Prepared for:
The BNSF Railway Company
Seattle, Washington

2007-2008 Annual Site-Wide Groundwater Monitoring Report

BNSF Former Fueling and Maintenance Facility – Skykomish, Washington

AECOM, Inc.
July 2009
Document No.: 01140-204-0340

AECOM

Prepared for:
The BNSF Railway Company
Seattle, Washington

2007-2008 Annual Site-Wide Groundwater Monitoring Report

BNSF Former Fueling and Maintenance Facility – Skykomish, Washington

Prepared by Cassie Smith, Geologist

Reviewed by Renee Knecht, L.G., Project Geologist

Reviewed by Thom Booth, L.H.G., Project Hydrogeologist

AECOM, Inc.
July 2009
Document No.: 01140-204-0340

AECOM

Contents

List of Appendices

List of Tables

List of Figures

1.0 Introduction

This Site-Wide Groundwater Monitoring Report (report) was prepared for the Burlington Northern Santa Fe (BNSF) Former Fueling and Maintenance Facility, Skykomish, Washington (Site) on behalf of the BNSF Railway Company, in accordance with Section VI.A.6. of Consent Decree No. 07-2-33672-9SEA and the *Groundwater Monitoring Plan* (Plan; RETEC, 2005a, 2007 and ENSR, 2008a) and describes the details and results of the site-wide groundwater monitoring activities performed from August 2007 to September 2008. This includes 1) semi-annual site-wide monitoring events completed in March and September 2008; 2) bi-monthly Levee Zone monitoring completed in October, November and December 2007; and 3) quarterly Levee Zone monitoring in March and June 2008.

1.1 Groundwater Monitoring Objectives

The *Groundwater Monitoring Plan* (Plan; RETEC, 2005a, 2007 and ENSR, 2008a) describes a program that is intended to accomplish the following objectives:

- Evaluate potential changes in total petroleum hydrocarbons (TPH) distribution that may affect implementation of cleanup actions throughout the Site.
- Provide monitoring data for the groundwater in the Levee Zone to assess how Levee Zone interim cleanup actions affect groundwater quality.
- Provide water level data to assess the groundwater flow direction in the vicinity of the Former Maloney Creek east wetland.

1.2 Background

The Site includes BNSF property and adjacent public and private properties within the Town of Skykomish, and encompasses an area of about 40 acres (Figure 1-1). The Site is approximately bounded by: the South Fork Skykomish River to the north, Skykomish city limits to the east, Old Cascade Highway to the south, and Maloney Creek to the west. Railroad Avenue separates BNSF property from the main commercial district of the town (Figure 1-2).

The Former Railway Maintenance and Fueling Facility in Skykomish is owned and operated by BNSF. Historical activities since the facility opened in the late 1890s included refueling and maintaining locomotives and operating an electrical substation for electric engines. BNSF stored Bunker C and diesel fuel at the Site in aboveground storage tanks (ASTs) and underground storage tanks (USTs) until 1974, when BNSF discontinued most fuel handling activities at the Site.

Some of the historic Site activities resulted in the release of petroleum products and other compounds to the surrounding environment. In early 1991, Washington State Department of Ecology (Ecology) designated the Site as a high priority cleanup site. Later that year, BNSF initiated plans to conduct a Remedial Investigation/ Feasibility Study (RI/FS) in accordance with the Ecology Model Toxics Control Act (MTCA). At that time, formal negotiations for Agreed Order No. DE 91TC-N213 began. Negotiations were completed in mid-1993. Following a public comment period, the Agreed Order, which included detailed work plans for the RI/FS process and early interim action for cleanup work, was signed by Ecology and BNSF. Ecology and BNSF signed a separate agreed order (No. DE 01TCPNR-2800) in 2001 for additional interim action cleanup work near the South Fork Skykomish River and the levee west of 5th Street. BNSF has been routinely monitoring groundwater at the Site pursuant to the 2001 Agreed Order and *Interim Action Basis of Design Report for the*

LNAPL Barrier System (RETEC, 2001). BNSF also conducted groundwater monitoring pursuant to the 1993 Order (after the RI and supplemental RI) in conjunction with the 1995 interim action (passive skimming wells).

