ThermoRetec

Interim Action Basis of Design for LNAPL Barrier System

Former BNSF Fueling and Maintenance Facility
Skykomish, Washington

Prepared by:

ThermoRetec Consulting Corporation
1011 S.W. Klickitat Way, Suite 207
Seattle, Washington 98134-1162

ThermoRetec Project Number: BN050-04018-460

Prepared for:

The Burlington Northern and Santa Fe Railway Company
2454 Occidental Avenue South, Suite #1A
Seattle, Washington 98134

May 1, 2001

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May 1, 2001

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1 Introduction

This report presents the basis of design for an interim action to be completed at the Burlington Northern and Santa Fe Railway Company's (BNSF's) former fueling and maintenance facility in Skykomish, Washington. This interim action will consist of a barrier wall and light non-aqueous phase liquids (LNAPL) recovery system to eliminate seeps of this material to the South Fork of the Skykomish River. This interim action will be implemented by BNSF pursuant to an Agreed Order with the Department of Ecology (Ecology) following public review and comment.

The purpose of this report is to provide the conceptual design for the interim action and the performance criteria that will guide the implementation and future operations and maintenance. This report is also intended to provide sufficient information regarding the proposed interim action to allow for public comment and input on the proposed interim action relatively early in the implementation process. Background information regarding the site, its physical location and geology/hydrogeology is presented below, followed by a description of the interim action. This section concludes with the organization for the remainder of this report.

1.1 Background

The site 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 the site is limited to the latter two activities and is owned and operated by BNSF. A detailed operational history of the railyard is provided in the draft Remedial Investigation (RI) report (RETEC, 1996) and the draft Feasibility Study (FS)(ThermoRetec, 1999).

In 1993, BNSF 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) and to implement certain interim actions. The order was prompted by oily seeps to the South Fork of the Skykomish River and the enactment of MTCA. The oil was first investigated during various phases of exploration performed from 1973 to 1992. The RI field work was completed in 1993 and 1994 and is documented in the RI report (RETEC, 1996). The draft RI report documents results of the field investigation, laboratory analytical testing, and conclusions developed under the RI. A draft Feasibility Study (FS) was submitted to Ecology in 1999 and is currently being reviewed. The FS identifies the alternatives available for cleanup of contaminated soil and groundwater at the site and provides a description of the proposed cleanup actions. Neither the draft RI nor the draft FS reports have gone through a 30-day public comment period. In February 2001, Ecology asked BNSF to perform an interim action to reduce and eventually eliminate petroleum seeps to the river during 2001. In response to

this request, BNSF proposed the interim action described herein. This interim action is part of the overall remedy proposed by BNSF in the FS.

1.2 Site Description

The site is located in the Town of Skykomish, King County, Washington, and includes BNSF property and surrounding areas impacted by activities performed at the former fueling and maintenance facility. The general site layout and BNSF property boundary are shown on Figure 1-1. Railroad Avenue separates the railroad property from the main commercial district of the town. Maloney Creek flows east of the site and a former channel of Maloney Creek lies in the southern portion of the BNSF property. Maloney Creek flows to the South Fork of the Skykomish River. The site encompasses an area of approximately 40 acres.

Previous site investigations have identified an LNAPL plume, which extends from the railyard downgradient of the facility. The approximate area of the LNAPL plume is shown on Figure 1-2. The LNAPL from the railyard is a mix of diesel and Bunker C fuel oil. LNAPL samples from the Skykomish site were tested and found to be lighter than water and highly viscous. Field monitoring data indicate the extent of the plume has remained stable since 1993, although our interpretation of the exact location, shape, distribution and product thicknesses in the interior of the plume has varied somewhat over time. Since 1995, recovery wells installed downgradient of the facility have been operated to recover product. Floating oil-absorbent booms are used seasonally to intercept and contain seeps occurring at the riverbank. The recovery wells and oil booms were implemented as interim actions under the 1993 Agreed Order.

1.3 Site Hydrogeology and Aquifer Properties

The site is located within the Skykomish River valley. The glaciofluvial sediments filling the valley consist mainly of poorly- to moderately-sorted sand, gravel, and cobbles. The base of the sediments is estimated to be located 200 to 250 feet below ground surface (bgs). Previous field investigations showed that the site is generally underlain by sand and gravel, with silt and clay lenses.

The aquifer at the site is unconfined and has been investigated to a depth of 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. Large cobbles and gravels are present throughout. The hydraulic conductivities of aquifer materials at the site were determined via slug tests to be between 0.4 feet per day (1.42×10^{-4} cm/s) and 79 feet per day (2.79×10^{-2} cm/s) during the RI. An average hydraulic conductivity of 50 feet per day has

been used in previous fate and transport modeling and in the modeling work presented in Appendix A.

Groundwater occurs at a shallow depth beneath the site (generally 5 to 15 feet bgs). Groundwater elevations are the highest at the southeast corner of the site and decrease northwestward toward the Skykomish River, indicating groundwater flow is generally from the southeast to the northwest. Gauging data indicate the seasonal variation in groundwater elevation can range from about 4 to 7 feet. 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). Figure 1-3 is a potentiometric surface map showing groundwater elevations in April 1998; Figure 1-4 shows groundwater elevations in September 1998. These figures are representative of typical high and low groundwater elevations, respectively, at the site.

1.4 Interim Action Scope

The preliminary scope of the interim action is documented in the *Estimated Scope of Interim Actions Planned for 2001* ThermoRetec letter dated February 26, 2001, and was further developed during subsequent meetings and correspondence with Ecology. The interim action scope of work includes installation of a barrier system to reduce and eventually eliminate petroleum seeps to the River. BNSF believes that a barrier wall with upgradient petroleum recovery provides the best opportunity to eliminate product seeps to the River.

The barrier system will be installed in a phased approach. Phase 1 will entail installation of a barrier wall, monitoring wells and recovery wells. The barrier wall will be installed along West River Road, adjacent to the flood control levee. The monitoring and recovery wells will be installed upgradient and at the ends of the wall to supplement the existing monitoring and recovery well network. Initial monitoring of LNAPL accumulation and equilibration will be performed after the wall is constructed. Figure 1-5 provides a schematic cross-section view of the wall, mounded LNAPL behind the wall, groundwater flow beneath the wall, and an example of an LNAPL recovery well.

All of the new monitoring wells would be sized and constructed in a manner to accommodate installation of belt skimmer product recovery systems that will be installed during Phase 2. Phase 2 will begin 6 to 12 months after the wall is installed. Phase 2 will also include installation of piping from recovery wells to a product storage area(s) and electrical hook-up. This phased approach eliminates the potential to connect "non-producing" wells to the recovery system.[1] The existing product recovery system will continue to

[1] Operation of the current product recovery system has shown that although LNAPL may be present during well installation that is not a reliable indication of continued recharge of LNAPL to the well.

operate upgradient of the barrier wall if it is able to be preserved during construction of the barrier wall. Depending on the extent of product accumulation in the new recovery wells prior to installation during Phase 2, periodic pumping of product will be performed as necessary and to determine the rate of recharge.

