6]	+[6]	+[6]	+	+	0	+[6]
L2 Housing and Demographics	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	++	0	0	0	0	0	++	++	0
L3 Aesthetics and Historical Structures	+	0	0	0	+	+	0	0	0	0	++	+	0	+	0	++	++	+	0	+	+	0	+++	++	0
Environmental Health																									
H1 Noise and Vibrations	0	+	0	0	++	++	++	+	0	0	++	++	++	++	0	++	++	++	++	++	++	++	++	++	+
H2 Hazardous Substances	++	0	0	0	0	+	0	0	0	0	0	+	0	+	0	0	+	+	0	+	0	0	++	+	0
Transportation and Services																									
T1 Roads and Transportation Systems	0	0	0	0	0	0	0	0	0	0	+	0	0	++	0	+	++	0	0	++	0	+	++	+	0
T2 Traffic [4]	0	+	0	0	++	++	+	+	0	0	++	++	+	++	0	+	+++	++	+	+	+	+	+++	+++	+
T3 Public Services	0	0	0	0	+	+	0	0	0	0	+	+	0	0	0	++	++	+	0	0	0	++	+++	+	0

Comments

[1] The listed value represents short-term (construction phase) impacts. Long-term impacts, by the nature of the clean-up project, are always positive (beneficial) compared to the no action alternative.

[2] Emissions and vapor intrusion are not significant under current conditions

[3] Compensatory wetland mitigation will be provided per WDOE and Town of Skykomish CAO requirements

[4] Traffic impacts assume that removed material will be hauled via U.S. 2 to either Everett or beyond. Use of trains to transport removed material would reduce impacts.

[5] The no action alternative represents a baseline, long-term impact in the absence of cleanup. The impacts reflect site-wide impacts and are not limited to any cleanup zone. All impacts from alternatives represent a comparison relative to the no-action alternative.

[6] Institutional controls will be imposed on all zones under all alternatives (including the no action alternative) except the standard alternative. These excavation restrictions to land use are primarily of concern to private landowners in the NE, NW, and S zones, and have been assigned a "minor" classification. In the public areas and the railyard, the restriction on excavation is considered less of an impact.. This footnote has been attached to these areas.

Table A-2 Summary of Impact Analysis

Legend: + = minor or temporary adverse impacts ++ =moderate adverse impacts +++ = major adverse impacts 0 = no impact or inapplicable	PB1						PB2					
	Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard	Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard
Comments	*Impacts same as SW1*	*Impacts same as SW1*	*Impacts same as SW1*		*Impacts same as SW4*	*Impacts same as SW4*	*Impacts same as SW3*	*Impacts same as SW1*	*Impacts same as SW1*	*Impacts same as for PB1*	*Impacts same as for SW4*	
Natural Environment												
Earth												
E1 Soil	0[1]	0	0[1]	++[1]	+[1]	0[1]	+[1]	0	0[1]	++[1]	+[1]	0[1]
E2 Topography	0	0	0	+	+	+	+	0	0	+	+	+
E3 Sediment	0	0	0	0	0	0	+	0	0	0	0	0
Air Quality												
A1 Emissions	0	0	0	+	+	+	+	0	0	+	+	+
A2 Vapor Intrusion	0	0	0	0	0	0	0	0	0	0	0	0
A3 Odors	0	0	0	+	+	+	+	0	0	+	+	+
Groundwater												
G1 Quantity	0	0	0	+	+	0	0	0	0	+	+	0
G2 Quality	0[1]	0[1]	0[1]	+[1]	+[1]	0[1]	0[1]	0[1]	0[1]	+[1]	+[1]	0[1]
Surface Water												
S1 Hydrology	0	0	0	0	0	0	+	0	0	0	0	0
S2 Floods	0	0	0	+	+	0	+	0	0	+	+	0
S3 Runoff/Infiltration	0	0	0	+	+	+	+	0	0	+	+	+
S4 Quality	0[1]	0[1]	0	0	0	0	+[1]	0[1]	0	0	0	0
Natural Environment												
N1 Habitat, Wetland and Wildlife	+	0	0	+	+	+	+	0	+	+	+	+
N2 Aquatic Resources	0	0	0	0	0	0	+	0	0	0	0	0

	PB3						PB4					
	Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard	Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard
Comments	*Impacts as for SW4 plus additional*	*Impacts same as SW4*	*Impacts same as SW3*		*Impacts same as for SW4*		*Impacts represent a worst case scenario*	*Impacts represent a worst case scenario*		*Impacts similar to PB4 but more extensive*	*Impacts same as for SW4*	*Impacts similar to PB4 but more extensive*
Natural Environment												
Earth												
E1 Soil	++[1]	0	+++[1]	++[1]	+[1]	0[1]	++[1]	0	+[1]	+++[1]	+[1]	0[1]
E2 Topography	+	+	0	+	+	+	+	+	+	+	+	+
E3 Sediment	+	++	0	0	0	0	+	++	0	0	0	0
Air Quality												
A1 Emissions	+	0	0	+	+	+	+	+	+	+	+	+
A2 Vapor Intrusion	0	0	0	0	0	0	0	0	0	0	0	0
A3 Odors	+	0	0	+	+	+	+	+	+	+	+	+
Groundwater												
G1 Quantity	+	+	0	+	+	+	+	+	+	+	+	+
G2 Quality	+[1]	0[1]	0[1]	+[1]	+[1]	+[1]	+[1]	+[1]	+[1]	+[1]	+[1]	+[1]
Surface Water												
S1 Hydrology	+	+	0	0	0	0	+	+	0	0	0	0
S2 Floods	++	+	0	+	+	0	++	+	+	+	+	0
S3 Runoff/Infiltration	++	+	0	.++	+	+	++	++	+	++	+	++
S4 Quality	+[1]	+[1]	0	0	0	0	+[1]	+[1]	0	0	0	0
Natural Environment												
N1 Habitat, Wetland and Wildlife	+	+++[3]	+	+	+	+	+	+++[3]	+	+	+	+
N2 Aquatic Resources	++	++	0	0	0	0	++	+++	0	0	0	0

	STD					
	Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard
Comments	*Impacts similar to PB4 but more extensive*	*Impacts similar to PB4 but more extensive*		*Impacts similar to SW2 plus additional*	*Impacts same as for SW2 (except L1)*	
Natural Environment						
Earth						
E1 Soil	++[1]	0	++[1]	+++[1]	+[1]	0[1]
E2 Topography	+	+	+	+	+	+
E3 Sediment	+	++	0	0	0	0
Air Quality						
A1 Emissions	+	+	+	+	+	+
A2 Vapor Intrusion	0	0	0	0	0	0
A3 Odors	+	+	+	+	+	+
Groundwater						
G1 Quantity	+	+	+	+	+	+
G2 Quality	+[1]	+[1]	+[1]	+[1]	+[1]	+[1]
Surface Water						
S1 Hydrology	+	+	0	0	0	0
S2 Floods	++	+	+	+	+	0
S3 Runoff/Infiltration	++	++	++	++	+	++
S4 Quality	++[1]	+[1]	0	0	0	0
Natural Environment						
N1 Habitat, Wetland and Wildlife	+	+++[3]	+	+	+	+
N2 Aquatic Resources	++	+++	0	0	0	0

Table A-2 Summary of Impact Analysis

Legend:
+ = minor or temporary adverse impacts
++ =moderate adverse impacts
+++ = major adverse impacts
0 = no impact or inapplicable

PB1

	Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard
Comments	*Impacts same as SW1*	*Impacts same as SW1*	*Impacts same as SW1*		*Impacts same as SW4*	*Impacts same as SW4*
Built Environment						
Land Use						
L1 Zoning and Land Use	+[6]	+[6]	+	+	0	+[6]
L2 Housing and Demographics	0	0	0	++	++	0
L3 Aesthetics and Historical Structures	0	0	0	++	++	0
Environmental Health						
H1 Noise and Vibrations	+	0	0	++	++	++
H2 Hazardous Substances	0	0	0	+	+	0
Transportation and Services						
T1 Roads and Transportation Systems	0	0	0	++	+	0
T2 Traffic [4]	+	0	0	+++	++	+
T3 Public Services	0	0	0	++	+	0

PB2

	Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard
Comments	*Impacts same as SW3*	*Impacts same as SW1*	*Impacts same as SW1*	*Impacts same as for PB1*	*Impacts same as for SW4*	
Built Environment						
Land Use						
L1 Zoning and Land Use	+[6]	+[6]	+	+	0	+[6]
L2 Housing and Demographics	0	0	0	++	++	0
L3 Aesthetics and Historical Structures	+	0	++	++	++	0
Environmental Health						
H1 Noise and Vibrations	++	0	+	++	++	++
H2 Hazardous Substances	+	0	0	+	+	0
Transportation and Services						
T1 Roads and Transportation Systems	++	0	+	++	+	0
T2 Traffic [4]	++	0	+	+++	+++	+
T3 Public Services	0	0	++	++	+	0

PB3

	Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard
Comments	*Impacts as for SW4 plus additional*	*Impacts same as SW4*	*Impacts same as SW3*		*Impacts same as for SW4*	
Built Environment						
Land Use						
L1 Zoning and Land Use	+[6]	+[6]	+	+	0	+[6]
L2 Housing and Demographics	+	0	0	++	++	0
L3 Aesthetics and Historical Structures	++	+	0	++	++	+
Environmental Health						
H1 Noise and Vibrations	++	++	++	++	++	++
H2 Hazardous Substances	+	0	0	+	+	+
Transportation and Services						
T1 Roads and Transportation Systems	+++	0	+	++	+	0
T2 Traffic [4]	++	+	+	+++	+++	+
T3 Public Services	0	0	++	++	+	0

PB4

	Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard
Comments	*Impacts represent a worst case scenario*	*Impacts represent a worst case scenario*		*Impacts similar to PB4 but more extensive*	*Impacts same as for SW4*	*Impacts similar to PB4 but more extensive*
Built Environment						
Land Use						
L1 Zoning and Land Use	+[6]	+[6]	+	+	0	+[6]
L2 Housing and Demographics	+	0	+	+++	++	0
L3 Aesthetics and Historical Structures	++	+++	++	+++	++	+
Environmental Health						
H1 Noise and Vibrations	++	++	++	++	++	++
H2 Hazardous Substances	+	+	+	++	+	+
Transportation and Services						
T1 Roads and Transportation Systems	+++	0	+	+++	+	++
T2 Traffic [4]	++	+	+	+++	+++	+++
T3 Public Services	0	0	++	+++	+	++

STD

	Levee and River Sediments	Former Maloney Creek Channel	NE Developed Zone	NW Developed Zone	South Developed Zone	Railyard
Comments	*Impacts similar to PB4 but more extensive*	*Impacts similar to PB4 but more extensive*		*Impacts similar to SW2 plus additional*	*Impacts same as for SW2 (except L1)*	
Built Environment						
Land Use						
L1 Zoning and Land Use	0	0	0	0	0	0
L2 Housing and Demographics	+	0	+++	+++	++	0
L3 Aesthetics and Historical Structures	++	+++	+++	+++	++	+
Environmental Health						
H1 Noise and Vibrations	++	++	++	++	++	++
H2 Hazardous Substances	+	+	+	++	+	+
Transportation and Services						
T1 Roads and Transportation Systems	+++	++	+	+++	+	++
T2 Traffic [4]	+++	++	++	+++	+++	+++
T3 Public Services	0	0	++	+++	+	++

Table A-4 Noise Levels for Construction Phases

Phase	Typical Range of Energy Equivalent Noise Levels at Construction Sites (Leqal in dBA)							
	Domestic Housing		Office Building, Hotel, Hospital, School, Public Works		Industrial Parking Garage, Religious Amusement & Recreations, Store, Service Station		Public Works Roads & Highways, Sewers, and Trenches	
	I	II	I	II	I	II	I	II
Ground Clearing	83	83	84	84	84	83	84	84
Excavation	88	75	89	79	89	71	88	78
Foundations	81	81	78	78	77	77	88	88
Erection	81	65	87	75	84	72	79	78
Finishing	88	72	89	74	89	74	84	84

I = All pertinent equipment present at site
II =Minimum required equipment present at site
Source: USEPA, Legal Compilation on Noise, Vol. 1, p. 2-104, 1973

SEPA Scoping and Final Draft Environmental Impact Analysis

Former Maintenance and Fueling Facility
Skykomish, Washington

Prepared by:

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RETEC Project Number: BN050-16423-250

Prepared for:

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August 14, 2003

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1 Scoping and Determination of Significance

This appendix summarizes the evaluation of significant adverse environmental impacts, mitigation measures, and unavoidable adverse environmental impacts that are required by the State Environmental Policy Act (SEPA), Chapter 43.21 RCW (WAC-197-11-440(6)). The impacts are discussed in order of category of impact, analogous to the presentation format for Chapter 2 of the FS/EIS. The impact categories discussed are those that were not eliminated in the refined scoping phase as *not significant adverse impacts*.