In 2006, Ecology and BNSF signed an additional agreed order (No. DE-2379) that outlined the interim action for cleanup work in the Levee Zone and part of the Northwest Developed Zone (NWDZ). This interim action consisted of:

- Temporary relocation of five residences,
- Excavation of the levee, underlying soils and sediments along the south bank of the South Fork Skykomish River,
- Reconstruction of the levee, and restoration of natural resources, private property and public infrastructure that were disturbed by the remediation activities.

Under the 2006 Agreed Order, BNSF was required to continue groundwater monitoring as described in the *Groundwater Monitoring Plan* (RETEC, 2005a). In October 2007, BNSF and Ecology signed a Consent Decree (CD, No. 07-2-33672-9 SEA). Any remaining work required by the 2006 order was incorporated into and required by the CD. The CD requires BNSF to conduct a final cleanup of the Site by implementing the 2006 *Action Plan for Cleanup* (CAP) (ENSR, 2007b) in accordance with the schedule identified in the CD.

Section VI.A.6 of the CD requires BNSF to conduct groundwater monitoring consistent with the *Groundwater Monitoring Plan* (RETEC, 2005a) as amended. Upon the approval of Ecology, the *Groundwater Monitoring Plan* was amended in 2007 to the *Groundwater Monitoring Plan, Revision 1* (RETEC, 2007), which went into effect in July 2007. This plan is revised annually. The most recent revision, *Groundwater Monitoring Plan* (ENSR, 2008a), was approved by Ecology and went into effect in July 2008.

Since 1993, investigations performed by BNSF, in cooperation with Ecology, have revealed petroleum residuals in soil, groundwater, sediments, and surface water. Detailed information about the scope of prior investigations and the results appear in the 1996 *Remedial Investigation Report* (RETEC, 1996), the 2002 *Supplemental Remedial Investigation Report* (RETEC, 2002), the 2005 *Feasibility Study (RETEC 2005b)* and the 2007 *Remedial Design Investigation Report* (RDI Report, ENSR, 2008b).

1.3 Report Organization

Section 1 of this report provides an introduction, background information and the objectives of the site-wide groundwater monitoring. Section 2 describes the monitoring well network, changes made to the network during the monitoring period, and forthcoming changes related to cleanup activities. Section 3 describes the methods used to perform the monitoring activities. Section 4 describes the laboratory analyses and reporting and the subsequent data management and validation activities performed by AECOM Environment (AECOM). The section also describes the groundwater cleanup levels and remediation levels that have been established for the Site. Section 5 describes the results of the monitoring activities, specifically the fluid level gauging and analytical results from the groundwater sampling. Section 6 provides a summary of the data and recommendations for future sampling events. Finally, Section 7 provides cited references.

2.0 Monitoring Well Network

This section describes the piezometers and wells that were included in the groundwater monitoring network for fluid level gauging and groundwater analytical sampling during the monitoring period. Piezometer and well locations are shown in Figures 2-1 and 2-2.

Since the 2007 monitoring event, 11 piezometers were added to the FMCZ and 18 monitoring wells were decommissioned along Railroad Avenue. In agreement with Ecology (ENSR, 2007a), the 11 piezometers were installed in the FMCZ East Wetland, RYZ, and SDZ during August and September 2007 to evaluate groundwater flow direction in the vicinity of the east wetland and to compare groundwater to surface water levels within the east wetland. Monthly gauging took place immediately following installation. These piezometers were officially added to the monitoring well gauging network in the *2008 Groundwater Monitoring Plan (ENSR, 2008a).*

The monitoring well gauging and sampling network was further modified after the March 2008 semi-annual groundwater sampling and gauging event. In April 2008, 18 monitoring wells were decommissioned along Railroad Avenue in preparation for the 2008 excavation and construction of the Hydraulic Contaminant Control (HCC) wall. Eight of these wells were part of the fluid level gauging network. Decommissioning details will be included in the *2008 Skykomish Remediation – As Built Completion Report*, which was submitted in March 2009 (AECOM 2009).