Fluid level gauging will be performed to provide information on the response of LNAPL plume distribution, thickness and potentiometric surface to installation of the barrier wall. These data will be used in design of the Phase 2 recovery system. Site wide groundwater sampling for dissolved total petroleum hydrocarbons (TPH) will also be performed periodically at the site.

1.5 Report Organization

Section 2 of this report presents the Phase 1 barrier wall and well design criteria and approach. The Phase 2 recovery system description and work to be done are presented in Section 3. Section 4 of this report presents the performance specifications for construction of Phase 1 of the interim action. Section 5 outlines the barrier monitoring plan and Section 6 describes the remaining tasks and schedule for completing the design and construction of Phase 1. References used in preparing this report are listed in Section 7. Appendices to this report include:

Appendix A – Groundwater Modeling Technical Memorandum

Appendix B – Hydrographs for Existing Wells along Proposed Barrier Wall Alignment

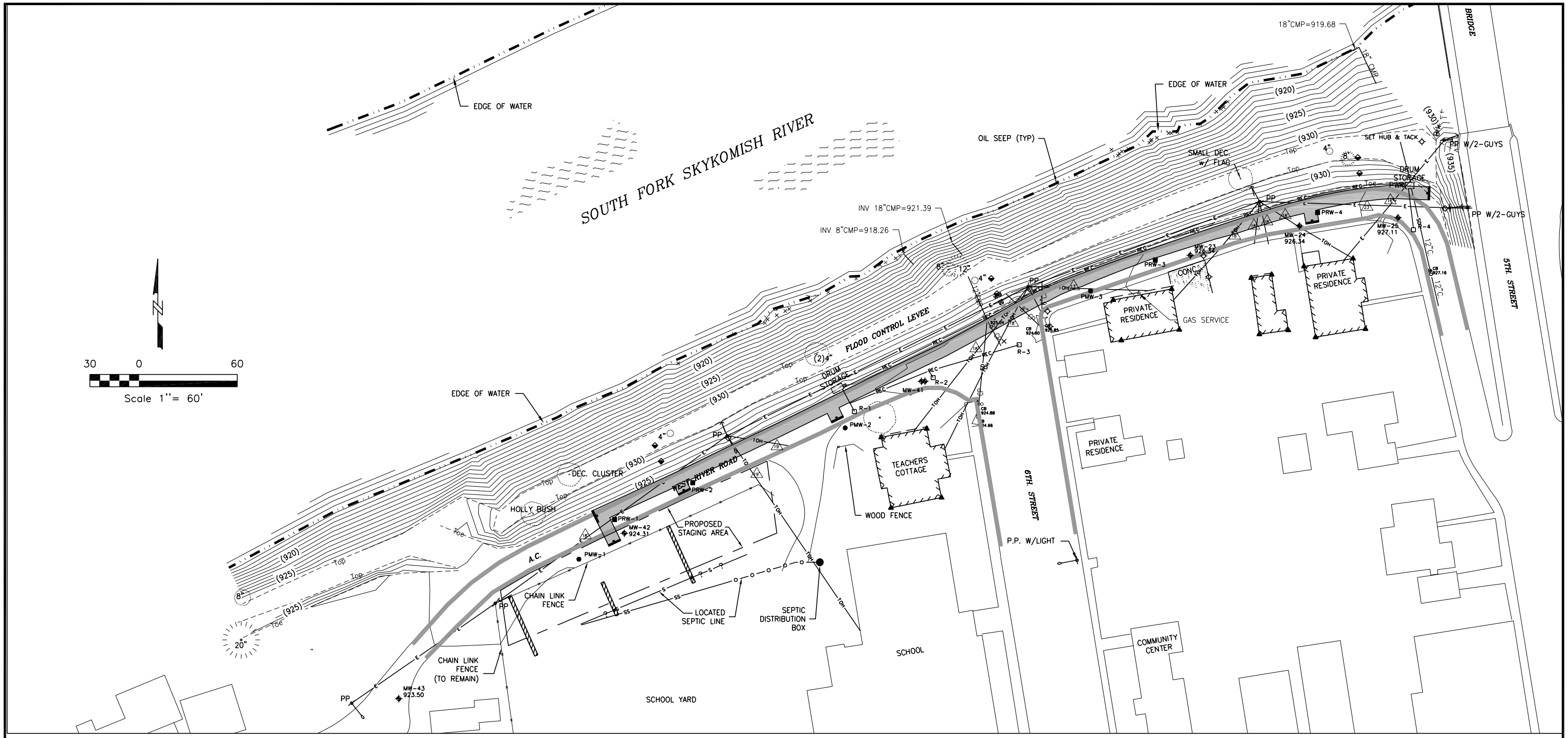
Appendix C – 2001 Topographical Survey of Proposed Barrier Wall Corridor and Vicinity

Appendix D – Flood Control Levee Details prepared by U.S. Army Corps of Engineers

Appendix E – Description of Grout Curtain Technology

Appendix F – SEPA Checklist

The barrier wall is intended to physically contain product, thereby enhancing its recoverability and minimizing the potential for non-producing wells.



LEGEND

- EDGE OF PAVEMENT
- ALLOWABLE BARRIER WALL ALIGNMENT CORRIDOR
- ENDS OF CONTINUOUS BARRIER WALL CONSTRUCTED WITHIN THE LIMITS OF ALIGNMENT CORRIDOR
- WING WALL SECTION OF CONTINUOUS BARRIER WALL CONSTRUCTED PERPENDICULAR TO MAIN WALL ALIGNMENT
- CONCRETE SURFACE

- A.C. ASPHALTIC CONCRETE
- CC CONCRETE CURB
- CW CONCRETE WALK
- CP CONCRETE PIPE
- CMP CORRUGATED METAL PIPE
- PP POWER POLE
- OBSERVED LNAPL SEEP
- CATCH BASIN

- ELECTRICAL HANDHOLE
- EXISTING SURVEY MONUMENT
- EXISTING MONITORING WELL LOCATION
- EXISTING RECOVERY WELL LOCATION
- PROPOSED MONITORING WELL LOCATION
- PROPOSED RECOVERY WELL LOCATION

- CONIFEROUS TREE (SIZE NOTED)
- DECIDUOUS TREE (SIZE NOTED)
- UTILITY POLE
- GUY ANCHOR
- STREET LIGHT
- ADDITIONAL CONTRACTOR WORK AREA BOUNDARY
- (920) GROUND SURFACE CONTOUR (FEET, MSL)