Ecology, as lead agency, has determined (DS, October 2002) that the cleanup proposal for the site is likely to have a significant adverse impact on the environment, thereby mandating integrations of this EIS into the FS. Ecology identified the following areas for discussion in the EIS:

- Impacts on health, safety, and welfare to the public in the town of Skykomish
- Impacts on fish and wildlife in the Skykomish River and surrounding region
- Impacts on the built environment
- Impacts on natural resources

Early scoping for the EIS was conducted during the fall of 2002, when agencies, affected tribes, and the public were invited to comment on the possible alternatives, mitigation/restoration processes, significant adverse impacts, and other issues either in writing or as part of the ongoing MTCA public review process. No specific comments related to the EIS were received as part of the public review process.

BNSF, as the Proponent, has conducted additional scoping to identify probable significant adverse impacts to evaluate in the EIS. Potential environmental issues covered by SEPA and MTCA are listed in Table A-1. As part of additional scoping, these issues were evaluated by personnel familiar with the site and the environmental issues. Issues that were considered not to result in significant adverse impacts were identified, and will be discussed no further in this EIS. However, public outreach activities have helped BNSF and Ecology gain a better understanding of community concerns related to cleanup of the site.

The following sections include:

1. A summary of outreach activities and public concerns

2. A discussion of significant adverse impacts (Table A-2) identified using the definitions of adverse impacts shown in Table A-3 for the scoping elements not rejected as not significant, per Table A-1

3. A discussion of unavoidable significant adverse impacts (as defined in Table A-3) following application of the mitigation measures identified for the remedial alternatives in Section 6

2 Public Concerns

This section presents a summary of the public concerns that have contributed to a Determination of Significance at the site. It also provides an overview of the outreach activities that have taken place during the scoping period, beginning with initial community interviews conducted in March and April 2001.

Under SEPA, if Ecology determines that a project or proposal is likely to result in a significant adverse impact on the environment (DS), then the process of preparing an EIS is initiated to evaluate potential associated impacts and consider various remedial alternatives. When preparing the EIS, the Department of Ecology is required to involve the public in what is known as "scoping," or the process of determining the range of remedial alternatives, areas of impact, and possible mitigation measures that should be evaluated as part of the environmental impact statement. Once the EIS is drafted, the public will again have an opportunity to comment on the proposal.

2.1 Community Interviews

During the spring of 2001, more than 25 members of various community and interest groups were interviewed to help BNSF and Ecology better understand community concerns related to the cleanup and the proposed Interim Action, and to determine how to best involve community members in the process. Interviewees included members of the town council, members of the school board, the school superintendent, business people, and residents, including a number along West River Road who would be directly affected by construction activities of the proposed Interim Action. An interview outline was used to guide the interview process; however, the interview questions were fairly open-ended and were designed to encourage discussion with interviewees. The input received during the interviews was also used to guide the development of a public participation plan.

The following concerns were identified during the interviews:

- **Environment.** Many in the community feel that protection of the environment is important, and that the oil seeps to the river do need to be addressed. However, protection of public health was generally identified as a higher priority. Several people requested that maintenance of the booms in the river be improved and that cleaning of the riverbank be evaluated.

- **Public Health.** The people that were interviewed are fairly comfortable that the petroleum products pose no imminent health risks, based on several studies done by the Washington State Department of Health and Seattle/King County Health Department. However, there are concerns about unknown long-term health effects. Several individuals expressed concern about potential exposure of children and tourists to PCBs and metals contamination when they enter or cross the railyard. Several residents expressed that cleanup of that area is of primary concern. Three people asked whether it is safe to have a garden in the town.

- **Water Supply and Wastewater Treatment.** The town's water supply wells are upgradient, and contamination of the supply is not a concern. Several people, however, expressed concern about contamination entering water lines located in the vicinity of the contaminant plume, should the lines become depressurized during maintenance or operational problems.

- **Economy.** Many people feel that activity during the cleanup could either help put Skykomish back on track for economic recovery, or finish the economic tumble from which it is trying to recover. Several individuals wondered how disruptive the cleanup would be to businesses.

- **Property Values.** Property owners expressed concerned about impacts on property values, their ability to sell their properties, and who is responsible for long-term liability associated with the contamination. They are also concerned about restrictions on property use associated with the contamination, such as the inability to dig in certain areas and future institutional controls (e.g., deed restrictions).

Community concerns have been actively solicited during recent major activities at the site. These include (1) the installation of the barrier wall as an interim action, (2) Supplemental RI investigations, and (3) Feasibility Study/Environmental Impact Statement investigations. Details of the public participation activities related to these events are provided below.

2.2 Barrier Wall Interim Action

In August 2001, BNSF installed a barrier wall as an interim action to help stop petroleum products from seeping into the Skykomish River via groundwater from upland areas on the railyard. The barrier wall is approximately 600 feet long and extends west from the Skykomish Bridge along West River Road. It is approximately 4 feet wide, 15 feet deep and is composed of cement and bentonite (CB). As part of the barrier wall, four wing walls were installed on the south side of the wall to aid in the capture of material as it moves toward the River. Monitoring wells were installed upgradient of the wall and at the ends of the wall to determine where contaminants accumulate. An automated recovery system was installed in 2002.

Public input on the interim action to prevent seeps into the river was an important factor in the decision to construct a CB slurry wall along West River Road. A public hearing was held in May 2001 during which time Ecology explained preliminary plans for the interim action and solicited public comment. More than 150 written comments were received from a total of 14 individuals, groups and organizations. Comments received from the public resulted in revisions to the draft Interim Action Basis of Design for LNAPL Barrier System, the Public Participation Plan for the Action, and the Agreed Order. The Department of Ecology held a public meeting in July 2001 to review the Responsiveness Summary and to discuss barrier wall activities, plans and schedule with residents.

Throughout the planning and implementation of the interim action as well as in the community interviews, people expressed concerns about the barrier walls possibly raising the groundwater table along West River Road. There is concern that the oil floating on the groundwater could be pushed to the surface, as well as concern about impacts of rising groundwater on septic drainfields for the school and residences in that area.

2.3 Supplemental Remedial Investigation

In December 2001 and January 2002, BNSF conducted an extensive supplemental sampling effort in Skykomish. With the permission of residents, BNSF obtained more than 100 surface soil samples, drilled twenty 15-foot borings, and installed more than 20 monitoring wells on private and public property and on the rail yard. Soil samples were tested for lead and arsenic. Subsurface samples were analyzed for total petroleum hydrocarbons, polynuclear aromatic hydrocarbons, benzene, toluene, ethylbenzene, xylenes, and/or extractable/volatile petroleum hydrocarbons. The information obtained from the sampling effort was used to help better define the nature and extent of contamination in the soils, sediments and groundwater and is being used in the formulation of remedial alternatives for the site.

Following completion of the sampling work in 2002, the Department of Ecology and BNSF held several meetings with the community to discuss the supplemental investigation, including the sampling results and remaining information gaps. In October, the Department of Ecology issued a Determination of Significance for the site and opened up a 30-day public comment period that ended on November 26, 2002. Ecology held an informal meeting to discuss the need for an EIS, including the evaluation of different potential impacts of various remedial alternatives and impacts on human and environmental receptors.

During the sampling effort and in community work group meetings, residents continued to express concern about decreasing property values if contamination was found on their property. Other concerns generally related to the logistics of the investigation (e.g., road access for emergency response vehicles during sampling effort, repair to potentially damaged septic tanks, utilities, etc.).

2.4 Feasibility Study/Environmental Impact Statement

Both the Department of Ecology and BNSF are holding a series of meetings with the public to review the regulatory process governing site cleanup, the site conceptual model, and the various remedial alternatives that are being considered in the FS/EIS. During each of the meetings held by BNSF, participants have articulated their concerns related to the overall cleanup process and timeline as well as concerns related to use of specific remedial technologies.

Concerns expressed during the community work group meetings regarding different remedial alternatives and technologies include the following:

Excavation

- Contaminants released into the air from ground disturbance
- Impact on septic systems
- Visibility of excavation and impact on business and tourism
- Loss of property values
- Disruption to residences (e.g., moving homes)
- Duration of excavation
- Noise
- Acquiring access to property
- Loss of tax revenue for the town/school
- Defining extent of excavation over plume

Pumping technology

- Could be more time-consuming than excavation
- More invasive with trenching, laying pipes, etc.
- Need to combine pumping with other technologies

Physical barriers, recovery trenches and surfactants

- Timing, impact on school/kids
- Invasiveness—location of trenches, roads
- Impact on private property
- Area needed for staging
- Vapor and odor
- Duration of recovery

Other concerns

- Frustrated by the constantly changing cleanup schedule, and how long it has taken to write an RI/FS
- Concerned about the potential duration of cleanup
- Residents/property owners continue to be concerned about the economic viability of the Town, taxes and decreased property values

3 Significant Adverse Impacts to the Natural Environment

3.1 Earth

3.1.1 Soil

This section addresses soil impacted by the project when considered as a soil resource. Topography and runoff issues are discussed elsewhere. In all cases the net impact on soil quality is beneficial, as the cleanup alternatives reduce the contamination present in site soils. In some alternatives, existing soil resources are removed and replaced with clean material instead of treated in place. Localized disturbance of soil due to excavation and installation of remedial equipment will occur.

3.1.1.1 Levee and Skykomish River Aquatic Resource Zone

Excavation of Levee

The levee contains a thin layer of topsoil along the top and south (town) side. Otherwise the levee consists of boulders, cobble and sand of limited value as a resource except fill. The excavation alternative would lead to the loss of the topsoil, but this material would be replaced when the levee is reconstructed. A moderate adverse impact to soil is expected if soil is excavated to the soil RL, soil CUL, or groundwater CUL, and minor impacts are expected if hot spots are excavated.

An equivalent volume of clean fill material will have to be brought in to replace the lost topsoil and contaminated levee fill (12,000 of the total 19,000 cy). This material will be acquired from commercial sources.

Access to the levee requires construction of a roadway west of the schoolyard. This road will disturb approximately 12,500 ft^2. Temporary stockpiling of clean, excavated soil from the top of the levee will be temporarily kept in the railyard, and thus will affect small areas in the railyard.

Sediment Removal

This alternative will not affect soils except for removal of some recently deposited material along the shoreline that is discussed under “sediment” below. Installation of cofferdams will occur in the riverbed.

Enhanced Bioremediation, Ozone Sparging, and In Situ Flushing

These alternatives will have minimal effect on the soil resource in the levee, except where wells are being installed (approximately 2,400 ft^2 will be surficially disturbed for excavator access the installation and maintenance of wells spaced 25 feet). A trench on the levee will be excavated, removing 229 cy for the enhanced bioremediation, ozone sparging, and *in situ* flushing alternatives. These alternatives will not adversely affect soil resources

3.1.1.2 Former Maloney Creek Aquatic Resource Area

The Former Maloney Creek area is an exclusively aquatic zone, and no soil resources are present.

3.1.1.3 Developed Zones

Excavation

Excavation alternatives will affect soil resources in the northeast, south, and northwest developed zones. All areas of excavation, regardless of surface condition, will be returned to pre-excavation conditions. Clean soil that is removed will be returned to its original location as backfill, which will be augmented with additional backfill of similar quality to the excavated material. Excavated surface topsoil will be replaced to a thickness that is consistent with the original condition.

Approximately 5.8 acres in the northwest zone, 0.96 acre in the northeast zone, and 0.11 acre in the south zone will be temporarily disturbed if excavation occurs to the cleanup level (assumed to be 2,000 mg/kg TPH). This yields a total of approximately 150,000 cy to be excavated, 40 percent of which is expected to be uncontaminated and will be reused as backfill. This material will be temporarily stored nearby the excavation so as to be replaced in the area from where it was taken. Excavation to the CUL and all free product in the NW zone will have a major impact to soil resources.

Approximately 27percent of the northwest zone, 55 percent of the northeast zone, and 90 percent of the south zone is accessible (no building present), combining for 3.5 total acres of undeveloped and unpaved, temporarily disturbed soil. Moderate impacts to soil resources will result from excavation of free product where accessible in the NW zone and to the CUL in the NE zone. Excavation in the south zone and of free product in the NE zone will have a minor or temporary effect to soil resources.

Free Product Recovery Trenches

Trenches will have minimal effect on the soil resources in the developed zones. All trenches will be backfilled to the original condition, but skimming pumps and an electric control panel will be located nearby for a period exceeding 10 years. Temporary effects include ditches excavated to a depth of approximately 14 feet, and berms will be temporarily constructed around the trenching area (composed of clean backfill material) to prevent losses of overflows.

Enhanced Bioremediation, Ozone Sparging, and In Situ Flushing

These alternatives will have minimal effect on the soil resources in the developed zones. The majority of the wells will be installed in areas accessible by existing roads or paved areas, but in areas where wells will be installed, disturbed land will be returned to its original condition.

3.1.1.4 Railyard

No long-term impacts to soil resources are expected to occur. The railyard is composed of compacted sand and gravel, with areas of old emplaced fill throughout much of the upper few feet. It will be returned to its original condition following excavation. Temporary effects to soil include excavation, removal, and stockpiling of contaminated and uncontaminated soil. Uncontaminated soil will be used as backfill and augmented with soil from off-site that is similar in composition to the original soil.

Installation of wells is not expected to have any significant adverse impact to the railyard.