The monitoring well network utilized from June 2007 to June 2008, as described in the *Groundwater Monitoring Plan, Revision 1* (RETEC, 2007), consisted of the following, as categorized by the monitoring frequency.

- Monthly Monitoring - 11 piezometers and 27 monitoring wells for fluid level gauging in the vicinity of Former Maloney Creek starting in November 2007
- Bi-Monthly Monitoring - 13 monitoring wells for fluid level gauging in the vicinity of the Levee Zone; 7 of these wells were sampled for TPH analysis by NWTPH-Dx
- Semi-Annual Monitoring –
  - 41 monitoring wells for Site-wide fluid level gauging; 28 of these wells were sampled for TPH analysis by NWTPH-Dx
  - 9 locations for surface water level gauging

The current monitoring well network, which was utilized from July 2008 to September 2008 and is as defined in the July 2008 version of the *Groundwater Monitoring Plan* (ENSR, 2008a) consists of the following, as categorized by the monitoring frequency.

- Monthly Monitoring - 11 piezometers and 27 monitoring wells for fluid level gauging in the vicinity of Former Maloney Creek
- Quarterly Monitoring - 13 monitoring wells for fluid level gauging in the vicinity of the Levee Zone; 7 of these wells were sampled for TPH analysis by NWTPH-Dx

- Semi-Annual Monitoring –
  - 33 monitoring wells for Site-wide fluid level gauging; 21 of these wells were sampled for TPH analysis by NWTPH-Dx
  - 9 locations for surface water level gauging

In the remainder of this document, the "Plan" refers to the 2008 revision of the Groundwater Monitoring Plan (ENSR, 2008a), as approved by Ecology, and described in Section 1.

In addition to the monitoring scope defined in the Plan, a seep, along the bank of the South Fork Skykomish River, located near the 6th Street fallout, was sampled in September 2008 per Ecology's request.

During site-wide gauging events during this reporting period there were two wells (2A-W-7 and 2A-W-4) with suspect groundwater elevations. The groundwater elevations in these wells were consistently higher than the surrounding areas. This is believed to be due to errors in well elevation survey data. This has been noted on the respective potentiometric map figures and these wells will be re-surveyed in the near future.

The conditional points of compliance for groundwater are generally described in Section 3.4 and Figure 6 of the CAP. The monitoring network described above was established, in part, before the CAP was issued by Ecology in October 2007; however, all of the wells in the network are well inside the groundwater compliance boundary. Compliance boundary wells will be identified in the Long-Term Compliance Monitoring Plan to be developed at the conclusion of active remediation.

3.0 Gauging and Sampling Procedures

This section describes the field methods that were used for the fluid level gauging and sample collection activities described in the Plan.

3.1 Fluid Level Measurements

3.1.1 Groundwater Levels and Product Thickness Measurements

Fluid level measurements were made to provide groundwater elevation and free product thickness data. The fluid levels were measured and recorded at each well location prior to purging or sample collection activities. Two methods were used to measure fluid levels at monitoring well locations depending on whether a well contained Light Non-aqueous Phase Liquid (LNAPL).

If LNAPL was observed as a light trace (0.01 feet thick) then the depth to the top and the thickness of the LNAPL was measured using tape and paste. In this method, a measuring tape was coated with a water-reactive paste. The tape was then lowered into the well until it was below the water level. The paste reacts to the water by changing color and the LNAPL thickness can be estimated by the tape interval that was coated with the petroleum product. The groundwater elevation was then derived from the length of measuring tape that has not changed color. The LNAPL thickness was added to the groundwater elevation to derive the LNAPL top elevation.