- BUILDING LINE
- FENCE
- TOH TELEPHONE WIRE (OVERHEAD)
- SD STORM DRAIN OR CULVERT
- E ELECTRIC
- REC APPROXIMATE LOCATIONS OF BURRIED RECOVERY SYSTEM PIPING AND ELECTRICAL
- SD STORM DRAIN

- STORM DRAIN MANHOLE
- W WATER MAIN
- WM WATER METER
- WATER VALVE
- HEIGHT OF OVERHEAD UTILITY (THE LOWEST SINGLE OR ONE OF SEVERAL LINES IN THE IMMEDIATE AREA AS MEASURED FROM CENTERLINE OF ROADWAY)

- SEPTIC LINE LOCATED ON MAY 24, 2001 WITH TV.
- SS SEPTIC LINE LOCATED ON JUNE 14, 2001 VIA GPR. LINE IS INFERRED BETWEEN LOCATION POINTS.
- S SEPTIC LINE LOCATION ON JUNE 29, 2001 VIA TEST TRENCHES. LINE IS INFERRED BETWEEN TRENCHES.
- TRENCH AREA

MONITORING POINTS

- LEVEE POINTS
- UTILITY POLE POINTS
- STRUCTURE POINTS
- SS CONTROL POINTS
- STRUCTURES PROPOSED FOR PRE-CONSTRUCTION VIDEO SURVEY

NOTE: BASEMAP OBTAINED FROM BUSH, ROED & HITCHINGS TOPOGRAPHIC SURVEY, JOB NO. 9528002, MARCH 1, 2001.

ThermoRetec

BNSF - SKYKOMISH, WA
RFP FOR CONSTRUCTION SERVICES
BN050-04018-460

BARRIER WALL ALINGMENT CORRIDOR

DATE: 07/17/01	DRWN: N.S.	FILE: 4018s199	PLATE 1

ENVIRONMENTAL CHECKLIST

Purpose of Checklist

The State Environmental Policy Act (SEPA), chapter 43.21 RCW, requires all governmental agencies to consider the environmental impacts of a proposal before making decisions. An environmental impact statement (EIS) must be prepared for all proposals with probable significant adverse impacts on the quality of the environment. The purpose of this checklist is to provide information to help you and the agency identify impacts from your proposal (and to reduce or avoid impacts from your proposal, if it can be done) and to help the agency decide whether an EIS is required.

Instructions for Applicants

This environmental checklist asks you to describe some basic information about your proposal. Governmental agencies use this checklist to determine whether the environmental impacts of your proposal are significant, requiring preparation of an EIS. Answer the questions briefly, with the most precise information known, or give the best description you can.

You must answer each question accurately and carefully, to the best of your knowledge. In most cases you should be able to answer the questions from your own observations or project plans without the need to hire experts. If you really do not know the answer, or if a question does not apply to your proposal, write “do not know” or “does not apply”. Complete answers to the questions now may avoid unnecessary delays later.

Some questions ask about governmental regulations, such as zoning, shoreline, and landmark designations. Answer these questions if you can. If you have problems, the governmental agencies can assist you.

The checklist questions apply to all parts of your proposal, even if you plan to do them over a period of time or on different parcels of land. Attach any additional information that will help describe your proposal or its environmental effects. The agency to which you submit this checklist may ask you to explain your answers or provide additional information reasonably related to determining if there may be significant adverse impact.

Use of Checklist for Nonproject Proposals

Complete this checklist for nonproject proposals, even though questions may be answers “does not apply”. IN ADDITION, complete the SUPPLEMENTAL SHEET FOR NONPROJECT ACTIONS (Part D).

For nonproject actions, the references in the checklist to the words “project”, “applicant”, and “property or site” should be read as “proposal”, “proposer”, and “affected geographic area”, respectively.

BNSF-SKYKOMISH
INTERIM CLEANUP ACTION
LNAPL BARRIER AND RECOVERY SYSTEM
AND SURFACE AND SUBSURFACE SOIL EXCAVATION
ENVIRONMENTAL CHECKLIST

A. BACKGROUND

EVALUATION FOR AGENCY USE ONLY

1. **Name of proposed project, if applicable**:

   BNSF-Skykomish Interim Cleanup Action (oil collection and recovery system, and surface and subsurface soil removal)

2. **Name of applicant:**

   The Burlington Northern and Santa Fe Railway Company (BNSF)

3. **Address and phone number of applicant and contact person:**

   Applicant:

   Bruce Sheppard
   Burlington Northern Santa Fe Railway Company
   2454 Occidental Avenue South, Suite #1A
   Seattle, Washington 98134
   Telephone: (206) 625-6035

   Contact Person:

   Halah Voges
   ThermoRetec Consulting Corporation
   1011 S.W. Klickitat Way, Suite #207
   Seattle, Washington 98134
   Telephone: (206) 624-9349

4. **Date checklist prepared:**
   April 20, 2001

5. **Agency requesting checklist:**
   Washington State Department of Ecology (lead agency)

Northwest Regional Office
Toxics Cleanup Program
3190 160th Avenue, SE
Bellevue, WA 98008-5452

Contact: Louise Bardy (Site Manager)
Phone 425 649-7209

6. **Proposed timing or schedule (including phasing, if applicable):**

The current proposal consists of a subsurface barrier wall and oil recovery system along the flood control levee. The barrier wall and oil recovery system will be constructed in two phases. Phase I includes construction of a barrier wall, monitoring and recovery wells and is currently planned for summer to fall of 2001. Phase II includes installation of product recovery equipment controls and piping, and is planned to start 6 to 12 months after installation of the barrier wall and wells. For additional details, see May 2001 "Interim Action Basis of Design for LNAPL Barrier System." BNSF also proposes to remove contaminated surface and subsurface soil from the railyard, independent of the subsurface barrier wall and oil recovery system, at a later date. For additional details see February 26, 2001 letter, p. 3, from BNSF to Ecology.

7. **Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? If yes, explain.**

There are currently no specific plans for additions or expansions to the proposed Interim Cleanup Action. Additional cleanup activity will eventually be required, and will be outlined in a future cleanup action plan (CAP) and a consent decree (CD) to be negotiated with Ecology. The 1996 Draft Remedial Investigation Report and 1999 Draft Feasibility Study contain information regarding the nature and extent of site contamination.

8. **List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal.**

- *Interim Action Plan for the BNRR Former Maintenance and Fueling Facility, Skykomish, Washington,* Revision 2, RETEC, August 1995.

- *Remedial Investigation for the Former Maintenance and Fueling Facility in Skykomish, Washington,* RETEC, January 1996.