3.1.2 Sediment

This section discusses adverse environmental impacts to the sediment resource. Adverse impacts to aquatic life are discussed above, and this section focuses on sediment volume and quality.

3.1.2.1 Levee and Skykomish River Aquatic Resource Zone

The sediment resource affected by sediment remedial action occupies a narrow strip (maximum 20 feet wide) and 725 feet long along the bank. As described in Section 2.2.1, the sediment resource is of limited volume and of seasonal and intermittent presence but at times may be a valuable resource for fish and other aquatic organisms. What sediment is present is interspersed in a matrix of gravel and cobble.

Except for alternatives involving excavation of the sediment and/or the levee, no alternative would adversely affect sediment quality or quantity. Excavation of the levee would result in the incidental removal of sediment in the biotic zone (top 4 inches). Focused removal of sediment only (assuming no levee excavation takes place) would result in the removal of 540 cy of sediment, gravel and cobble in the impact zone. Any sediment removed or affected by any of the remedial alternatives would be expected to be replaced by unimpacted sand and silt deposited (and removed) by natural river seasonal fluctuations, and no permanent loss of resource is expected.

Removal of all or part of the surface sediment and/or the levee may be a significant adverse impact to downstream locations due to siltation and suspended solids. Mitigation options should include safeguards to avoid release of suspended solids or silt, and work performed during low-flow seasons when most or all the affected zone is above the waterline.

No permanent or unavoidable significant adverse impacts are anticipated for the sediment resource.

3.1.2.2 Former Maloney Creek Aquatic Resource Zone

Remove Surface Sediment

The sediment present in the former Maloney Creek area is a valuable resource for wetland vegetation and biota. Adverse impacts on biota due to removal of surface sediment (the biologically significant top 4 inches and/or the top one foot of sediment included in the definition of a wetland classification) are discussed in Section 3.4.1. Removal of all or part of the surface sediment will result in a net loss of sediment quantity. The lost sediment would be replaced by natural siltation from river action. The temporary loss is not a significant adverse impact. Spot removal of impacted sediment by definition will have a beneficial impact on overall sediment quality.

Natural Attenuation

Natural attenuation of surface sediment will have no adverse impact on sediment quality or quantity relative to the no action alternative.

Enhanced Bioremediation

The application of this remedial action to the contaminated subsurface material would have no adverse or beneficial impacts on the sediment volume or quality. However, see above for potential impacts to biota.

Excavation

Excavation of the former Maloney Creek area to reach the hydrocarbon impacted smear zone would incidentally remove all surface sediment resources in the area. Clean soil between the surface sediment and the impacted smear zone would be removed, stockpiled, and used as backfill. The impact to the surface sediment therefore is the same as for surface sediment removal, although the total footprint of the excavation may be larger, resulting in longer term and more widespread disturbance. An estimated 540 cubic yards of surface sediment (top foot) may need to be excavated. If all sediment and subsurface soil including the impacted smear zone is excavated the total volume disturbed is 7,256 cubic yards.

3.1.2.3 Developed Zones and Railyard

No sediment is present or is potentially affected as a result of cleanup alternatives in the upland developed zones or the railyard.

All intrusive cleanup alternatives for developed zones and the railyard will have a storm water management plan in place to avoid runoff of contaminated water and suspended solids to surrounding aquatic habitat zones. An effective storm water management plan will eliminate unavoidable adverse impacts associated with receiving water siltation or sediment quality degradation.

3.1.3 Topography

3.1.3.1 Levee and Skykomish River Aquatic Resource Zones

Excavation of Levee and Sediment Removal

Temporary changes in topography will result from excavation of portions of the western part of the levee for sediment excavation and of the entire levee for the levee excavation. The levee will be returned to its original contours following excavation. Stockpiled soil in the railyard as a result of levee excavation will add areas of higher elevation in the railyard, but all stockpiled soil will be removed and topography will return to its original form following excavation.

Reconstruction of the levee may include some changes in the riparian contours next to the river's edge in order to enhance its value as juvenile fish habitat during high flows. Such additions to the levee constitute a net positive impact.

Enhanced Bioremediation, Ozone Sparging, or Flushing

No permanent changes in topography are expected as a result of the installation of wells and access points for these options. A temporary access ramp will be constructed on the western end of the levee. After well installation, this section of the levee will be restored to the original topography. Some aboveground wells, pipes, and electric control panels may remain following the return of disturbed areas to the original topography, but the topography of the land will not change.

3.1.3.2 Former Maloney Creek Aquatic Resource Zone

No permanent changes in topography are expected to result from excavation or installation of wells in the zone. All grades and surfaces will be restored to their original conditions.

3.1.3.3 Developed Zones

No permanent changes in topography are expected as a result of any of the potential elements of the remedies. Temporary changes in topography will occur with berms and stockpiles of stockpiled uncontaminated soil adjacent to excavation areas, but all grades and contours will be returned to the original condition. Some aboveground wells, pipes, and electric control panels may remain following the return of disturbed areas to the original topography, but the topography of the land will not change.

3.1.3.4 Railyard

No permanent changes in topography are expected as a result of any of the potential elements of the remedies.

3.2 Water

3.2.1 Surface Water Hydrology

3.2.1.1 Levee and Skykomish River Aquatic Resource Zone

Excavation. Excavation of the flood control levee and/or removal of sediment in the river require the temporary placement of a removable cofferdam to prevent river water from affecting excavation and to minimize runoff from the excavation to the river. Excavation will be performed between July 1 and September 15 during low-flow conditions. During these low-flow conditions the river is less than bed-full, and the southern shoreline area is normally exposed, with only occasional pools present. Minimal changes in hydrology are expected because the cofferdams will be placed on exposed gravel and cobbles that are normally dry during this time of year. The South Fork of the Skykomish River main channel and flow are unchanged. No effect on water volume is expected.

The key mitigation step is placement of the cofferdam and excavation during low-flow conditions to minimize effects on river hydrology. No pumping will be necessary since sufficient area in the riverbed will be available to move water past the dam. No permanent or unavoidable adverse effects to river hydrology are anticipated.

Enhanced Bioremediation, Ozone Sparging, and Flushing. These measures will have no effect on river hydrology.

3.2.1.2 Former Maloney Creek Aquatic Resource Zone

Excavation. Temporary or minor adverse effects to creek hydrology are anticipated. Excavation of sediment in the zone will involve the installation of a cofferdam to keep surface water away from the excavation. Work will be performed in the summer to minimize the likelihood of precipitation. A bypass pump and hose will be used to pump any collected surface water around the excavation area.

Enhanced Bioremediation. This measure will have no effect on river hydrology.

3.2.1.3 Developed Zones and Railyard

No permanent or unavoidable adverse effects to river or creek hydrology are anticipated.

3.2.2 Surface Water Quality

3.2.2.1 Aquatic Resource Zones (Levee/Skykomish River and Former Maloney Creek

Although no hydrologic studies are available for confirmation, it is likely that most of the intermittent flow during low water table conditions in the former Maloney Creek wetland, and a significant portion of the water flowing through the wetland during high water table conditions, is derived from surface runoff and drainage. See App. P. This surface water reaches Maloney Creek and ultimately the Skykomish River. Under the no-action alternative, ongoing contaminant migration to the river, which is a Class AA water, will continue. All cleanup alternatives will result in a long-term net improvement in water quality as sources to the aquatic zones are controlled and contamination in the aquatic zones addressed. No adverse impact to the current use designation, and no degradation of water quality are expected. Net impacts are beneficial under all alternatives.

Minor and temporary impacts to water quality may occur as a result of sediment excavations. Best management practices (BMP) representing mitigation efforts will be used to minimize any impacts to surface water quality for excavation of the levee and excavation of sediments. Activities will take place during low-flow periods (between July 1 and September 15) to minimize alterations to flow of surface water in the river. Cofferdams will be installed around the excavation areas to prevent surface water contact. Other BMP associated with excavation along the river include the placement of adsorbent pads and booms around the cofferdam to prevent contamination from groundwater.

There is a possibility that chemicals used during *in situ* flushing will not be fully recovered and could reach the river. This is not expected to be a significant impact because of the efficiency of the recovery wells. It is not expected that these chemicals would reach the river in toxic amounts or in amounts resulting in violation of anti-degradation statutes. See Section 7.2.6 for discussion of impacts to aquatic biota.

3.2.2.2 Upland Zones

No surface water resource will be directly impacted by cleanup activities in upland areas. Appropriate runoff controls will be used to avoid runoff reaching surface water areas.

3.2.3 Runoff/Infiltration

3.2.3.1 Levee and Skykomish River Aquatic Resource Zone

Excavation of surface sediment may have moderate impact to runoff, but excavation of levee soil will have minor and temporary impact. Temporary runoff resulting from remedial activities will result from disturbance of the surface soil, and includes the clearing of vegetation from the levee for excavation and installation of groundwater wells. Runoff from the cleared areas will likely carry dirt washed away from the work area. Best management practices that include the use of silt fencing and cofferdams will mitigate the effects of runoff from the levee. Silt fencing will be used in all areas where runoff is likely to result from the activities. Adsorbent booms will also be placed on the edges of the river to prevent any accidental spills of contaminated water from flowing into the river.

3.2.3.2 Former Maloney Creek Aquatic Resource Zone

No long-term changes in runoff are expected to occur. Temporary runoff may result from clearing of vegetation and installation of wells, and moderate impacts may result from sediment excavation. Best management practices will mitigate runoff generated from these activities.

3.2.3.3 Upland Zones (Railyard and Developed Zones)

Temporary runoff may result from clearing of vegetation, installation of wells, smaller soil excavations, and stockpiling soil. Moderate changes to runoff may result from larger excavations and those that interfere with drainage basins. Best management practices will mitigate runoff generated from these activities. Silt fencing will be placed around areas likely to generate runoff. Temporary stockpiles of clean soil adjacent to excavations and on the railyard will be hydroseeded to prevent additional erosion and runoff if they are anticipated to be unused for long periods of time.

Contaminated materials excavated will be stockpiled in the railyard and contained with best management practices to mitigate runoff and infiltration into groundwater. Contaminated material will be stockpiled on an impermeable layer of high-density polyethylene (HDPE) or visqueen to prevent infiltration of contaminated soil and water.

3.2.4 Floods

3.2.4.1 Levee and Skykomish River Aquatic Resource Zone

Excavation of Flood Control Levee

Excavation of all or part of the flood control levee, originally installed in 1951 by the USACE to protect against flooding, would temporarily lower flood protection for the town and may subject it to potentially more severe flooding in the event of a large flooding event (see Figure 2-9 in the FS/EIS). Excavation of the levee would be performed during periods of low flow (July 1 through September 15), when flood events are unlikely. However, the potential impact of a highly unlikely major flooding event occurring during the 12 weeks of construction could be severe.

The flood control levee will be rebuilt with clean fill material and would be completed by the end of the period of low flow (September 15). The 100-year flood contours will not change if the levee is built to the current dimensions (see Figure 2-9 in the FS/EIS). If a flood control levee were to be built in dimensions other than the current, the 100-year flood contours for Skykomish may change. However, in a 100-year flood only the top of the levee is safe from flooding, as the levee would be completely surrounded by water. The primary function of the levee is to protect against destructive flood surges and erosion, not flooding per se.

Reconstruction of the levee to its current dimensions will mitigate or eliminate any adverse effects relating to flooding. No irreversible or unavoidable adverse impacts are expected.

Sediment Removal

Sediment removal (absent levee excavation) would require partial removal of the riverside (northern) side of the flood levee to allow for placement of the cofferdam. The levee would need to be lowered approximately 6 vertical feet. However, the integrity of the levee should not be compromised, and potential impacts are less than excavation of the entire levee.

Enhanced Bioremediation, Ozone Sparging, and Flushing

No impacts on flooding or the 100-year flood contours are expected.

3.2.4.2 Former Maloney Creek Aquatic Resource Zone and Upland Zones

No changes to the 100-year floodplain are expected to result from remedial activities in the railyard and developed zones. All areas will be restored to pre-excavation conditions. Temporary effects of flooding during excavation may result in a decrease in floodwater storage capacity in the former Maloney Creek Aquatic Zone when the cofferdam is in place, in which case, an increase in pumping rates around the dam will occur. Berms around excavated areas and trenches will prevent flooding into the excavated areas, but effects are considered temporary and minor.

3.2.5 Groundwater Quantity

3.2.5.1 Levee and Skykomish River Aquatic Resource Zone

Groundwater flux into the Skykomish River is variable and relatively low. During high water, the river recharges the bank (RETEC, 2002a). Groundwater flow is further disrupted by the presence of a slurry wall. Minor and temporary changes to groundwater quantity in the levee zone will occur as a result of cleanup alternatives that involve excavation of soil below the water table and *in situ* flushing, which temporarily removes groundwater from the ground.

3.2.5.2 Former Maloney Creek Aquatic Resource Zone and Upland Zones

Only minor or temporary changes in groundwater quantity are expected as a result of the cleanup alternatives, specifically *in situ* flushing which temporarily removes groundwater from the ground.

3.2.5.3 Developed Zones and Railyard

Minor changes to groundwater quantity are expected for alternatives that involve flushing and excavation of free product and to the CUL.