If the LNAPL was observed at a greater thickness (0.02 feet or more thick), then, in addition to the tape and paste method, the thickness was verified using a site-specific method that employs a peristaltic pump. First the top of fluid was measured. Then, polyethylene tubing was lowered into the well to a depth below the water table. Water was pumped while the tubing was gradually raised. Once the pump began to pump LNAPL instead of water, the remaining tubing was pulled from the well and its length was measured to derive elevation.

If LNAPL was not observed, then a water level meter was used to gauge depth to water. The method used for gauging each well was noted on the gauging field forms, which are provided in Appendix A.

All measurements were collected in accordance with the Plan (ENSR, 2008a). Measurement equipment was decontaminated between wells in accordance with Standard Operating Procedure (SOP) 7600 and fluid level data were recorded on appropriate field forms (provided in Appendix A of the Plan). The field form includes fields for date and time of the measurement, depth to water (in feet), depth to LNAPL (in feet), LNAPL thickness (in feet) and measurement method. In addition, the well condition (including the condition of the lock, monument integrity, and legibility of well labels) was recorded for each location.

Upon completion of a measurement event, the field manager inspected the field forms and collected data. After assuring that the information was complete, the field manager signed the quarterly gauging sheets before the field staff left the Site.

3.1.2 Surface Water Level Measurements

River stage measurements were collected at five locations along the South Fork Skykomish River during the site-wide fluid level measuring events. Two of the locations are at known permanent landmarks (a storm outfall and a bridge abutment). The other three locations are set equidistant from the two landmarks.

The river stage elevations at each location were measured using a surveying level and rod. The elevations were measured from permanent surveying monuments in the street, parallel to the river bank.

Surface water level measurements were also collected from four piezometer locations within the FMCZ -east wetland. The piezometers, which are also used to measure groundwater elevations beneath the wetlands, were constructed with blank casing tops well above the surface water and the top-of-casing elevations have been surveyed. Therefore, the piezometer casings were used to measure the surface water elevations by placing a water level meter along the outside of the piezometers and measuring from the top of the casing to the surface of the water.

3.2 Sampling Methods

Standard EPA-approved low-flow sampling techniques, described in the Plan (SOP 235), were used for monitoring wells that have historically been free of LNAPL.

A different sampling methodology was used for wells containing LNAPL. Due to the nature and physical properties (high viscosity and specific gravity of 0.97) of Bunker C, there is a risk that LNAPL could mix with the underlying groundwater and be entrained in groundwater samples using standard sampling procedures. Therefore, as described in the Plan, air was blown out through the polyethylene tubing as it was lowered into the well. This was done in an attempt to prevent any free product from entering the tubing. These wells were then purged for 10 minutes at a low flow rate before sample collection. The low-flow purging was intended to minimize disturbance and the potential for LNAPL/water mixing. No field parameters were collected.

The fluid level measurements (described in Section 3.1) were used at each product-containing well to position the polyethylene tubing such that the tubing inlet was approximately one foot below LNAPL/water interface. Samples were then collected using low-flow sampling techniques. After sampling was complete at each location, the polyethylene sampling tube was discarded.

3.2.1 Well Purging and Field Parameter Collection

Each well was purged prior to sampling using a peristaltic pump with new disposable tubing at a flow rate of 0.1 to 0.5 L/min. During purging, the flow rates, water levels, and water quality parameters (pH, conductivity, temperature, dissolved oxygen, oxidation-reduction potential, and turbidity) were recorded. Purging continued until the parameters stabilized (i.e., the measured values showed little variation). Water quality parameter measurements are discussed in Section 5.2 of this report.

As previously stated, field parameters were not measured at wells that contain measurable LNAPL because the petroleum product could damage the water quality meters.