- *Annual Product Recovery Progress Report*, RETEC, May 1997.

- *Annual Product Recovery Progress Report for March 1997–March 1998.*, RETEC, May 1998.

- *Annual Product Recovery Progress Report for March 1998–March 1999,* ThermoRetec Consulting Corporation, April 1999.

- *Feasibility Study for BNSF Former Maintenance and Fueling Facility, Skykomish, Washington*, ThermoRetec Consulting Corporation, October 1999.

- *Interim Action Basis of Design for LNAPL Barrier System for BNSF Former Maintenance and Fueling Facility, Skykomish, Washington*, ThermoRetec Consulting Corporation, May 1, 2001.

9. **Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? If yes, explain.**

There are currently no applications or pending governmental approvals of other proposals which would directly affect the property covered in this proposal.

10. **List any government approvals or permits that will be needed for your proposal, if known.**

The Department of Ecology (lead agency) must approve the interim Cleanup Action prior to its implementation by BNSF. No other state or federal permits or approvals have been identified at this time. BNSF and Ecology will sign an Agreed Order pursuant to the Model Toxics Control Act, RCW 70.105D, such that no local permits or approvals will be required. However, the Interim Cleanup Action must be implemented in a manner consistent with substantive local regulations and ordinances, such as the Town of Skykomish right-of-way standards, building code and shoreline development regulations. The substantive provisions of the King County Department of Health regulations for septic systems and the Puget Sound Clean Air Agency regulations for dust control may also be applicable to the proposal.

11. **Give brief, complete description of your proposal, including the proposed uses and the site of the project. There are several**

questions later in this checklist that ask you to describe certain aspects of your proposal. You do not need to repeat those answers on this page. (Lead agencies may modify this form to include additional specific information on project description.)

The Interim Cleanup Action proposed by BNSF is part of an on-going effort by BNSF to address contamination at the former fueling facility in Skykomish, WA. The first part of this Interim Cleanup Action proposal will address floating oil, a light nonaqueous phase liquid (LNAPL) plume currently results in oily seeps to the Skykomish River. This proposal is to install a barrier system with upgradient recovery and monitoring wells to reduce and eventually eliminate the seeps to the River. The wall will be approximately 600 feet long and 15 feet deep. For additional details, see May 2001 "Interim Action Basis of Design for LNAPL Barrier System." The second part of this proposal it to remove and dispose off-site surface and subsurface soil.

12. **Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description, site plan, vicinity map, and topographic map, if reasonably available. While you should submit any plans required by the agency, you are not required to duplicate maps or details plans submitted with any permit applications related to this checklist.**

The proposed Interim Cleanup Action will be located in Skykomish, Washington, in King County. The proposed barrier wall and recovery wells are located on West River Road, between 5th Street and the school yard, in Skykomish. The site plan, vicinity map and proposed work zone are shown on Figures 1-1, 2-1 and 2-6 of the "Interim Action Basis of Design for LNAPL Barrier System" (May 1, 2001 2001). The proposed surface and subsurface soil removal will occur on the BNSF railyard, and disposal of that soil will occur at a licensed, off-site facility.

TO BE COMPLETED BY APPLICANT:	EVALUATION FOR AGENCY USE ONLY

B. ENVIRONMENTAL ELEMENTS

1. **Earth**

a. **General description of the site (circle one):**
Flat, rolling, hilly, steep slopes, mountainous, other:

The proposal will be located in the narrow, steep-sided valley of the Skykomish River. The topography in the Town of Skykomish gently slopes southwest towards the river. The specific location of the proposed Interim Cleanup Action is flat.

b. **What is the steepest slope on the site (approximate percent slope)?**

The site of the proposal is essentially flat with an approximate slope of less than one percent. Immediately north of the proposed barrier wall and recovery wells is a flood control levee along the Skykomish River with side slopes of 30 to 50 percent.

c. **What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck)? If you know the classification of agricultural soils, specify them and note any prime farmland.**

The soil type is classified as Arents (USDA, 1992); coarse alluvial sands and gravels underlie topsoils

d. **Are there surface indications or history of unstable soils in the immediate vicinity? If so, describe.**

There is no surface indication or history of unstable soils.

e. **Describe the purpose, type, and approximate quantities of any filling or grading proposed. Indicate source of fill.**

The barrier wall and recovery well project does not involve any cut/fill or grading work. However, installation of the proposed monitoring and recovery wells will result in some spoils which will be disposed off-site. Standard well construction requires use of clean silica sand for well filter packs. Sand will be provided by the companies contracted to perform the work and must meet grain size and other specifications. Pavement subgrade

materials and asphalt will be imported for repair and resurfacing of West River Road; the source of road base material is unknown at this time, but will meet Town of Skykomish requirements.

The surface and subsurface soil removal project involves the excavation of approximately 6,900 cubic yards of soil from the BNSF railyard. The soil would be shipped off-site for disposal at a properly licensed facility. The excavation would be back-filled with clean soil.

f. **Could erosion occur as a result of clearing, construction, or use? If so, generally describe.**

No erosion is expected to occur as a result of this proposal.

g. **About what percent of the site will be covered with impervious surfaces after project construction (for example, asphalt or buildings)?**

The barrier wall will be installed within the West River Road right-of-way limits. The existing asphalt pavement will be repaired and resurfaced with no increase in impervious areas after the barrier system installation. No impervious surfaces will be removed or created during the surface and subsurface soil excavation on the railyard.

h. **Proposed measures to reduce or control erosion, or other impacts to the earth, if any:**

No erosion is expected to occur. However, erosion control measures, such as silt fences, hay bales, etc., will be placed along the perimeter of the work zone to control erosion which may result during construction consistent with applicable Town of Skykomish and King County erosion control requirements.

2. **Air**

a. **What type of emissions to the air would result from the proposal (i.e., dust, automobile, odors, industrial wood smoke) during construction and when the project is completed? If any, generally describe and give approximate quantities if known.**

Air emissions would result from the use of heavy equipment and vehicles

during construction. This would result in a temporary increase in engine emissions and dust. Also, if a slurry wall construction method is used, excavation and exposure of diesel and Bunker C soil may result in increased emissions and odor from the exposed oil. Similarly, emissions and odors from grout may result from grout curtain construction. The proposal will not generate any air emissions or odors after completion.

b. **Are there any off-site sources of emissions or odor that may affect your proposal? If so, generally describe.**

There are no known off-site sources of emissions or odor that may affect this proposal.

c. **Proposed measures to reduce or control emissions or other impacts to air, if any:**

Modern, well-maintained equipment will be used for the proposed construction to mitigate vehicle emissions. Dust/odor control measures will be implemented as necessary, such as periodic watering along construction traffic areas or use of mechanical devices.