3.2.6 Groundwater Quality

Degraded groundwater quality is a key issue addressed by the FS. Impacted groundwater is present throughout the site. All cleanup alternatives will have a net beneficial effect on groundwater quality compared to the no-action alternative, either through direct cleanup or through source removal. Only temporary impacts are anticipated for any Cleanup Zone or cleanup alternative. More aggressive alternatives (e.g., NAPL excavation) are expected to result in a quicker beneficial effect.

Short-term impacts during remediation are not expected to reduce the quality of the existing groundwater. Addition of surfactants or ozone will not have a significant adverse effect on groundwater, as it is not used or usable under current conditions. Any impacts due to additions of ozone, surfactants, or nutrients are expected to be short-lived, and therefore not likely to transport to off-site aquatic zones or locations were human contact is possible.

3.3 Air

3.3.1 Emissions and Odors

Potential impacts may be due to wind-blown particulate sources and VOCs. However, no VOCs are detected as IHSs for any media at the site and should not be a major concern for activities as discussed in Section 5. Odors are a concern during excavation and will likely result in adverse impacts to residents near excavations.

3.3.1.1 Levee and Skykomish River Aquatic Resource Zone

Remove Surface Sediment

The temporary road constructed to remove surface sediment would increase particulate emissions from vehicular traffic for approximately 2 weeks. Emissions of VOCs will result from soil handling operations. Emissions from temporary roads during dry summer months may be controlled with water spray. Emissions generated from sediment handling operations are minor and temporary are not expected to require controls.

Enhanced Bioremediation and Ozone Sparging

Offgases from enhanced bioremediation activities will be released to the atmosphere. The resulting VOCs are the same as those found in the soil with a bias towards the lighter constituents and are expected to be of low flow rate. The use of blowers, ozone and oxygen generators will produce small quantities of NO_x and CO. Adverse impacts to the air associated with this remedial alternative element are not significant and are not expected to require controls.

***In Situ* Flushing**

The greatest potential for air emissions from the soil flushing alternative is the generation of VOCs during the excavation, materials handling, feed preparation, and extraction processes. Waste streams also have the potential to be sources of VOC emissions. Emissions from soil flushing may emanate from the soil surface, solvent storage vessels and spray system, and from locations where the contaminant-laden flushing solution is recovered and treated. Products of aerobic and anaerobic decomposition are possible from the soil flushing operations. Adverse impacts to the air associated with this remedial alternative are not expected to be significant.

However, as discussed in Section 5, it may be necessary to develop air cleanup levels, conduct air monitoring during remedy implementation, and mitigate as necessary.

Excavation

Emissions of VOCs, particulates, and odor may result from exposed waste in the excavation pit, material as it is dumped from the excavation bucket, and from soil in short-term storage piles. In addition, vehicular travel on an unpaved temporary road will produce short-term increases in particulate emissions. Mitigation measures for these emissions may include covers and physical barriers over soil piles, water sprays with or without dust control chemicals, wind barriers, and operational controls. Effective operational controls include controlling the rate of excavation, limiting the surface area of exposed contaminated soil, limiting the duration that soil piles are left uncovered, and curtailing excavation during periods of high wind. Adequate operational controls will be used to ensure impacts of odors and particulate are not significant.

3.3.1.2 Former Maloney Creek Aquatic Resource Zone

Remove Surface Sediment

Vehicular traffic associated with the removal of surface sediment will slightly increase emissions of VOCs and particulates for approximately 2 weeks. Emissions of VOCs will result from soil handling operations. Adverse impacts to the air associated with this remedial alternative are not expected to be significant.

Natural Attenuation

No significant adverse effects to the air are expected.

Enhanced Bioremediation

Offgases from enhanced bioremediation activities will be released to the atmosphere. The resulting VOCs are the same as those found in the soil with a bias towards the lighter constituents and are expected to be of low flow rate. Odor controls are not typically required for these operations. The use of blowers will produce small quantities of NO_x and CO. Adverse impacts to the air associated with this remedial alternative element are expected to be minimal.

Excavation

Emissions of VOCs particulates, and odors may result from exposed waste in the excavation pit, material as it is dumped from the excavation bucket, and from soil in short-term storage piles. Mitigation measures for these emissions may include covers and physical barriers over soil piles, water sprays with or without dust control chemicals, wind barriers, and operational controls. Effective operational controls include controlling the rate of excavation, limiting the surface area of exposed contaminated soil, limiting the duration that soil piles are left uncovered, and curtailing excavation during periods of high wind. Adverse impacts to the air associated with this remedial alternative are not expected to be significant.

3.3.1.3 Northeast Developed Zone

Natural Attenuation

No significant adverse effects to the air are expected.

Enhanced Biodegradation

Offgases from enhanced bioremediation activities will be released to the atmosphere. The resulting VOCs are the same as those found in the soil with a bias towards the lighter constituents and are expected to be of low flow rate. Odor controls are not typically required for these operations. The use of blowers, ozone and oxygen generators will produce small quantities of NO_x and CO. Adverse impacts to the air associated with this remedial alternative element are expected to be minimal.

Excavation

Emissions of VOCs particulates, and odors may result from exposed waste in the excavation pit, material as it is dumped from the excavation bucket, and from soil in short-term storage piles. Mitigation measures for these emissions may include covers and physical barriers over soil piles, water sprays with or without dust control chemicals, wind barriers, and operational controls. Effective operational controls include controlling the rate of excavation, limiting the surface area of exposed contaminated soil, limiting the duration that soil piles are left uncovered, and curtailing excavation during periods of high wind.

3.3.1.4 South Developed Zone

Natural Attenuation

No significant adverse effects to the air are expected.

Excavation

Emissions of VOCs, particulates, and odors may result from exposed waste in the excavation pit, material as it is dumped from the excavation bucket, and from soil in short-term storage piles. Mitigation measures for these emissions may include covers and physical barriers over soil piles, water sprays with or without dust control chemicals, wind barriers, and operational controls. Effective operational controls include controlling the rate of excavation, limiting the surface area of exposed contaminated soil, limiting the duration that soil piles are left uncovered, and curtailing excavation during periods of high wind.

3.3.1.5 Northwest Developed Zone

Surface Soil Excavation

Vehicular traffic will produce particulate emissions for approximately 2 weeks. Emissions of VOCs will result from exposed soil, handling of material, and soil in storage piles. Emissions from unpaved roads during dry summer months can be controlled with water spray with or without dust control additives. Operational controls such as controlling the rate of excavation, limiting the surface area of exposed contaminated soil, limiting the duration that soil piles are left uncovered, and curtailing excavation during periods of high wind can be used to minimize emissions of VOCs and odors during excavation. Adverse impacts to the air associated with this remedial alternative are expected to be below the significance level.

Natural Attenuation

No significant adverse effects to the air are expected.

Free Product Recovery Trenches

Impacts to the air for free product recovery trenches are associated with the excavation and material handling required. Due to the short duration and small quantity of material excavated, trenching would not have significant adverse impacts to the air. Free product in the trenches is a potential source of odor in the immediate area.

Enhanced Biodegradation

Offgases from enhanced bioremediation activities will be released to the atmosphere. The resulting VOCs are the same as those found in the soil with a bias towards the lighter constituents and are expected to be of low flow rate. Odor controls are not typically required for these operations. The use of blowers, ozone and oxygen generators will produce small quantities of NO_x and CO. Adverse impacts to the air associated with this remedial alternative element are expected to be minimal.

In Situ Flushing

The greatest potential for air emissions from the soil flushing alternative is the generation of VOCs during the excavation, materials handling, feed preparation, and extraction processes. Waste streams have the potential to be sources of VOC emissions. Emissions from soil flushing may emanate from the soil surface, solvent storage vessels and spray system, and from locations where the contaminant-laden flushing solution is recovered and treated. Products of aerobic and anaerobic decomposition are possible from the soil flushing operations. Adverse impacts to the air associated with this remedial alternative are expected to be below the significance level.

Excavation

Vehicular traffic will produce particulate emissions for the duration of the excavation. Emissions of VOCs, particulates, and odors may result from exposed waste in the excavation pit, material as it is dumped from the excavation bucket, and from soil in short-term storage piles. Mitigation measures for these emissions may include covers and physical barriers over soil piles, water sprays with or without dust control chemicals, wind barriers, and operational controls. Effective operational controls include controlling the rate of excavation, limiting the surface area of exposed contaminated soil, limiting the duration that soil piles are left uncovered, and curtailing excavation during periods of high wind. Adverse impacts to the air associated with this remedial alternative are expected to be below the significance level.

3.3.1.6 Railyard

Excavate Surface Soil

Emissions of VOCs will result from soil handling operations associated with removal of the surface soil. Adverse impacts to the air associated with this remedial alternative are expected to be below the significance level.

Free Product Recovery Trenches

Impacts to the air for free product recovery trenches are associated with the excavation and material handling required. Due to the short duration and small quantity of material excavated, trenching would not have significant adverse impacts to the air. Free product in the area is a potential source of odor.

Natural Attenuation

No significant adverse effects to the air are expected.

Enhanced Biodegradation

Offgases from enhanced bioremediation activities will be released to the atmosphere. The resulting VOCs are the same as those found in the soil with a bias towards the lighter constituents and are expected to be of low flow rate. Odor controls are not typically required for these operations. The use of blowers, ozone and oxygen generators will produce small quantities of NO_x and CO. Adverse impacts to the air associated with this remedial alternative element are expected to be minimal.

In Situ Flushing

The greatest potential for air emissions from the soil flushing alternative is the generation of VOCs during the excavation, materials handling, feed preparation, and extraction processes. Waste streams have the potential to be sources of VOC emissions. Emissions from soil flushing may emanate from the soil surface, solvent storage vessels and spray system, and from locations where the contaminant-laden flushing solution is recovered and treated. Products of aerobic and anaerobic decomposition are possible from the soil flushing operations. Adverse impacts to the air associated with this remedial alternative are expected to be below the significance level.

Excavation

Emissions of VOCs, particulates, and odors may result from exposed waste in the excavation pit, material as it is dumped from the excavation bucket, and from soil in short-term storage piles. In addition, vehicular travel on unpaved roads will produce short-term increases in particulate emissions. Mitigation measures for these emissions may include covers and physical barriers over soil piles, water sprays with or without dust control chemicals, wind barriers, and operational controls. Effective operational controls include controlling the rate of excavation, limiting the surface area of exposed contaminated soil, limiting the duration that soil piles are left uncovered, and curtailing excavation during periods of high wind. Adverse impacts to the air associated with this remedial alternative are expected to be below the significance level.

3.3.2 Vapor Intrusion

Under current conditions the subsurface contamination contains little VOCs. Vapor intrusion from NAPL, contaminated groundwater or contaminated soil is not a significant exposure pathway under the no-action alternative, as detailed in Section 5.2.1. All cleanup alternatives will lead to a decrease of contaminant concentrations, so long-term or permanent impacts are net positive.

No cleanup alternative in any area except for *in situ* flushing is expected to lead to temporary changes in vapor intrusion during remediation.

In situ flushing, a cleanup alternative in all Cleanup Zones, involves injecting a heated water/detergent solution into the ground to reduce the viscosity and thus enhance recovery of hydrocarbons. The heated solution will cause a heating of the subsurface formation to at least 40 ºC and possibly as high as 50 ºC. A potential impact would be an increase in volatile vapor intrusion as a result of heating during the remediation work.

The heating is not expected to lead to adverse impacts due to vapor intrusion. A sample of hydrocarbon was tested using headspace methodology. Headspace testing involved heating of the mixture to 50 ºC and testing the resultant headspace vapors. When the product headspace was compared to MTCA Method B levels for ambient air cleanup (Table 5-2 in the FS/EIS) no individual VOC exceeded the limit (RETEC, 2002a). No ambient or indoor air impacts therefore are expected on heating, and no significant adverse impacts are anticipated at present. However, if subsurface temperatures exceed 50 ºC as a result of remedial action, it may be necessary to reevaluate this pathway.

3.4 Upland Habitats, Wetlands, and Wildlife

The effects of ground-disturbing activity, including clearing of vegetation, are described below for each remedial treatment in each cleanup zone. Other potential effects of the remedial activities include disturbance of wildlife by noise and also introduction and spread of noxious weed species. Noxious weed control will be incorporated into the BMPs for the construction and revegetation phases of the cleanup activity in accordance with state and county regulations. The potential for noise disturbance of wildlife will not be significant.

No significant adverse effects to federally threatened or endangered wildlife are expected to occur. The closest potential habitat for the federally threatened spotted owl is over 2 miles away. No direct effects to this species or its habitat are expected to occur. Bald eagles may occasionally travel through the area along the levee and South Fork of the Skykomish River during the winter season. The majority of noisy activity, including drilling and excavation, is scheduled to occur during the summer months. Operation of the flushing systems would occur during winter; however, these systems would be located largely underground and would create a low-level background noise during operation. As noted in the Aquatic Habitat section, the proposed remedial activities are not expected to negatively affect fish resources in the South Fork of the Skykomish River. No effects to bald eagles, their food resources or habitats are expected to occur as a result of implementation of the cleanup activities.