3.2.2 Sample Preservation and Handling

Appropriate packaging and shipping methods were used to minimize the potential for sample breakage, leakage or cross contamination (the Plan, SOP 7600). In addition, the documentation accompanying the samples provided a record of sample custody from collection to analysis. All sample containers were pre-preserved in laboratory-cleaned containers. All sample preservation, handling, and analysis were conducted in accordance with the Plan.

3.2.3 Investigation-Derived Waste

All decontamination water and purge water was drummed, labeled and disposed of at a licensed disposal facility in accordance with applicable regulations and the Plan.

4.0 Laboratory Analysis and Reporting

This section summarizes the laboratory analysis and reporting procedures, and the subsequent data management and validation. Groundwater samples were analyzed by Test America Analytical Laboratories (TestAmerica), located in Bothell, Washington. TestAmerica is a Washington-certified laboratory.

4.1 Analytical Methods

Groundwater samples were analyzed for TPH using method NWTPH-Dx both with and without the acid-silica gel cleanup method.

The laboratory was instructed to report sample concentrations to the method detection limit (MDL) rather than the higher method reporting limit (MRL). It was recognized that reported concentrations above the MDL but below the MRL have a greater degree of uncertainty. Accordingly, these results were qualified as estimated (J-flagged). Reporting of results to the MDL has the advantage of reporting detected concentrations at a lower level. This also minimizes the chances that a non-detected result will be reported with a detection limit greater than the cleanup level (CUL).

4.2 Data Packages

TestAmerica provided both electronic data deliverables that could be directly imported into the environmental data management system and text data reports. The text data reports were provided as hard copies (Appendix B) and in electronic (.pdf) files.

Each data report included copies of the chain-of-custody forms and a case narrative with the following information: description of case, comments on sample condition upon receipt, and description of sample preparation and analysis. The following data were included in the data report: MDL, MRL, units of measure, dilution factor, batch number, date received, date prepared, date analyzed, analytical method, and any notes or qualifiers.

The report also contained the details and results of laboratory QA/QC procedures that were performed on the samples.

4.3 Data Management and Validation

Upon receipt of the data from TestAmerica, the electronic data deliverables and case narratives were checked for completeness, and then validated by staff chemists. Once validated, the data were imported into the environmental data management system. Finally, a quality control check was performed on the imported data to ensure that it was accurately uploaded and that transfer errors did not occur.

AECOM chemists evaluated the groundwater data to assess whether the analytical results met the quality control/validation standards described in the Plan. These metrics included precision, accuracy, method compliance and completeness of the data set. The validation results were then used to evaluate whether the data were suitable for their intended use. The validation was performed based on the criteria provided in:

- *USEPA Contract Laboratory Program (CLP) National Functional Guidelines for Organic Data Review*, document number EPA540/R-99/008 of October 1999

- *USEPA CLP National Functional Guidelines for Superfund Organic Methods Data Review*, document number USEPA-540-R-07-003, July 2007.

- *Analytical Methods for Petroleum Hydrocarbons*, ECY 97-602. June 1997.

Field duplicate relative percent difference review and applicable control limits were taken from the USEPA Region I Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses, December 1996.

Data validation reports are presented in Appendix C.

4.4 Groundwater Cleanup Levels and Remediation Levels

The groundwater TPH CUL (208 µg/L) and RL (477 µg/L) are specified in Section 3.4 and Table 1 of the CAP in accordance with WAC 173-340-720. The CAP anticipates that cleanup levels will be attained at points of compliance following implementation of all cleanup actions specified in the CAP and final compliance monitoring begins in 2012. (CAP, Sections 4 and 6.2.)

5.0 Results

This section presents a summary and evaluation of the results from the fluid level gauging and TPH analytical sampling conducted during the reporting period.

5.1 Fluid Levels

This section provides data and conclusions drawn from the quarterly fluid level gauging that occurred from August 2007 through September 2008. Table 5-1 presents gauging results from this reporting period. Seasonal variations in groundwater elevations and product thickness, and changes in groundwater gradients are discussed below.