3. **Water**

a. **Surface**:

1) **Is there are surface water body on or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands)? If yes, describe type and provide names. If appropriate, state what stream or river it flows into.**

The Site is located immediately south of the South Fork of the Skykomish River. A flood control levee separates the proposed barrier wall from the river. The Skykomish River flows into the Snohomish River which discharges to Puget Sound.

2) **Will the project require any work over, in, or adjacent to (within 200 feet) the described waters? If yes, please describe and attach available plans.**

The barrier wall and recovery system work described in this proposal will be performed within 200 feet of the Skykomish River, but no work

will be performed over or in the river. Plans are presented in Figures 2-1 and 2-6 of the "Interim Action Basis of Design for LNAPL Barrier System" (May 1, 2001).

3) **Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicate the area of the site that would be affected. Indicate the source of fill material.**

No fill or dredge material will be placed in or removed from surface water or wetlands under this proposal.

4) **Will the proposal require surface water withdrawals or diversion? Give general description, purpose, and approximate quantities if known.**

No surface water withdrawals or diversions are included in this proposal. Water for dust control will be provided by the existing Town water system.

5) **Does the proposal lie within a 100-year floodplain? If so, note location on the site plan.**

The proposed barrier wall and recovery wells are located within the 100-year floodplain as shown in Figure F-1 of the "Interim Action Basis of Design for LNAPL Barrier System" (May 1, 2001).

6) **Does the proposal involve any discharges of waste materials to surface waters? If so, describe the type of waste and anticipated volume of discharge.**

The proposal does not involve any discharge of waste materials to surface waters.

b. **Ground**:

1) **Will ground water be withdrawn, or will water be discharged to ground water? Give general description, purpose, and approximate quantities if known.**

The barrier wall and surface and subsurface soil removal will not involve any groundwater withdrawal or discharge to groundwater. Monitoring and recovery wells will be developed through withdrawal of small quantities of groundwater. Also, purging of wells will be performed prior to sampling. All purged groundwater will be containerized and properly disposed of at an off-site recycler.

2) **Describe waste material that will be discharged into the ground from septic tanks or other sources, if any (for example: Domestic sewage; industrial, containing the following chemicals …; agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) are expected to serve.**

The proposal will not discharge any waste materials into the ground from septic tanks or other sources.

c. **Water Runoff (including storm water):**

1) **Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? If so, describe.**

Stormwater is the source of runoff at the Site. Temporary erosion controls will be used to contain any runoff within the two project work zones (West River road and the railyard). The existing stormwater catch basins on West River Road and the railyard will be temporarily plugged or relocated to outside the work zones so that soil/spoil runoff will not be discharged into catch basins which might drain to the Skykomish River. Stormwater outside either of the work zones either infiltrates or runs off.

2) **Could waste materials enter ground or surface waters? If so, generally describe.**

The proposed barrier system and recovery wells and proposed soil removal will not cause waste materials to enter ground or surface water. However, there is a small potential for slurry or grout loss into

the river during construction of the barrier wall. The slurry and grout material is not considered "hazardous" under applicable regulations and is generally inert.

d. **Proposed measures to reduce or control surface, ground, or runoff water impacts, if any:**

Temporary erosion controls will be used to contain any runoff within the two project work zones (West River road and the railyard). The existing stormwater catch basins on West River Road and the railyard will be temporarily plugged or relocated to outside the work zones so that soil/spoil runoff will not be discharged into catch basins which might drain to the Skykomish River. Stormwater outside either of the work zones either infiltrates or runs off. Oil-absorbent booms will continue to be used to intercept and contain the existing oily seeps when water levels in the river are low. Removal of oil that collects behind booms using a vacuum tank may also be implemented during extremely low river stage conditions pending review by Dept. of Fish & Wildlife and King County Surface Water Management.

The contractor will have a contingency plan in place to address potential grout or slurry loss to the river. Since construction is scheduled for summer to early fall when river levels are at their lowest, it is likely that oil absorbent booms will be maintained in the river during the construction period. However, since the grout or slurry mix is denser than water, if grout/slurry loss to the river were to occur, siltation may be visible and the grout would not float. Rather, the grout/slurry would lay on the river bottom and could most likely be removed if necessary.

4. **Plants**

a. **Check or circle types of vegetation found on the site:**

__ deciduous tree: alder, maple, aspen, other
___ evergreen tree: fir, cedar, pine, other
__ shrubs
_x_ grass
___ pasture
___ crop or grain
___ wet soil plants: cattail, buttercup, bullrush, skunk cabbage, other
___ water plants: water lily, eelgrass, milfoil, other
_X__ OTHER TYPES OF VEGETATION

b. **What kind and amount of vegetation will be removed or altered?**

Some trampling of grass may occur as the result of traffic diversion or heavy equipment.

c. **List threatened or endangered species known to be on or near the site**.

Threatened or endangered fish (steelhead and trout) and the Bald Eagle occur in or near the Skykomish River. See also 5.b. below. There are no other threatened or endangered species known to be on or near the Site.

d. **Proposed landscaping, use of native plants, or other measures to preserve or enhance vegetation on the site, if any**:

No landscaping or other measures to preserve or enhance vegetation on the Site is proposed other than to replant/restore lawns/landscaping in the event the school yard or private residences' lawns are disturbed.

5. **Animals**

a. **Circle or underline any birds or animals that have been observed on or near the site or are known to be on or near the site:**
birds: hawk, heron, eagle, songbirds, other: **Harlequin Duck, Spotted Owl, Bald Eagle**
mammals: deer, bear, elk, beaver, other: _____
fish: bass, salmon, trout, herring, shellfish, other: **Dolly Varden/Bull Trout, Olympic Mud Minnow, Steelhead**

b. **List any threatened or endangered species known to be on or near the site.**

Within a 1-mile radius of the Site exists the Harlequin Duck (priority species), the Spotted Owl (listed species), and the Bald Eagle (listed species). Within the 7½-minute quadrangle also exist the Mountain Goat (priority species), the Northern Goshawk (listed species), and the Marbled Murrelet (listed species). See also 4.c. above.

c. **Is the site part of a migration route? If so, explain.**

Migratory fish and waterfowl are present in the Skykomish River. The Dolly Varden/Bull Trout and Olympic Mud Minnow spawn within 1 mile of the Site. The Harlequin Duck breeds within 1 mile of the Site. The only known anadromous fish in the Skykomish River is Steelhead. The proposed projects are not expected to cause any adverse effects on any threatened or

endangered species.

d. **Proposed measures to preserve or enhance wildlife, if any:**

This project will not adversely affect any of the animals mentioned due to the mitigation of other adverse impacts such as erosion, dust and odor controls; no additional mitigation is proposed.