3.4.1 Levee and Skykomish River Aquatic Resource Zone

3.4.1.1 Remove Surface Sediment

Construction of the access road to the river's edge would require temporary removal of about 0.1 acre of upland vegetation from the east end of the levee. Additional small areas of riparian vegetation (less than 0.1 acre) would be removed with sediment along the riverbank. The site would be revegetated after the approximately 3-week activity period.

No significant adverse effects to wetlands or wildlife are anticipated.

3.4.1.2 Enhanced Bioremediation, Ozone Sparging, and In Situ Flushing

The effects of these three treatment activities on upland habitats in the levee zone are similar. The levee (approximately 1.0 acre) would be cleared of trees and shrubs for construction of a temporary access road at the east end of the levee and for installation of sparging/injection wells and associated equipment.

The enhanced bioremediation treatment includes air sparging and injection of nutrients into subsurface soils. Soil microbes and plants would use the nutrients. Revegetation of the levee under this treatment may be limited to grasses and understory species; planting of trees may be precluded, as the air sparging equipment would be operated indefinitely.

The flushing treatment would occur over a period of 3 to 6 months. Surfactants used in the process would be largely recovered. The surfactants proposed for use range in degree of biodegradability from readily biodegradable to moderately persistent. Due to the high recovery rate of surfactants and injection of the compound well below the surface soils, it is not expected that the treatment would preclude revegetation of the site upon conclusion of the treatment.

Ozone sparging would occur for approximately 5 years with a 10 percent concentration of ozone. Toxicity of ozone to vascular plants is largely unknown. However, ozone rapidly decomposes in the presence of contaminants and organic compounds within subsurface and surface soils. Due to the rapid decomposition rate, it is not expected that the treatment will preclude revegetation of the site upon completion of the treatment.

No significant adverse effects to wetlands or wildlife are anticipated. Wildlife habitat provided by the trees and shrubs on the levee would be removed; at a minimum, the site would be revegetated with grass and forb species for erosion control purposes. No use of the habitat by special status wildlife or threatened or endangered wildlife is known or suspected, and no effects to these species are expected to occur.

3.4.1.3 Excavation

Excavation of the levee site would include clearing of vegetation from the levee (1.0 acre) and from an additional 0.3 acre of developed habitat for temporary road construction. Excavation is expected to be completed in about 3 months, after which period the levee would be reconstructed and exposed soils would be revegetated.

No significant adverse effects to wetlands or wildlife are anticipated. Wildlife habitat provided by the trees and shrubs on the levee would be removed. No use of the habitat by special status wildlife or threatened or endangered wildlife is known or suspected, and no effects to these species are expected to occur.

3.4.2 Former Maloney Creek Aquatic Resource Zone

For purposes of this evaluation, the habitat within this zone is considered to be wetlands. No upland habitats would be affected by the proposed remedial alternatives within this zone.

3.4.2.1 Remove Surface Sediment

Two proposals for removal of surface sediments are under consideration. Removal to remediation level would require clearing of about 0.5 acre of wetland habitat. Removal to the cleanup level would require that the entire wetland site (about 1.1 acres) be cleared and excavated to a depth of about 1 foot. Soils would be replaced and replanted with native plant species. Excavation and replacement of soils would occur during a 2-week period in summer.

No significant adverse effects to wildlife are anticipated. Wildlife habitat would be altered by the temporary loss of wetland vegetation on 0.5 to 1.1 acres of the wetland. The site would be revegetated upon completion of the excavation. No use of the habitat by special status, threatened or endangered wildlife is known or suspected, and no effects to these species are expected to occur.

3.4.2.2 Natural Attenuation

No significant adverse effects to wetlands or wildlife are expected.

3.4.2.3 Enhanced Bioremediation

Vegetation would be cleared from approximately 0.4 acre of the wetland site for installation of injection wells and associated piping. Remaining wetland vegetation is not expected to be significantly adversely affected by the treatments. The area would be revegetated with native species upon completion of the treatment.

The enhanced bioremediation treatment would include air sparging and injection of nutrients such as potassium nitrate and potassium phosphate into subsurface soils for a period of about 10 years. Soil microbes and plants would use the nutrients. After removal of equipment, disturbed soils would be revegetated with native species.

No significant adverse effects to wildlife are anticipated. Wildlife habitat would be altered by temporary loss of an estimated 0.4 acre of wetland vegetation. No use of the habitat by special status, threatened or endangered wildlife is known or suspected, and no effects to these species are expected to occur.

3.4.2.4 Excavation

Approximately 1.1 acres of wetland habitat would be cleared for excavation of soils. Soils would be replaced and revegetated with native plant species. Excavation and replacement of soils would occur during a 2-week period in summer.

No significant adverse effects to wildlife are anticipated. Wildlife habitat would be altered by the removal of trees and shrubs in portions of the wetland; compensatory mitigation for the wetland habitat would be provided. No use of the habitat by special status, threatened or endangered wildlife is known or suspected, and no effects to these species are expected to occur.

3.4.3 Northeast Developed Zone

3.4.3.1 Natural Attenuation

No significant adverse effects to upland habitats, wetlands, or wildlife are expected as a result of natural attenuation.

3.4.3.2 Enhanced Bioremediation

This action would affect about 0.8 acre of developed habitats, most of which are occupied by structures and roads. No significant adverse effects to upland habitats, wetlands, or wildlife are expected.

3.4.3.3 Excavation

Two proposals for excavation are under consideration: removal of free product (0.22 acre) or removal of all free-product areas and soils exceeding cleanup levels (0.96 acre). Each of the proposed treatments would affect developed habitats occupied by structures and roads. No significant adverse effects to upland habitats, wetlands, or wildlife are expected.

3.4.4 South Developed Zone

3.4.4.1 Natural Attenuation

No significant adverse effects to upland habitats, wetlands, or wildlife are expected as a result of natural attenuation.

3.4.4.2 Excavation: NAPL, Surface Soil or to Cleanup Levels

Three proposals for excavation are under consideration: removal of free product (0.02 acre), removal of surface soil (0.1 acre), and removal of all soils to cleanup level (0.1 acre). Each of these proposals will affect primarily developed habitats intermixed with lawns, yards, and other upland vegetation. No significant adverse effects to upland habitats, wetlands, or wildlife are expected.

3.4.5 Northwest Developed Zone

3.4.5.1 Excavation of Surface Soil

Excavation of surface soils would affect about 0.1 acre of developed lands. No significant adverse effects to upland habitats, wetlands, or wildlife are expected.

3.4.5.2 Natural Attenuation

No significant adverse effects to upland habitats, wetlands, or wildlife are expected as a result of natural attenuation.

3.4.5.3 Free Product Recovery Trenches

This treatment would directly affect approximately 0.1 acre of developed habitat for construction of trenches and an equipment pad for a period of about 10 years. No significant adverse effects to upland habitats, wetlands, or wildlife are expected to occur in this developed zone.

3.4.5.4 Enhanced Bioremediation

This action would require approximately 0.1 acre of developed land for installation of air sparging wells and related equipment. No significant adverse effects to upland habitats, wetlands, or wildlife are expected.

3.4.5.5 In Situ Flushing

This action would affect about 0.4 acre of developed habitats. No significant adverse effects to upland habitats, wetlands, or wildlife are expected.

3.4.5.6 NAPL Excavation

Excavation of free product is expected to affect about 2.2 acres of developed land in this zone. No significant adverse effects to upland habitats, wetlands, or wildlife are expected.

3.4.5.7 Excavation

Excavation to remove all free product would affect about 5.8 acres of developed habitats. No significant adverse effects to upland habitats, wetlands, or wildlife are expected.

3.4.6 Railyard

3.4.6.1 Excavate Surface Soil

Excavation of surface soil in the railyard zone would affect approximately 3.3 acres of the developed/disturbed habitat. No significant adverse effects to upland habitats, wetlands, or wildlife are expected.

3.4.6.2 Free Product Recovery Trenches

Excavation of free product is expected to affect about 0.03 acre of developed land in this zone. No significant adverse effects to upland habitats, wetlands, or wildlife are expected.

3.4.6.3 Natural Attenuation

No significant adverse effects to upland habitats, wetlands, or wildlife are expected as a result of natural attenuation.

3.4.6.4 Enhanced Bioremediation

Approximately 0.3 acre of developed railyard habitats would be affected by implementation of enhanced bioremediation. No significant adverse effects to upland habitats, wetlands, or wildlife are expected.

3.4.6.5 In Situ Flushing

Flushing would affect about 0.4 acre of developed habitats in the railyard zone. No significant adverse effects to upland habitats, wetlands, or wildlife are expected.

3.4.6.6 NAPL Excavation

Excavation of free product would affect about 1.2 acres of developed land in this zone. No significant adverse effects to upland habitats, wetlands, or wildlife are expected.

3.4.6.7 Excavation

Excavation to remove all free product would affect about 21 acres of developed habitats. No significant adverse effects to upland habitats, wetlands, or wildlife are expected.

3.5 Aquatic Resources

Aquatic habitat is present in only two of the six cleanup zones. Potential effects of cleanup activities on aquatic resources within the levee and Skykomish River Zone and the Former Maloney Creek Zone are described below.

3.5.1 Levee and Skykomish River Aquatic Resource Zone

3.5.1.1 Excavate Surface Sediment

The removal of surface sediments from the existing levee will temporarily alter the aquatic habitat conditions along the South Fork of the Skykomish River near the site. Spot removal of surface sediments will occur at various locations along approximately 725 linear feet of aquatic shoreline. Some sediment removal may occur within the South Fork channel, extending at most 10 feet waterward from the levee. A temporary cofferdam will be installed in the South Fork channel parallel to the levee. Cofferdam installation and removal will occur during the approved in-stream work window, when South Fork flows are low and the riverbed adjacent to the site is expected to be dry. However, placement of the dam still entails a small risk of trapping salmonids. During installation, fish removal and recovery efforts will be implemented to ensure trapping of fish does not occur if the water level is not low enough to eliminate any chance of fish presence.

Installation and removal of the cofferdam may temporarily increase turbidity in the immediate vicinity of construction. As mentioned above, the site is expected to be dry during construction. However, in the months following project completion when water levels rise and encounter disturbed areas, small increases in turbidity may occur. Adherence to BMPs during installation and removal of the dam is expected to minimize turbidity increases within the South Fork of the Skykomish River.

Surface sediment removal will alter the aquatic habitat conditions along the base of the levee. Spot sediment removal along the levee will require the clearing of the riparian vegetation in those areas. Additionally, coarse sediments along the base of the levee and in the channel will be disturbed. These activities will decrease the quality and function of aquatic habitat along the levee over the short term. However, habitat quality and function is expected to increase within 2 to 3 years as shoreline vegetation becomes reestablished and as sediment is redeposited by natural river action.

3.5.1.2 Enhanced Bioremediation

Enhanced bioremediation within the levee would involve sparging indefinitely. In addition to oxygen injection, nutrients would be injected into the subsurface soils to enhance the efficiency of the bioremediation process.

Oxygen sparging is not expected to entail any significant risks to the aquatic environment. The possibility of elevated nutrient concentrations reaching surface waters within the South Fork of the Skykomish River is expected to be very small, as nutrient uptake by microbes and root systems in the soil is expected to be high. Any residual nutrients that potentially enter surface waters as part of the general groundwater flux from sparging wells would be in quantities so low that it would not affect surface water concentrations, and biological impacts in the aquatic environment therefore are negligible.

3.5.1.3 Ozone Sparging

Ozone sparging in the levee with 10 percent ozone (100 ppm) combined with air would occur over a period of 5 years. As described in Section 3.4.1.2, the ozone is expected to diffuse through the vadose zone and decompose relatively quickly as it oxidizes available petroleum contamination and organic material.

As a result of the rapid oxidation rate of dissolved ozone, residual ozone is not expected to reach surface waters. Ozone toxicity data indicate that subacute exposure of adult salmonids (96-hour) to dissolved ozone causes mortality at relatively low concentrations (approximately 10 µg/L) based on the study conducted by Wiedemeyer et al., (1979). Residual ozone would not be expected to remain at concentrations resulting in mortality for any significant length of time, particularly any traces reaching the surface water due to its reactivity with water constituents and physical degradation processes (e.g., photodegradation). As such, the risk of residual ozone affecting salmonids in the South Fork of the Skykomish River is expected to be minimal.

3.5.1.4 *In Situ* Flushing

As described in Section 5 soil flushing in the levee with anionic surfactant and polymers combined with 40 to 50-ºC water would occur for a period of 3 to 6 months.

Available data suggest the surfactants proposed for use have relatively low toxicity in the aquatic environment. The proposed surfactants are expected to be readily biodegradable to moderately biodegradable, indicating that escaped surfactant may potentially persist in the aquatic environment. However, the proposed surfactants are completely biodegradable, and generally are thought to have low toxicity. Surfactant introduced into the subsurface is expected to react with contaminants, and potential surfactant release to the Skykomish River aquatic environment is expected to be negligible. See Section 4.3.2.1 for more detail on the surfactants.