There were two notable variations from the planned fluid level measurement activities. During the January 2008 monthly gauging event only a subset of locations were inaccessible due to unusually heavy snowfall. The snowfall continued through February 2008 making access to monitoring wells unsafe. Between June 30 and August 25, 2008 potentiometric surface gradients and flow directions were affected by construction dewatering and the installation of the sheetpile HCC wall.

Groundwater levels show seasonal variations in response to river levels and seasonal changes in precipitation. Figure 5-1 shows the locations of the wells and South Fork Skykomish River gauges used in the hydrographs. Figures 5-2 and 5-3 show seasonal groundwater variation for the past five years (January 2003 to September 2008) and for the period from August 2007 to September 2008, respectively. Figure 5-4 shows river levels and groundwater well data from August 2007 to September 2008.

Six wells from around the Site were selected to evaluate the relationship between free product thicknesses and groundwater elevations. Figures 5-5 through 5-10 are scatter plots of water level vs. product thickness from gauging events from 2002 through 2008. These data suggest there may be a slight trend showing a decrease in product thickness as the groundwater elevation increases.

Monthly potentiometric surface maps for the reporting period starting in October 2007 are shown in Figures 5-11 through 5-22. As shown in these figures, the groundwater flow direction is consistently towards the river, to the north or northwest, regardless of the season. These figures also show the groundwater elevations are lower in the levee remediation area due, at least in part, to the impermeable liner, which is shown on the figures and is described in the *Levee Zone Interim Action for Cleanup 2006- As Built Completion Report (*ENSR, 2007b).

5.2 Field Parameters

Table 5-2 presents stabilized field parameter measurements collected during the quarterly and semi-annual groundwater sampling events of the reporting period from all wells except those containing free product. Each field parameter is discussed separately below.

5.2.1 pH

The median pH of groundwater across the site during the reporting period was 6.02. The minimum pH was 4.83 at 2A-W-6 in December 2007 and the maximum pH was 7.45 at 5-W-16 in March 2008. The median, minimum and maximum pH measurements were consistent with past measurements at the Site.

5.2.2 Conductivity

The median conductivity (in µmhos/cm) of groundwater across the Site during the reporting period was 69. The minimum was 32 at MW-37 in March 2008 and the maximum was 307 at 5-W-15 in March 2008. These measurements were consistent with historical values.

5.2.3 Temperature

The median temperature (C) in groundwater during the reporting period was 7.18. The minimum temperature was 0.90 at MW-4 in March 2008, and a maximum temperature was 16.0 at 5-W-4 in September 2008. The temperature varied seasonally.

5.2.4 Dissolved Oxygen

The median dissolved oxygen (DO) concentration (mg/L) in groundwater across the Site during the reporting period was 2.34. The minimum DO was 0.00 mg/L (suspected meter error) and the maximum was 10.70 at 5-W-16. In general, the wells within the 2006 interim action area and outside the areas of known contamination had higher concentrations of DO than the wells within the dissolved plume area. The lowest concentrations of DO were typically measured in areas within and downgradient from the areas of known contamination and in areas having higher concentrations of groundwater contamination. These measurements are consistent with historical values.

5.2.4 Oxidation-Reduction Potential

The median oxidation reduction potential (ORP) in groundwater across the site during the reporting period was 101.2. The minimum ORP value was -112 mV at MW-35 in March 2008 and a maximum was 536 mV at 5-W-17 in March 2008. ORP in groundwater at the site is most commonly positive. These measurements were consistent with historical values.

5.2.5 Turbidity

The median turbidity in groundwater across the Site during the reporting period was 1.90 NTU. The minimum turbidity was 0 at 5-W-17 in September 2008, and the maximum was 48.2 NTU at MW-3 in September 2008. Turbidity measurements were generally less than 10 during the reporting period and are consistent with historic measurements.