6. **Energy and Natural Resources**

a. **What kinds of energy (electric, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc.**

Electricity will be used to operate the oil recovery pumps and for heat tracing product transfer lines.

b. **Would your project affect the potential use of solar energy by adjacent properties? If so, generally describe.**

This proposal will not affect the potential use of solar energy by adjacent properties.

c. **What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any:**

Oil recovery pumps will be maintained in good working order and operated using a timer.

7. **Environmental Health**

a. **Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste, that could occur as a result of this proposal? If so, describe.**

The proposed barrier wall will be constructed using the jet grout or slurry wall technology. Therefore, the oil that is currently in the subsurface may be excavated or exposed for potential direct contact by the personnel. Similar exposure to contaminants in the soil could occur during the excavation, transport and off-site disposal of that contaminated soil. All persons working on this proposal inside the areas of existing contamination will be trained, monitored and equipped according to the applicable worker

health and safety requirements of the state and federal agencies such as OSHA and WISHA.

There are some existing septic systems located on the upgradient side of the proposed barrier system. The septic systems could potentially be impacted by the groundwater mounding that may result from the barrier wall. Groundwater modeling for the Site, as presented in this report, indicates that the groundwater table mounding is expected to be minimal due to the relatively high transmissivity of the aquifer. However, the groundwater table could potentially rise to a certain level that might impede the proper drainage of the septic systems, or the LNAPL product could interfere with the septic drainfield, which in turn could cause malfunctioning of the septic systems. Although unlikely, some surface ponding on the upgradient side of the barrier wall could occur if there are areas where shallow perched water table exists.

Phase II of the proposed barrier wall and recovery system will install monitoring and recovery wells at the Site. Some impacted soil spoils will be generated during installation of these wells. Petroleum hydrocarbon product will be recovered from the wells and stored on site in drums or a tank at the railyard. The risks to personnel involved with handling the petroleum hydrocarbon-impacted soil is expected to be minimal. The short-term risks to the surrounding environment are manageable and not considered to be significant.

1) **Describe special emergency services that might be required.**

The Fire Department is located in close proximity to the Site. They have the personnel, training and equipment required in the event of a discharge of fuel or oil.

2) **Proposed measures to reduce or control environmental health hazards, if any:**

In the event that the septic systems malfunction or local flooding occurs under normal climatic conditions, additional groundwater gauging will be performed to collect data for groundwater level evaluation. If results of the evaluation indicate that the barrier wall causes the excessively higher water table, measures will be taken to control/remedy the situations. Temporary septic system

pumping will be performed to allow the continuing use of the septic system. Existing wells could easily be converted to pumping wells or additional pumping wells could be installed on the upgradient of the barrier wall to lower the water table to restore the water table to pre-construction levels, or the barrier wall could be perforated and a different LNAPL remedy installed.

All persons working on this proposal inside the areas of existing contamination will be trained, monitored and equipped according to the applicable worker health and safety requirements of the state and federal agencies such as OSHA and WISHA.

b. **Noise**

1) **What types of noise exist in the area which may affect your project (for example: traffic, equipment operation, other)?**

Existing noise sources outside or adjacent to the project area are limited to local automobile traffic and train traffic. These noise sources will not adversely affect this proposal as it is not sensitive to noise.

2) **What types and levels of noise would be created by or associated with the project on a short-term or a long-term basis (for example: traffic, construction, operation, other)? Indicate what hours noise would come from site.**

Short-term noise increases generated by construction equipment necessary for the barrier wall installation and soil removal will occur due to this proposal. Noise from construction equipment and vehicles will occur during the working hours selected based on public input. No noise associated with the barrier wall or soil removal will be generated after the construction.

Only very minimal noise will be generated by oil recovery pump operation after recovery system installation. The noise level resulting from pump operation is approximately 20 dB. Pumps will be installed in subsurface vaults and it is unlikely that they will be audible at ground surface. In the event of complaints about noise from the pumps, they will be monitored to determine if they meet applicable noise levels under WAC 173-60.

3) **Proposed measures to reduce or control noise impacts, if**

any:

All construction activities will be performed during the working hours determined through public input, and will be limited to daylight hours. The Community will be notified regarding the operational hours prior to the commencement of work. All activities will meet applicable noise criteria in WAC 173-60.

8. **Land and Shoreline Use**

a. **What is the current use of the site and adjacent properties?**

The current land use of the of West River Road is public right-of-way (barrier wall location). The surrounding area is residential and commercial. The current use of the railroad property is industrial.

b. **Has the site been used for agriculture? If so, describe.**

The Site has not been used for agricultural purposes.

c. **Describe any structures on the site.**

Three houses with detached garages, teacher's cottage and a school yard are located immediately south of the proposed barrier system.

d. **Will any structures be demolished? If so, what?**

No structures will be demolished.

e. **What is the current zoning classification of the site?**

The zoning designation for the project Site is residential.

f. **What is the current comprehensive plan designation of the site?**

West River Road is designated as a public right-of-way and residential. The railyard is designated as industrial.

g. **If applicable, what is the current shoreline master program designation of the site?**

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Town of Skykomish – Shoreline Master Program, 1999.

h. **Has any part of the site been classified as an "environmentally sensitive" area? If so, specify.**

No

i. **Approximately how many people would reside or work in the completed project?**

No persons would reside or work in the complete project.

j. **Approximately how many people would the completed project displace?**

No persons would be displaced as a result of this project.

k. **Proposed measures to avoid or reduce displacement impacts, if any:**

No mitigation is proposed.

l. **Proposed measures to ensure the proposal is compatible with existing and project land uses and plans, if any:**

See Section 2.5 Community Issues of the "Interim Action Basis of Design for LNAPL Barrier System" (May 1, 2001).

9. **Housing**

a. **Approximately how many units would be provided, if any? Indicate whether high, middle, or low-income housing.**

No housing units would be provided.

b. **Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low-income housing.**
No housing units would be eliminated.

c. **Proposed measures to reduce or control housing impacts, if any:**

No housing would be provided or eliminated under this proposal, therefore

no measures to reduce or control housing impacts are proposed.

10. **Aesthetics**

a. **What is the tallest height of any proposed structure(s), not including antennas; what is the principal exterior building material(s) proposed?**

Two existing small shelters in the West River Road right-of-way may continue to be used to store recovered oil product. The shelters are approximately 8 feet tall and constructed with wood siding. Additional shelters may be constructed depending upon the operational data from the additional recovery wells described in this proposal. Similar shelters, if needed, may be constructed (with town's concurrence) within the West River Road right-of-way consistent with the Town and Historical Design Review Board standards for such shelters, or on BNSF property at the railyard.

b. **What views in the immediate vicinity would be altered or obstructed?**

No views would be altered or obstructed.

c. **Proposed measures to reduce or control aesthetic impacts, if any:**

Any additional drum storage shelters will be painted a neutral color to match the existing shelters and properly maintained. Shelters will be constructed consistent with the Town and Historical Design Review Board standards for such shelters whether in the right-of-way or on BNSF property at the railyard.