3.5.1.5 Excavation

Soil excavation along the existing levee will temporarily alter the aquatic habitat conditions along the South Fork of the Skykomish River near the site. Excavation of the existing levee will disturb approximately 0.14 acre of existing aquatic habitat, encompassing approximately 725 linear feet of aquatic shoreline. Portions of the South Fork channel, extending up to 10 feet waterward of the base of the levee, also will be disturbed during levee excavation. A temporary cofferdam will be installed along the existing levee. Cofferdam installation and removal will occur during the approved Washington Department of Fish and Wildlife in-stream work window. In addition, fish removal and recovery efforts will be implemented during placement of the dam to minimize trapping of fish, if water levels are not low enough to eliminate any chance of fish presence.

Installation and removal of the cofferdam may temporarily increase turbidity in the immediate vicinity of construction. However, adherence to BMPs during this process is expected to minimize the potential for increased turbidity within the South Fork of the Skykomish River.

As discussed in the Habitats, Wetlands and Wildlife sections above, all existing vegetation on the levee will be removed. In addition, large substrates along the base of the levee will be disturbed. These activities will decrease the quality of rearing, refuge, and low-velocity shoreline habitat for juvenile salmonids over the short-term. However, habitat quality and function is expected to increase within 2 to 3 years as shoreline vegetation becomes reestablished.

3.5.2 Former Maloney Creek Aquatic Resource Zone

3.5.2.1 Remove Surface Sediment

The removal of surface sediments within the former Maloney Creek will alter the aquatic habitat conditions within and immediately surrounding those areas. The removal of surface sediments in various areas will occur over approximately 0.5 to 1.1 acres to a depth of 1 foot, including approximately 800 lineal feet of the former Maloney Creek channel. During sediment removal activities, fish access to the channel will be blocked by the installation of a temporary cofferdam. Sediment removal activities and cofferdam installation and removal will occur during the approved in-stream work window.

Short-term increases in turbidity may occur in downstream areas during installation and removal of the dam. However, adherence to BMPs would minimize turbidity.

Riparian canopy and understory vegetation within the remediated areas will be cleared prior to excavation. As a result of surface sediment removal, aquatic habitat function within the remediated areas in the former Maloney Creek channel will be reduced in quality over the short term. However, as mentioned, vegetation will be replanted in remediated areas and understory species would be expected to reestablish in 2 to 3 years. Aquatic habitat quality and function within the former Maloney Creek channel will increase as the riparian vegetation reestablishes.

3.5.2.2 Natural Attenuation

Under this alternative, existing aquatic habitat conditions within the former Maloney Creek channel will remain, as no ground or vegetation disturbance activities will occur.

3.5.2.3 Enhanced Bioremediation

Enhanced bioremediation within the former Maloney Creek channel would involve oxygen sparging with a period of 10 years. In addition to oxygen injection, nutrients would be injected into the subsurface soils to enhance the efficiency of the bioremediation process.

Nutrient uptake by microbes and vegetation root systems in the soil is expected to lower any risk of nutrient concentrations reaching surface waters, particularly in the former Maloney Creek channel where vegetation is much more dense than on the South Fork of the Skykomish River levee. Oxygen sparging is not expected to entail any significant risks to the aquatic environment. As a result of the relatively shallow depth of nutrient injection into the former Maloney Creek channel, the risk of escaped nutrients occurring at higher concentrations is slightly higher than in the South Fork of the Skykomish River levee. However, the overall risk of adverse impact is quite small due to an abundance of microbes and vegetation within the channel that can utilize the nutrients.

3.5.2.4 Excavation

The removal of the surface sediments will alter the aquatic habitat conditions within the former Maloney Creek channel. Soil excavation will include the removal of all surface sediments over the entire 1.1-acre site, including approximately 800 linear feet of the former Maloney Creek channel. Fish access to the channel will be blocked by the installation of a temporary cofferdam. Sediment removal activities and cofferdam installation and removal will occur during the approved in-stream work window.

Short-term increases in turbidity may occur in downstream areas during installation and removal of the dam. However, adherence to BMPs would minimize potential increases in turbidity. Riparian canopy and understory vegetation within the channel will be cleared prior to excavation. As a result of surface sediment removal, aquatic habitat within the former Maloney Creek channel will be reduced in quality and function. However, as mentioned previously, vegetation will be replanted and understory species would be expected to reestablish in 2 to 3 years. Aquatic habitat quality and function within the former Maloney Creek channel will increase as the riparian vegetation reestablishes.

4 Significant Adverse Impacts to the Built Environment

4.1 Land Use

4.1.1 Zoning and Land Use

4.1.1.1 Aquatic Resource Zones (Levee/Skykomish River and Former Maloney Creek)

The Levee/Skykomish River and Former Maloney Creek cleanup zones are considered critical areas under the Critical Areas Ordinance (CAO) as discussed in Section 2.3.1. Some of the proposed actions have the potential to affect Critical Areas as defined under the CAO. The CAO specifies that a Critical Area review be completed prior to granting permit approval of alteration at or adjacent to a Critical Area, unless an Exemption or Variance is granted under Section 3.01 of the CAO. The necessary documentation will be completed as part of the ongoing cleanup process.

The current zoning for the levee and Skykomish River Aquatic Resource Zone is Public. The land use will not change. There are no major adverse impacts to land use anticipated if the levee is excavated to cleanup levels (except briefly during construction). Institutional controls will be used with all other remedial alternatives in the form of deed restrictions and a Town Ordinance requiring owners to apply for a permit before excavating in contaminated areas in residential, commercial, and public zones. This restriction may result in minor unavoidable adverse impact to landowner land use. Current zoning for the Former Maloney Creek Aquatic Resource Zone is industrial or residential, although little development has occurred. The Former Maloney Creek Aquatic Resource Zone is defined as a Critical Area under the CAO criteria. No cleanup alternative will lead to a change in the current land use or function. Wetland functions may be adversely impacted if excavation is conducted as described further in Section 7.6, however no institutional controls will be put in place. Institutional controls will be used with every other alternative as described above for the levee and Skykomish River Aquatic Resource Zone. Housing, Demographics, and Historic Structures

Notable buildings are shown on Figure 2-16 of the FS/EIS. Two buildings that may be significantly impacted (Maloney's General Store and the Former Depot) are on the national registry of historical places while others are considered notable buildings locally. Figure A-1 shows structures potentially impacted by remedial activities.

4.1.1.2 Developed Zones

Excavation

Excavation to cleanup levels or to residual saturation (10,000 mg/kg) in the smear zone in the Northwest Developed Zone would require the demolition or relocation of approximately 14 structures including the school, the community center, and many residential buildings. Temporary structural support will be required to allow excavation underneath several other structures. Excavation of the shallow smear zone or excavation of free product where accessible will not require demolition or relocation of any structures. Excavation of all free product could impact approximately 9 structures while excavation to cleanup levels. These impacts are major and unavoidable.

Excavation of all free product areas and all soil exceeding cleanup levels in the Northeast Developed Zone would require the relocation of two to three residences. Use of shoring may be necessary to protect some structures. These impacts are major and unavoidable.

None of the other remedial alternatives in the Northeast Developed Zone will have a significant impact on buildings, demographics or historic structures.

No excavation in other areas requires the demolition or relocation of buildings. There are no significant adverse impacts on housing associated with the remedial alternatives in these zones.

4.1.2 Aesthetics

Significant adverse impacts on aesthetics would be in the form of structures built or removed as part of the remedial alternatives that affect the character of the town or the scenic resources of the area. There are no structures that will be built as part of any excavation alternative. The demolition of or relocation of homes and historic buildings as well as excavation of the town will have a significant impact on its aesthetics.

4.1.2.1 Aquatic Resource Zones

Ozone Sparging

Ozone sparging on the levee requires ozone and oxygen generators. Due to the nature of ozone the generators need to be located close to the point of injection. This will require constructing a one-story building near the levee. Construction of these buildings is a moderate adverse impact. The impact is unavoidable and will exist for the duration of ozone sparging which is estimated to be 5 years.

Enhanced Bioremediation

Enhanced bioremediation in both aquatic zones requires blowers. Approximately one blower is needed for every 30 wells. Well number estimates indicate that one blower for the levee and two blowers for the former Maloney Creek will be needed. Due to the noise generated by blowers they will be placed in sound enclosures that will be approximately 6 feet long, 3 feet wide, and 4 feet high. The sound enclosure will sit on an equipment pad approximately 6 feet by 10 feet. The equipment pad for the levee area will be on the levee while the equipment pad for the former Maloney Creek channel will be in the railyard. The impact is minor, but unavoidable and permanent.

In Situ Flushing

In situ flushing on the levee requires a water conditioning system and a water treatment plant. Both of these approximately 40-foot by 80-foot one-story structures will be constructed on the railyard. The impact is unavoidable and will last for the duration of *in situ* flushing, which is estimated to be 3 to 6 months. The location and duration of the structures make this a moderate impact.

4.1.2.2 Developed Zones

Only excavation alternatives exist for remediation in the South Developed Zone. There are no significant impacts on aesthetics associated with any remedial alternatives in the South Developed Zone.

Enhanced Bioremediation

Enhanced bioremediation in the Northeast Developed Zone, the Northwest Developed Zone, and the railyard will require blowers in sound enclosures as described under Aquatic Zones. Enhanced bioremediation will likely require one blower in the Northeast Developed Zone, two blowers in the Northwest Developed Zone and two to three blowers in the railyard depending on whether the remediation is applied site-wide or at the property boundary. The dimensions of the sound enclosure are the same as above. The impact on aesthetics from enhanced bioremediation in the developed zones is moderate, unavoidable and permanent.

In Situ Flushing

In situ flushing in the Northwest Developed Zone and the railyard require the water conditioning system and water treatment plant as described above for the Aquatic Zone. The moderate impact is unavoidable and will last for the duration of *in situ* flushing which is estimated to be 3 to 6 months.

4.2 Public Services

Public services, including police, hospitals, fire protection, and city services will not be impacted by any of the remedial alternatives.

Utilities potentially affected include potable water supply and electricity. Skykomish lacks a sewage collection system, and most residences and businesses are connected to individual septic systems and leach fields. Impacts to these will be discussed in this section. Impacts to public services are only of concern for the developed zones. However, several water mains and electric lines cross under the railyard.

All buildings in Skykomish use individual septic tank systems and leach fields. Excavation near buildings in the developed zones will likely require excavation of septic systems. Well installations in developed zones could potentially damage existing septic systems. Injection of fluids could cause septic systems to overflow. Temporary facilities such as aboveground holding tanks or portable toilets would be used during excavation. Following excavation, a permanent waste solution will be developed with input from the community. This solution could be in the form of replacement of on-site septic systems, a community leach field, or wastewater treatment plant.

4.2.1 Aquatic Resource Zones

There are no buildings in the aquatic resource zones so there are no impacts on septic systems or water mains associated with any alternatives in these zones.

4.2.2 Northeast Developed Zone

Enhanced bioremediation wells in the Northeast Developed Zone will be placed on Railroad Street. There will be no impacts on septic systems. Water mains run along Railroad Street and will need to be rerouted for well installation. A telephone switching station in the Northeast Developed Zone would need to be protected as would associated fiber optics cables which may need to be rerouted. This impact is moderate and unavoidable.

Excavation of free product in the Northeast Developed Zone would be restricted to the Railroad Street right of way. This would result in rerouting of the water mains that is a moderate impact. There would be no impact on septic systems.

Excavation of all soil exceeding cleanup levels would result in rerouting of water mains and could impact septic systems. This impact is moderate and unavoidable.

4.2.3 South Developed Zone

Excavation in the South Developed Zone would not impact water mains but could impact septic systems. All utilities may be temporarily disconnected during excavation. This impact would be minor and temporary.

4.2.4 Northwest Developed Zone

Surface metal excavations, free product excavation, shallow smear zone excavation, and excavation to cleanup levels in the Northwest Developed Zone would impact septic. The water main that runs down Fifth Street would need to be rerouted for free product excavation and excavation to cleanup levels. Free product excavation, shallow smear zone excavation, and excavation to cleanup levels will result in the rerouting of the water main on Sixth Street. Other utilities will need to be rerouted during excavation. These impacts are significant and unavoidable.

Well installations in the Northwest Developed Zone could impact septic systems. Installations along rights of way (such as in zone-wide enhanced bioremediation) could result in rerouting of water mains as well as other utilities such as electricity or fiber optics cables.

4.2.5 Railyard

Remedial alternatives on the railyard could significantly impact septic system of the Depot. None of the potential excavations of the rail yard will result in rerouting of the water main. However, utility lines commonly parallel main line tracks. Excavation to cleanup levels would result in rerouting of the utilities that lie along the mainline of the BNSF railroad. None of the other alternatives should be close enough to the mainline to cause the utilities to be rerouted.

4.3 Environmental Health

4.3.1 Noise and Vibrations

Significant adverse impacts on environmental health from the remedial alternative elements may include increases in noise and vibration. Noise and vibration will result from construction and operation of some of the remedial alternatives. Due to the small size of the site all of the cleanup zones are considered together by remedial alternative element. As noted in FS/EIS Section 2.3.3.1, the Skykomish area is already affected by noise disturbances.