5.3 Total Petroleum Hydrocarbons

TPH in groundwater was analyzed using method NWTPH-Dx, which measures diesel range (TPH-D, C12–C25) and oil range (TPH-O, C25-C36) hydrocarbons. Figures 5-23 through 5-28 show the extent of TPH (measured as method NWTPH-Dx without acid/silica gel cleanup) in groundwater. Concentrations provided on the figures are the sums of oil-range (oil) and diesel-range (diesel) TPH concentrations (no silica gel cleanup). Table 5-3 presents the TPH data for the reporting period.

TPH concentrations were compared to the CUL (208 µg/L) and RL (477 µg/L). As described in the Cleanup Action Plan, the CUL should be applied in areas where TPH concentrations in groundwater should be protective of sediments (e.g., near the South Fork Skykomish River and Former Maloney Creek) and the RL should be applied where TPH concentrations in groundwater should be protective of drinking water. The conditional point of compliance (CPOC) boundary shown on figures 2-26 through 5-28 is adapted from CAP Figure 6.

The CPOC is still considered tentative and may be adjusted after cleanup activities are completed. However, for the purposes of discussion, the CPOC is included on the figures and individual results are compared with both the CUL and RL. .

5.3.1 Site-Wide Wells

TPH results for site-wide monitoring are illustrated on Figures 5-23 through 5-28. Oil concentrations ranged from non-detect to 2,490 µg/L. Diesel concentrations ranged from non-detect to 7,750 µg/L. TPH (oil plus diesel) concentrations ranged from 61 to 10,240 µg/L. TPH (oil plus diesel range) concentrations in wells located within or adjacent to the plume typically exceeded the RL.

Analytical results from groundwater samples collected from the semi-annual sampling events were reviewed to evaluate whether TPH concentrations vary seasonally. Figure 5-29 presents time-concentration plots of TPH in selected wells. As this figure shows, TPH concentrations were generally greatest during the fall/winter months. Figure 5-30 shows historical TPH data (when available); no long-term trends are evident within the Site, indicating that the plume location is relatively stable. These figures show that the groundwater concentrations generally increase with higher groundwater elevations.

5.3.2 Levee Zone Wells

TPH results in the Levee Zone are illustrated on Figures 5-23 through 5-28. Oil concentrations ranged from non-detect to 855 µg/L. Diesel concentrations ranged from non-detect to 1,540 µg/L. TPH (oil plus diesel) concentrations ranged from 61 µg/L to 1,965 µg/L. The average concentration was 454 µg/L. Concentrations (oil plus diesel) in wells 5-W-15, 5-W-18, and 5-W-20 typically exceeded the RL. Oil and diesel results using acid-silica gel cleanup were mostly non-detect and TPH concentrations (oil plus diesel) did not exceed the RL or CUL, suggesting potential biogenic interferences. However, since significant remaining TPH has been observed in soil south of the Levee Zone excavated area and in confirmational soil samples along the western excavation side-wall, there is other evidence that TPH-affected groundwater may be present in the Levee Zone. The oil and diesel concentrations at the seep were 111 µg/L and 261 µg/L. The TPH concentration (oil plus diesel) at the seep was 372 µg/L, which exceeds the CUL.

5.3.3 Former Maloney Creek Wells

TPH results in the wells in the vicinity of Former Maloney Creek are illustrated on Figures 5-23 through 5-28. Oil concentrations ranged from non-detect to a 1,050 µg/L. Diesel concentrations ranged from non-detect to 1,030 µg/L. TPH (oil plus diesel) concentrations ranged from 61 µg/L to 1,910 µg/L. The average concentration was 609 µg/L. TPH (oil plus diesel) concentrations in wells 2A-W-9 and 2A-W-10 typically exceeded the CUL. TPH (oil plus diesel) concentrations in wells 2A-W-11 and MW-39 typically exceeded the RL. Analysis using acid-silica gel cleanup was not completed for these wells.