11. **Light and Glare**

a. **What type of light or glare will the proposal produce? What time of day would it mainly occur?**

The proposal would not produce any light or glare.

b. **Could light or glare from the finished project be a safety hazard or interfere with views?**

This proposal would not result in any light or glare.

c. **What existing off-site sources of light or glare may affect your proposal?**

No existing off-site light sources would affect this proposal.

d. **Proposed measures to reduce or control light and glare impacts, if any:**

None is proposed.

12. **Recreation**

a. **What designated and informal recreational opportunities are in the immediate vicinity?**

Fishing and non-motorized water activities (i.e., kayaking) are available on the Skykomish River.

b. **Would the proposed project displace any existing recreational uses? If so, describe.**

The proposed project will not displace any existing recreational uses or public shoreline access areas.

c. **Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project or applicant, if any:**

None is proposed.

13. **Historic and Cultural Preservation**

a. **Are there any places or objects listed on, or proposed for, national, state, or local preservation registers known to be on or next to the site? If so, generally describe.**

King County has registered buildings on Railroad Avenue (between 3rd and 6th Streets) as historic buildings. The Skykomish School and grounds and the teacherage were designated King County Historic Landmarks on April 4, 1995. See attached Figure F-2.

b. **Generally describe any landmarks or evidence of historic, archaeological, scientific, or cultural importance known to be on or next to the site.**

See 13.a. above.

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c. **Proposed measures to reduce or control impacts, if any:**

No adverse impacts to historic or cultural resources are expected as a result of this proposal. The construction work zones will be limited to the West River Road right-of-way limits and the railyard. Potential impacts on the buildings due to the vibrations of construction equipment and vehicles will be closely monitored by conducting surveys of structures and videotaping of structures before and after construction. Plans for any additional drum shelters will be submitted for review to the Town Design Review Board to ensure design consistency.

14. **Transportation**

a. **Identify public streets and highways serving the site, and describe the proposed access to the existing street system. Show on site plans, if any.**

The Town of Skykomish is served by US Highway 2, located just north of the Skykomish River. The proposed barrier system will be located along West River Road. This site and the railyard can be accessed via 5th Street and 6th Street, as shown in Figure 1-1 of the "Interim Action Basis of Design for LNAPL Barrier System" (May 1, 2001).

b. **Is site currently served by public transit? If not, what is the approximate distance to the nearest transit stop?**

The Site is not currently served by public transit. The nearest transit stop is in Gold Bar, approximately 20 miles west of Skykomish.

c. **How many parking spaces would the completed project have? How many would the project eliminate?**

This proposal will neither create nor eliminate any parking spaces.

d. **Will the proposal require any new roads or streets, or improvements to existing roads or streets, not including driveways? If so, generally describe (indicate whether public or private).**

Implementation of this proposal would not require any new roads, or streets or improvements to existing roads or streets. The proposal will involve excavation within the West River Road right-of-way. The road will be repaired to its original condition according to applicable local standards.

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e. **Will the project use (or occur in the immediate vicinity of) water, rail, or air transportation? If so, generally describe.**

The project will not use or occur in the immediate vicinity of water or air transportation. The barrier wall and recovery well proposal will not use rail transportation. The soil excavation will occur adjacent to existing rail transportation facilities on the railyard, and may use rail to transport excavated soils to a disposal facility.

f. **How many vehicular trips per day would be generated by the completed project? If known, indicate when peak volumes would occur.**

The completed proposal will generate one vehicular trip per month for project maintenance, in addition to what currently exist at the Site.

g. **Proposed measures to reduce or control transportation impacts, if any.**

This proposal will not have any long-term impacts to the existing transportation systems. No measures to reduce or control transportation impacts are proposed.

15. **Public Services**

a. **Would the project result in an increased need for public services (for example: fire protection, police protection, health care, schools, other)? If so, generally describe.**
Implementation of this proposal is not expected to increase the need for any public services.

b. **Proposed measures to reduce or control direct impacts on public services, if any.**

No measures are proposed

16. **Utilities**

a. **Circle or underline utilities currently available at the site: <u>electricity</u>, natural gas, <u>water, refuse service, telephone</u>, sanitary sewer, <u>septic system</u>, other.**

b. **Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on**

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the site or in immediate vicinity which might be needed.

Electricity will be required to run the oil recovery pumps. Puget Sound Energy currently supplies power to the site, and there is an existing meter. A new breaker panel and/or increased capacity may be required.

C. SIGNATURE

The above answers are true and complete to the best of my knowledge. I understand the lead agency is relying on them to make its decision.

Signature: _____

Bruce Sheppard

Date submitted: _____

This checklist was reviewed by: _____

Louise Bardy

Environmental Specialist, Department of Ecology

Any comments or changes made by the Department are entered in the body of the checklist and contain the initials of the review.

_____

Conditions

- Erosion control measures, such as silt fences, hay bales, etc., will be placed along the perimeter of the work zone to control erosion which may result during construction consistent with applicable Town of Skykomish and King County erosion control requirements.

- Modern, well-maintained equipment will be used for the proposed construction to mitigate vehicle emissions. Dust/odor control measures will be implemented as necessary, such as periodic watering along construction traffic areas or use of mechanical devices.

- Temporary erosion controls will be used to contain any runoff within the two project work zones (West River road and the railyard). The existing stormwater catch basins on West River Road and the railyard will be temporarily plugged or relocated to outside the work zones so that soil/spoil runoff will not be discharged into catch basins which might drain to the Skykomish River. Stormwater outside either of the work zones either infiltrates or runs off. Oil-absorbent booms will continue to be used to intercept and contain the existing oily seeps when water levels in the river are low. Removal of oil that collects behind booms using a vacuum tank may also be implemented during extremely low river stage conditions.

- Replanting, restoration or landscaping will be performed in the event the school yard or private residences' lawns are disturbed.

- Oil recovery pumps will be maintained in good working order and operated using a timer.

- In the event that the septic systems malfunction or local flooding occurs under normal climatic conditions, additional groundwater gauging will be performed to collect data for groundwater level evaluation. If results of the evaluation indicate that the barrier wall causes the excessively higher water table, measures will be taken to control/remedy the situations. Temporary septic system pumping will be performed to allow the continuing use of the septic system. Existing wells could easily be converted to pumping wells or additional pumping wells could be installed on the upgradient of the barrier wall to lower the water table to restore the water table to pre-construction levels, or the barrier wall could be perforated and a different LNAPL remedy installed.