4.3.1.1 Well Installation (Ozone Sparging, Enhanced Biodegradation, Flushing)

Ozone sparging, enhanced biodegradation, and flushing well installations require similar types of equipment and are addressed together. Noise would result mostly from excavating activities, backfilling activities, and the increased truck traffic for the transport of excavated soil and backfill. Typical noise levels produced by construction equipment are shown on Figure 2-18 (in the FS/EIS). Representative hourly average noise levels produced 50 feet from construction sites are shown in Table A-4. All phases of construction would exceed 60 dBA (the noise level at which activity or speech communication outside and sleep inside would be affected) at a distance of 300 feet, assuming a direct line of sight. Speech interference indoors occurs at 45 dBA for steady noise and above 55 dBA for fluctuating noise (Ecology, 1999). Well installation is expected to take up to 8 weeks for some remedial alternative elements. Due to the short-term impact and the fact that construction will be limited to daytime hours on weekdays, the impact on residences is considered moderate.

The proximity of the school to construction on the levee and in the Northwest Developed zone would result in noise of 60 dBA and above. There will be unavoidable significant impacts on the school from noise resulting from construction.

Ten-cubic yard trucks will be used to remove contaminated soil to the railyard for stockpiling and to bring in clean soil. The trucks would generate approximately 62 dBA and thus would not be distinguishable from excavation noise near the construction site. Trucks would be used only during the excavation periods. Impacts along U.S. Highway 2 and at the disposal sites would be negligible. Twenty-cubic yard trucks will be used to transport the contaminated material along Highway 2. If trains were used instead of trucks to transport the contaminated material, noise levels would not be significantly different from the current (no-action) alternative.

Heavy machinery used for well installation will generate vibrations. Heavy machinery will only operate during daytime hours during weekdays. There are no significant adverse impacts in the form of vibrations due to well installation.

4.3.1.2 Excavation (Soil, NAPL, Surface, and Sediment)

Depending on the extent of excavation, excavation as a remedial alternative element could last from 3 weeks for sediment removal in the aquatic zones to 23 weeks for excavation to cleanup levels in the Northwest Developed zone. Excavation will take place during low water conditions (in the summer). Should the Northwest Developed Zone be excavated to cleanup levels the school will be relocated in which case noise from construction will not affect the school. There are no adverse impacts in the form of noise due to excavation at the school. Due to the short-term impact and the fact that construction will be limited to daytime hours on weekdays, the impact from noise on residences is considered moderate.

Heavy machinery used for excavation will generate vibrations. Heavy machinery will only operate during daytime hours during weekdays. There are no significant adverse impacts in the form of vibrations due to excavation activities.

4.3.1.3 Ozone Sparging

Ozone sparging is anticipated to last 5 years. Both ozone and oxygen generators will be required in each zone where ozone sparging is taking place. Generators typically produce 85 dB. Generators will be placed in sound enclosures that generally reduce sound by 10 dB (J. Franz, telephone commun., June 10, 2003). This would result in 75 dB audible outside of the sound enclosure. This is considered a major impact because the generators will run continuously.

4.3.1.4 Soil Flushing

Soil flushing is anticipated to last 3 to 6 months. A water treatment system will be constructed on the railyard for this remedial alternative element. The distance from the railyard to residences and commercial buildings is expected to attenuate the noise produced. Pumps used to inject the surfactants will be aboveground and will produce 60 dB of noise. Pumps used to extract water will be belowground and are not considered to be a source of noise. Due to natural attenuation the impacts from the pumps is anticipated to be moderate and not major.

4.3.1.5 Enhanced Bioremediation

Enhanced bioremediation could last indefinitely. Blowers will be required in cleanup zones where enhanced bioremediation is taking place. Blowers generate approximately 65 to 85 dB of noise and would operate 24 hours a day. When placed in sound enclosures, the blowers would generate at most 55 dB of noise just outside of the enclosure. Taking into consideration attenuation of sound outdoors, noise is not expected to be a significant impact from enhanced bioremediation.

4.3.1.6 Natural Attenuation

There are no significant adverse impacts on noise associated with this remedial alternative element.

4.3.2 Hazardous Substances

Hazardous substances at the project site are of two types:

- Residual contamination in environmental media (air, water, sediment and soil) that are the subject of the cleanup action (e.g., petroleum hydrocarbons).

- Hazardous substances managed as part of the cleanup action (e.g., surfactant detergents, fuel for equipment).

These materials may result in human health or ecological risk from chronic (long-term) or acute (short-term) exposure via incidental ingestion or dermal contact, inhalation of dust or vapors, or inhalation of emissions. Receptors include community residents, remediation workers, and fish and wildlife.

The management of human health and ecological risk from residual contamination present at the project site is the primary driver for the project. The determination of cleanup levels for soil, groundwater, surface water, and sediment by their nature mean that the remedial actions will result in a net beneficial impact on environmental health compared to the no-action alternative. Any cleanup action that meets the MTCA cleanup objectives will not result in significant adverse impacts to environmental health.

The following discussion therefore focuses on short-term impacts due to use of hazardous substances as part of the cleanup action.

4.3.2.1 Levee and Skykomish River Aquatic Resource Zone

Remove Surface Sediment, Enhanced Bioremediation, and Excavation

No hazardous substances are used as part of these alternatives. Short-term risk to remediation workers is limited to exposure to emissions from the excavation machinery, and accidental exposure to any product exposed or removed. Use of appropriate personal protective equipment (PPE) will mitigate this risk.

Ozone Sparging

Ozone is fairly stable in dry air and has a half-life of several hours in low concentration. In water, ozone half-life is several minutes. Because ozone is very reactive in an aqueous environment, ozone can oxidize material between 10 to 1,000 times faster (Hoishe and Bader, 1983) than most oxidants used in water treatment. Because ozone has such a short half-life, it cannot be compressed and stored. Instead, it must be generated on site and used immediately. The short half-life also implies that ozone is not likely to reach the surface, disperse in the atmosphere, or to adversely impact environmental health. No significant adverse impacts are expected. Use of appropriate PPE will mitigate any risk to remediation workers during gas generation and application.

In Situ Flushing

Flushing entails the use of a combination of heat, polymers and surfactants to remove free product. The surfactants include anionic surfactants such as Alfoterra© 123-8PO Sulfate, a branched alcohol propoxylate sulfate. Toxicity tests on similar materials indicate that toxicity is low (oral LD50 for rats greater than 5 g/kg), eye irritation is low (rabbit Draize score of 12 to 21 on a scale of 100), and rabbit skin irritation is moderate (approximately 4 on a scale of 8). While repeated or prolonged contact may cause irritation of the skin, this material is considered of low toxicity with no hazard to human health under normal use (Sasol, 2001). The polymers are generally considered inert. As discussed in Section 7.2.2, the heating process is not expected to result in increased volatilization or intrusion of vapors. The heated mixture will be prepared at a facility on the railyard and pumped in pipes to the injection locations. No exposure to the material is expected except for remediation workers operating the system. Remediation workers are expected to use appropriate PPE. No significant adverse impacts to residents are expected.

4.3.2.2 Former Maloney Creek Aquatic Resource Zone

See discussion for the levee and Skykomish River Zone above for flushing, ozone sparging, excavation, enhanced bioremediation and surface sediment removal impacts.

Natural Attenuation

In this option any chronic human health risk from surface sediment exposure will likely remain longer than under more intrusive remedial methods. However, the risk to human health from the low current levels of petroleum hydrocarbons in surface sediment (500 mg/kg or less, compared to the Method A screening level of 2,000 mg/kg) is not expected to be significant and therefore no significant adverse impact is expected. The higher concentrations of contaminants present in the deeper smear zone is not an active exposure pathway, and as long as no deep excavation occurs in the area will not result in significant adverse impact.

4.3.2.3 Developed Zones

All cleanup actions proposed for groundwater and soil in the developed zones occur in areas with public access and residents present. Therefore, potential impacts include short-term impacts to residents and visitors, in addition to remediation workers.

Natural Attenuation

This cleanup approach does not result in significant short-term adverse impacts as no hazardous materials are handled. Long-term adverse impacts are relatively larger (longer term) than more intrusive cleanup approaches, and are similar to the no-action alternative.

Enhanced Biodegradation

This cleanup approach does not result in significant short-term adverse impacts as no hazardous materials are handled.

In Situ Flushing

See discussion for the levee and Skykomish River Zone above.

Excavation

Excavation of impacted soil and free product in all or part of the developed area is disruptive. It may be expected that heavy excavation equipment operating in close proximity to inhabited buildings and public roads will result in vehicle emissions and objectionable odors. Contact with contaminated soil and free product via accidental exposure or dust is possible, particularly when excavating in residential areas where children may access the dig after hours. Significant adverse impacts are moderate (dust, odors, incidental contact) to severe (accidental acute exposure to product).

Mitigation measures include dust control, effective access control (including after hours), up to temporary evacuation during excavation.

Surface Soil Excavation

This cleanup approach is proposed for 400 cy of surface soil affected by lead (greater than 250 mg/kg) covering 0.12 acre in the Northwest Developed Zone. Removal actions may result in dust contaminated with lead. Neighbors, visitors, schoolchildren, and remediation workers may be exposed to unacceptable levels of inhaled lead. The risk from lead is magnified for children, which is significant as one area affected is the schoolyard. The volume of soil is fairly low, and the expected time to complete the removal is short (2 days). Potential adverse impacts can be qualified as minor. The Occupational Safety and Health Administration (OSHA) standard for occupational lead exposure is $0.05\mu g/m^3$, which is not likely to be approached at this site. However, children are more sensitive, and exposure to dust from the excavation should be avoided.

Mitigation measures for this cleanup approach focuses on appropriate dust control to avoid dust spreading to neighboring properties or to buildings. Use of appropriate PPE by remediation workers is assumed.

Appropriate mitigation should mean that no unavoidable significant adverse impact from dust is present.

Free Product Recovery Trenches

The installation of free product trenches on public and private property is minimally intrusive. No hazardous materials are used. Temporary emissions from excavation equipment are short-lived. The skimming equipment is located in subsurface vaults where they are inaccessible. No exposure to recovered product is expected, except for remediation workers servicing the units. Such workers will be required to wear appropriate PPE and take appropriate precautions if accessing confined spaces.

4.3.2.4 Railyard

The railyard is similar to the developed zones, except that residents and visitors are not supposed to be present. However, the railyard area is not fenced or guarded, and trespassing is likely to occur.

Excavate Surface Soil

This cleanup approach is proposed for areas with elevated TPH, arsenic and lead. Approximately 10,000 cy, of which 5,700 cy are associated with metals, would be excavated. Significant adverse impacts from spread of contaminated dust are possible. The excavation locations are a bit more distant from residences than in the developed zone case, but the nearest residences are still within 120 yards. Use of heavy excavation machinery may result in exposure to emissions.

A key mitigation measure is effective dust control to avoid dust reaching adjacent residential areas from the excavation or the stockpiles. Use of appropriate PPE by remediation workers is required.

No unavoidable significant adverse impacts are expected, except transiently to vehicle and equipment emissions.

Free Product Recovery Trenches, Natural Attenuation, Enhanced Biodegradation, and *In Situ* Flushing

See discussion for Developed Zones above.

Excavation

Excavation may encompass the entire railyard (21 acres to 14 feet depth), NAPL only (1.06 acres to 14 feet), or the south plume only (0.175 acre to 11 feet [average]). Excavation of impacted soil and free product is disruptive. Contact with contaminated soil and free product via accidental exposure or dust is possible, particularly when excavating although excavation is occurring in areas off-limits to the public. However, the absence of fencing indicates some after-hours access is possible. The distance to residences and businesses suggest that dust and odors is of less significance but potentially present. Significant adverse impacts are minor (dust, odors, incidental contact) to severe (accidental acute exposure to product).

Mitigation measures include dust control and improved access control (including after hours).

4.4 Transportation

Significant adverse impacts on transportation and services could result from wear and tear on roadways, increased traffic, temporary shutdowns of power and other utilities, and damage to on-site septic systems. This section considers impacts on roads, transportation systems, traffic and public services.

There are two classes of truck traffic that are considered in this section. The first class is local truck traffic between excavation sites and stockpiles on the railyard. The second class of truck traffic is to the off-site disposal facility in Roosevelt, Washington near the Washington-Oregon border. Trucks will likely travel east on U.S. Highway 2 and then south on U.S. Highway 97 and Interstate 82. Trucks will continue on Washington Highway 22, Washington Highway 221, and Washington Highway 14 to the landfill. Contaminated waste may also travel by rail to Roosevelt, Washington. Trains of approximately 25 railcars might leave from and travel by rail to Roosevelt. Trains could leave Skykomish as often as 2 to 3 times per week for 3 weeks up to 50 weeks depending on the alternative chosen. The existing siding should be adequate to accommodate the loading of these railcars. The number of trains per week can be decreased if the number of weeks that trains transport material is increased. Alternatively trucks may transport the waste to a transfer station in Everett, Washington by traveling west on U.S. Highway 2. The following analysis assumes the maximum number of trucks (100) trucks will transport material off-site each day. This would be about a 4.2% increase in traffic on U.S. Highway 2. The number of truck trips per day can be decreased if the number of days that trucks transport material is increased.