6.0 Summary and Recommendations

This report presents the results of groundwater monitoring performed in the third and fourth quarters of 2007 and the first three quarters of 2008. Approximately 103 groundwater samples were collected during the reporting period.

The fluid level and monitoring data collected throughout the reporting period were compared to previous monitoring data. These data indicate groundwater flow gradients are relatively consistent throughout the year and similar to historic gradients; however, the installation of the HCC wall during the 2008 remediation effort has modified the groundwater flow by cutting off the flow from the railyard to the downgradient properties. This wall has not affected the direction of the groundwater flow but has caused a slight mounding on the upgradient side of the wall and caused the groundwater downgradient of the wall to be at a lower elevation than the pre-wall construction elevations. This mounding is being corrected by pumping the groundwater from recovery wells into the on site treatment system. These data also indicate that the LNAPL and dissolved plume extents have remained relatively stable throughout the monitoring period and do not appear to have migrated or changed size, although there are some seasonal fluctuations in TPH concentrations.

TPH concentrations during the monitoring events exceeded the CUL (208 µg/L) and RL (477 µg/L) at locations downgradient and immediately adjacent to areas containing free and residual product.

The TPH CUL (208 µg/L) was exceeded in a sample collected from a seep observed on the bank of the South Fork Skykomish River. The TPH concentration (oil plus diesel range) was 372 µg/L. The seep is located in an area where in-place soil exceeds the soil RL of 3,400 mg/kg NWTPH-Dx. This area west of the levee cleanup zone will be investigated further in 2009 to assess the extent of soil concentrations exceeding the RL and/or the CUL (22.0 mg/kg NWTPH-Dx). During seasons of lower river levels, samples will be collected from the seep and analyzed to more completely understand the potential TPH effects on the South Fork Skykomish River.

7.0 References

ENSR, 2007a. *Remedial Design Investigation Work Plan, Former Maintenance and Fueling Facility – Skykomish, Washington.* Seattle, Washington: ENSR Corp. July 2007.

ENSR, 2007b. *Interim Action for Cleanup 2006 – As Built Completion Report, Former Maintenance and Fueling Facility – Skykomish, Washington*. Seattle, Washington: ENSR Corp. July 2007

ENSR, 2008a. *Draft Groundwater Monitoring Plan, Former Maintenance and Fueling Facility – Skykomish, Washington.* Seattle, Washington: ENSR Corp. May 2008.

ENSR, 2008b. *Remedial Design Investigation Report – Former Maintenance and Fueling Facility, Skykomish, Washington.* Seattle, Washington: ENSR Corp. May, 2008

RETEC, 1996. *Remedial Investigation for the Former Maintenance and Fueling Facility in Skykomish, Washington.* Seattle, Washington: Remediation Technologies, Inc., January 1996.

RETEC, 2001. *Interim Action Basis of Design for LNAPL Barrier System: Former BNSF Fueling and Maintenance Facility, Skykomish, Washington, Vol. 1 of 2.* Seattle, Washington: The RETEC Group, Inc., August 10, 2001.

RETEC, 2002. *Supplemental Remedial Investigation: BSNF Former Maintenance and Fueling Facility, Skykomish, Washington*. Seattle, Washington: The RETEC Group, Inc., July 12, 2002.

RETEC, 2005a. *Groundwater Sampling Plan. Former Maintenance and Fueling Facility, Skykomish, Washington*. Seattle, Washington: The RETEC Group, Inc., May 12, 2005.

RETEC, 2005b. *Final Feasibility Study. Former Maintenance and Fueling Facility, Skykomish, Washington*. Seattle, Washington: The RETEC Group, Inc., March 15, 2005.

RETEC, 2007. *Groundwater Monitoring Plan, Revision 1. Former Maintenance and Fueling Facility, Skykomish Washington*. Seattle, Washington: The RETEC Group, Inc., June 7, 2007.

Tables

Figures

Appendix A

Field Forms

Appendix B

Data Reports

Appendix C

Data Validation Reports