For the purposes of this EIS, significant impacts are defined as given in Table A-3.

4.4.1 Levee and Skykomish River Aquatic Resource Zone

4.4.1.1 Well Installation (Ozone Sparging, Soil Flushing, Enhanced Bioremediation)

Well installation requires a temporary road for the drill rig to reach the top of the levee. The temporary road would be on the western end of the levee and cover approximately 2,400 ft^2. Depending on the type of wells installed, up to 50 truck trips would occur between the levee and the railyard transporting excavated material and clean backfill during the 1 day of trench excavation. Due to the short duration of the increased traffic, these effects on roads or transportation associated with well installation on the levee are considered temporary and minor.

4.4.1.2 Soil Excavation

Excavation of the levee would require the purchase and demolition of an abandoned house as shown on Figure A-1. A temporary road covering approximately 12,500 ft^2 through this lot would allow dump trucks to reach the railyard on a dedicated access road. This remedial alternative element would result in approximately 200 trucks per day driving between the levee and the railyard for 1 month. Approximately 12,000 cy of excavated material will need to be disposed of off site. This would result in 7 days of increased traffic along Highway 2. This is a major impact on traffic along U.S. Highway 2. If the contaminated excavated material were to be shipped by rail, it would require three trains per week for the 4 weeks of excavation. This is considered a major impact on existing transportation conditions associated with levee excavation.

4.4.1.3 Sediment Removal

Sediment removal to remediation levels or cleanup levels would require an access ramp on the east end of the levee that covers approximately 4,500 ft^2. This road would be temporary. Sediment removal would require up to 11 truck trips per day for a 2-week period to transport excavated material to the railyard for stockpiling or off site for disposal. If trains were used to transport material off site, up 14 railcars would be needed otherwise 6 truck departures during would be needed. Due to the short-term impact these impacts on existing traffic conditions associated with sediment removal are considered temporary and minor.

4.4.2 Former Maloney Creek Aquatic Resource Zone

4.4.2.1 Well Installation (Enhanced Bioremediation)

No trenches will be placed in the Former Maloney Creek itself. Up to 18 truck trips total will be needed to move excavated soil from trenches on the railyard to stockpiles for wells in the former Maloney Creek. A total of one truck trip or one rail car will be needed to transport contaminated waste during the day of excavation. Due to the small magnitude and short duration of the increased traffic, well installation in the Former Maloney Creek Zone would have no significant impact on roads and transportation but would have a minor impact on traffic.

4.4.2.2 Soil Excavation and Sediment Removal

Soil excavation in the Former Maloney Creek Zone would require approximately 150 truck trips per day to transport excavated material and backfill for a 2-week period from the former Maloney Creek to the railyard. If the contaminated material were to be removed by rail it would result in three trains per week for 2.5 weeks. If it were to be removed by truck it would result in 4 days of 4.2% increased traffic with 100 truck trips each day. These are moderate impacts on roads, transportation, and traffic.

Sediment removal would result in up to 24 truck trips per day during the 1-week excavation to transport the material to the railyard for stockpiling and to transport the material off site for disposal. If rail were used to transport the material, up to 15 railcars would be needed (out of 25 railcars on a train). Alternatively, 30 truck trips could be used to haul the contaminated material off site for disposal. Due to the small magnitude and short duration of the increased traffic, there are no significant adverse impacts on existing traffic conditions associated with sediment removal in the Former Maloney Creek Zone.

4.4.3 Northeast Developed Zone

4.4.3.1 Well Installation (Enhanced Bioremediation)

Excavated soil resulting from trenching for enhanced bioremediation well installation will require at most 84 truck trips during the day that the trenches are excavated to transport the soil to the railyard. There should not be more than three railcars of excavated soil or 5 truckloads of excavated soil requiring off-site disposal. Due to the short duration and small magnitude of this traffic, this alternative would not have significant adverse impacts on roads, transportation, or traffic.

4.4.3.2 Soil and NAPL Excavation

NAPL excavation in the Northeast Developed Zone would result in approximately 200 truck trips per day between the Northeast Developed Zone and the railyard during the week of excavation. Approximately two trains (of 25 railcars each) would be needed to transport the contaminated waste. If contaminated material were transported by truck off site, there would be less than 2 days of increased truck traffic of 100 truck trips per day. NAPL excavation would have minor and temporary impacts on roads, transportation, and traffic.

Soil excavation to the cleanup level would result in approximately 185 truck trips per day during the 5 weeks of excavation to transport excavated material and clean backfill to and from the railyard. Approximately three trains per week will be needed to transport material for off-site disposal over 4 weeks. Should trucks be used to transport contaminated material to the landfill, there would be 6 days of increased truck traffic of 100 truck trips per day (4.2% increase). These impacts are significant and unavoidable.

Use of trains instead of trucks to haul soil to off-site disposal areas would mitigate impacts on U.S. 2 traffic.

4.4.4 South Developed Zone

4.4.4.1 Soil, Surface, and NAPL Excavation

Due to the small area of the South Developed Zone excavation activities under any of these remedial alternative elements would last no more than 2 days. The maximum traffic resulting from the excavations would be 200 truck trips per day for 2 days between the South Developed Zone and the railyard. Transportation of soil to an off-site disposal facility would require one train per week or up to 1 day of increased traffic. The impact on traffic is considered moderate and the impact on roads and transportation is considered minor and temporary.

4.4.4.2 Natural Attenuation

There are no significant adverse impacts on roads and transportation associated with this remedial alternative element.

4.4.5 Northwest Developed Zone

4.4.5.1 Soil Flushing and Enhanced Bioremediation Well Installation

Trench excavation activities for the installation of soil flushing wells in the Northwest Developed Zone would result in 135 truck trips for transportation of material to and from the railyard during the day of excavation. Off-site disposal would require less than 1 day of increased truck traffic or eight railcars.

Trenching for enhanced bioremediation wells would result in approximately 35 truck trips during the day of excavation. Nine truck loads or two railcars would be needed for off-site disposal of contaminated material. Due to the short duration of the traffic increase due to well installation, soil flushing and enhanced bioremediation would have moderate adverse impacts on roads and transportation.

4.4.5.2 Soil Excavation

Soil excavation to cleanup levels would result in 200 truck trips per day transporting excavated material and backfill during the 27 weeks of excavation. The contaminated soil would require three trains a week or approximately 42 days of increased truck traffic to be removed off site. This is considered a major and unavoidable adverse impact on roads and transportation.

Excavation would disrupt traffic, as some excavation will take place in rights of way. However, if soil is excavated to cleanup levels all of the buildings will be relocated or demolished.

Use of trains instead of trucks to haul soil to off-site disposal areas would mitigate impacts on U.S. 2 traffic.

4.4.5.3 Surface Excavation

Surface excavation in the Northwest Developed Zone would take approximately 2 days. During these 2 days, 40 truck trips per day could be expected between the excavation site and the railyard. Contaminated soil would require approximately 10 railcars to be transported off site. If trucks were used to transport material off site, there would be less than 1 day of increased traffic of 100 trucks per day. Due to the short duration and the small magnitude of this traffic, this alternative would minor adverse impacts on roads, transportation, and traffic.

4.4.5.4 Natural Attenuation

There are no significant adverse impacts on roads and transportation associated with this remedial alternative element.

4.4.5.5 NAPL Skimming and Trenching

NAPL skimming and trenching will require approximately three truck trips per week during the 17 weeks of excavation to transport excavated material to the railyard for stockpiling. At most, 6 trucks or three railcars would be needed to transport contaminated material off site. Due to the short duration and the small magnitude of this traffic, NAPL skimming and trenching in the Northwest Developed Zone would have minor adverse impacts on roads and transportation and a moderate impact on traffic.

4.4.5.6 NAPL Excavation

NAPL excavation in the Northwest Developed Zone could be in accessible areas or could be of all free product. Excavation of all free product would require 200 truck trips per day during the 9 weeks of excavation between the Northwest Developed Zone and the railyard. Off-site disposal would require approximately three trains per week or 13 days of increased (by 4.2%) traffic on U.S. Highway 2. These impacts on roads and transportation are moderate. The impact on traffic is major and unavoidable.

Excavation of NAPL, where accessible, would require 200 truck trips per day to transport material from the excavation to the railyard for stockpiling during the 7 weeks of excavation. Eleven days of increased traffic on U.S. Highway would be needed for off-site disposal during the 7 weeks of excavation.

NAPL excavation where accessible will leave all existing structures in place. However, traffic will be disrupted during excavation. This is considered a major and unavoidable adverse impact on traffic.

4.4.6 Railyard

4.4.6.1 Soil Flushing

Soil flushing on the railyard would require up to 84 truck trips per day during the 2 days of trench excavation depending on where on how many flushing wells are installed. At most, five railcars (total) or 10 truckloads would be needed to transport contaminated soil off site. Due to the short duration and the small magnitude of this traffic, *in situ* soil flushing in the railyard would have temporary and minor adverse impacts on roads, transportation, and traffic.

4.4.6.2 Excavation

There are four proposed types excavations on the railyard: surface excavation, excavation of the southern plumes of free product, excavation of all soil to residual saturation where accessible, and excavation of all soil to cleanup levels.

4.4.6.3 Surface Excavation

Surface excavation does not require excavating near the mainline of the BNSF railroad or the two sidelines. Surface excavation should not disrupt existing train traffic that passes through Skykomish. Surface excavation would require approximately 100 truck trips per day to move material around the railyard during the 3 weeks of excavation. Off-site disposal would require two trains per week or 3 days of increased truck traffic along U.S. Highway 2. Due to the short duration of this traffic, surface excavation in the railyard would have moderate adverse impacts on roads, transportation, and traffic.

4.4.6.4 Excavation of Southern Plumes

Excavation of the southern plumes does not require excavating near the mainline of the BNSF railroad or the two sidelines. Excavation of the southern plume should not disrupt existing train traffic that passes through Skykomish. Excavation of the southern plumes would require approximately 200 truck trips per day to transport material around the railyard during the 3 days of excavation. Off-site disposal would require two trains total or up to 2 days of increased traffic along U.S. Highway 2. Excavation of the two southern plumes in the railyard would have major adverse impacts on roads, transportation, and traffic.

4.4.6.5 Excavation to Residual Saturation

Approximately 20 truck trips per day during the 20 weeks of excavation will be needed to transport excavated material and clean backfill around the railyard. Excavation to residual saturation where accessible on the railyard would require three trains per week or 27 days of increased (by 4.2%) truck traffic. This is considered a major and unavoidable adverse impact on roads and transportation.

4.4.6.6 Excavation to Cleanup Levels

Excavation to cleanup levels in the Railyard Zone would require rerouting of the mainline of the BNSF railroad prior to excavation. Approximately 200 trucks per day will be needed to move material around the railyard. Approximately 41 days of increased traffic would be required to transport excavated material off site. These impacts on transportation are significant and unavoidable.

4.4.6.7 Enhanced Bioremediation

There are two proposed enhanced bioremediation alternatives: along the property boundary or zone-wide. Enhanced bioremediation along the property boundary would result in 82 truck trips transporting excavated material around the railyard during the 1 day of excavation. Zone-wide enhanced bioremediation requires approximately 117 truck trips per day during the 2 days of excavation transporting excavated material around the railyard. It is estimated that up to seven railcars or 15 truckloads would be needed to transport material for off-site excavation. Due to the small magnitude and duration of the increased traffic, there is are moderate adverse impacts on roads, transportation, and traffic associated with enhanced bioremediation on the railyard.

4.4.6.8 Natural Attenuation

There are no significant adverse impacts on roads and transportation associated with this remedial alternative element.

4.4.6.9 NAPL Skimming and Trenching

NAPL skimming and trenching will require approximately one truck trip per day during the 8 weeks of excavation to transport excavated material around the railyard for stockpiling. Approximately three truck trips or two railcars would be needed for off-site disposal. Due to the short duration and the small magnitude of this traffic, NAPL skimming and trenching in the railyard would not have significant adverse impacts on roads and transportation.

Summary of Proposed Cleanup Approaches for the BNSF-Skykomish Site

	Least Aggressive Approach (Surface Water [SW])	More Aggressive Approach (Property Boundary [PB])	Most Aggressive Approach (Standard [STD])
Technologies	Less Excavation Less Wells within Community Trenches and Skimming	Excavation Numerous Wells within Community Trenches Enhanced Bioremediation Flushing	Excavation
Impacts	Buildings Mostly Left Intact Residents Remain On Site or Relocated Less Disruption	Buildings Removed/Replaced Residents Remain in Homes - Temporarily Relocated Moderate to a Lot of Disruption	Buildings Removed/Replaced Residents Temporarily Relocated A Lot of Disruption
Results	A Lot of Contamination Left Numerous Follow-Up Activities Institutional Controls	Partial Cleanup, Some Contamination Left Numerous Follow-Up Activities Institutional Controls	Complete Cleanup Few Follow-Up Activities Few or No Institutional Controls
Timeframe	Never/Unknown Number of Years for Most Zones (Possibly greater than 30 years)	Unknown Number of Years for Most Zones (Possibly up to 30 years)	2-5 Years