- All persons working on this proposal inside the areas of existing contamination will be trained, monitored and equipped according to the applicable worker health and safety requirements of the state and federal agencies such as OSHA and WISHA.

- All construction activities will be performed during the working hours determined through public input, and will be limited to daylight hours. Community will be notified regarding the operational hours prior to the commencement of work. All activities will meet applicable noise criteria in WAC 173-60.

- Any additional drum storage shelters will be painted a neutral color to match the existing shelters and properly maintained. Shelters will be constructed consistent

with the Town and Historical Design Review Board standards for such shelters whether in the right-of-way or on BNSF property at the railyard.

- No adverse impacts to historic or cultural resources are expected as a result of this proposal. The construction work zones will be limited to the West River Road right-of-way limits and the railyard. Potential impacts to buildings due to the vibrations of construction equipment and vehicles will be closely monitored by conducting topographic survey of structures and videotaping of structures before and after construction. Plans for any additional drum shelters will be submitted for review to the Town Design Review Board to ensure design consistency. The contractor will have a contingency plan in place to address potential grout or slurry loss to the river. Since construction is scheduled for summer to early fall when river levels are at their lowest, it is likely that oil absorbent booms will be maintained in the river during the construction period. However, since the grout or slurry mix is denser than water, if grout/slurry loss to the river were to occur, siltation may be visible and the grout would not float. Rather, the grout/slurry would lay on the river bottom and could be removed if necessary.

WAC 197-11-970 Determination of nonsignificance (DNS).

DETERMINATION OF NONSIGNIFICANCE

Description of proposal **The proposal consists of the installation of an underground barrier wall and oil recovery system adjacent to the flood control levee along the Skykomish River. The barrier wall and oil recovery system will be constructed in two phases. Phase I includes construction of a barrier wall (that may be either an injected grout curtain or cement bentonite slurry), monitoring and recovery wells and is planned for summer to fall of 2001. Phase II includes installation of oil recovery equipment controls and piping, and is planned to start 6-12 months after installation of the barrier wall and wells.**

Proponent **Burlington Northern Santa Fe Railway Company (BNSF)**

Location of proposal, including street address, if any: **West River Road between 5th Street and the end of the school yard to the west in the town of Skykomish, WA**

Lead agency **Department of Ecology**

The lead agency for this proposal has determined that it does not have a probable significant adverse impact on the environment. An environmental impact statement (EIS) is not required under RCW 43.21C.030 (2)(c). This decision was made after review of a completed environmental checklist and other information on file with the lead agency. This information is available to the public on request.

☐ There is no comment period for this DNS.

☐ This DNS is issued after using the optional DNS process in WAC 197-11-355. There is no further comment period on the DNS.

[**X**] This DNS is issued under WAC 197-11-340(2); the lead agency will not act on this proposal for 14 days from the date below. **A 30-day public comment period begins May 1 - 31, 2001. Comments should be sent to Louise Bardy, project manager, at 3190 160th Ave. SE, Bellevue, WA 98008 or by phone at (425) 649-7209. Comments will also be taken at a public hearing on May 10, 2001 at the Skykomish Community Center, Skykomish, WA.**

Responsible official **Steve Alexander**

Position/title **Section Supervisor, Toxics Cleanup Progrm-NWRO** Phone**. (425) 649-7054**

Address **3190 160th Avenue SE, Bellevue, WA 98008**

Date. _____ Signature _____

☐ You may appeal this determination to (name) _____
at (location) _____
no later than (date) _____
_____ by (method) .....

You should be prepared to make specific factual objections.
Contact _____to read or ask about the procedures for SEPA appeals.

☐ There is no agency appeal.

S. S. PAPADOPULOS & ASSOCIATES, INC.
Environmental & Water-Resource Consultants

Memorandum

Date: May 10, 2001

From: Michael J. Riley

To: Halah Voges

Subject: Skykomish Model Comment from URS

Comments on the Skykomish Groundwater Model Technical Memorandum were provided by Gregory Burgess of URS to Nnamdi Madakor of the Washington Department of Ecology. The comments are based on a slightly different interpretation of the hydrologic effects of the Skykomish River on groundwater flow patterns. However, it should be recognized that this alternative interpretation would not change the results of the model with respect to the effect of the shallow LNAPL interception wall on groundwater flow patterns and water level mounding upgradient from the wall.

I have reviewed the comments and broken them out as follows.

1. The Technical Memorandum states "the exterior boundaries of the model area are no-flow boundaries, which means that groundwater flow is generated through constant head, specified flows and recharge within the model area". In my opinion, this language is contractidory. Either a boundary is no flow, general head, or constant head not both or all three. No flow means no flow.

Response: This statement caused some confusion to Ecology as well and will be revised. The intent is to describe the boundary of the model domain as no flow boundaries. However, some Skykomish River and Maloney Creek cells are on the boundary of the model domain. Constant head cells are used to simulate the Skykomish River, and the river package is used to simulate Maloney Creek. With respect to the potential for a boundary to have more then one definition, MODFLOW does not limit the user to only one boundary specification within a cell.

2. Secondly, the memo states "the Skykomish River is treated as a MODFLOW constant head boundary. In the eastern portion of the model where the river is higher, the river contributes flow to groundwater. To the west where the river is lower, the river receives flow from groundwater". The model assumes that water flows from the river to groundwater in the east portion of the model domain, migrates west and flows from groundwater to the river in the western portion of the domain. This implies that groundwater flow in the model domain is driven only by the river.

Response: The flow pattern in the model domain is a combination of the flow contributed from the Skykomish River, Maloney Creek and recharge. The groundwater head

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contours clearly show that there is strong component of flow from the south, which is from the Maloney Creek watershed. The primary effect of the Skykomish River is to provide a discharge boundary with a water level slope from east to west. This causes the groundwater contours to be oriented to the northwest and west rather than directly north, which would be the case if the Skykomish River had a constant rather than sloping water level. Similarly, if Maloney Creek was not present, there would still be groundwater contours trending from east to west in the alluvium. While the Skykomish River influences the shape of the groundwater contours, the primary driver on groundwater flow is the contribution form the Maloney Creek watershed.

3. Typically, flow models are setup whereby the regional groundwater flow is influenced locally by rivers, not driven by rivers. The setting is a narrow, glacio-fluvial sediment filled valley with sediments up to 250 feet thick. The valley is very long and likely has a regional groundwater flow from east to west downgradient with the valley. Locally, the river influences groundwater flow in both the vertical and horizontal plane, but, it is not necessarily the driving force. It is the no flow boundaries on the eastern and western edges of the domain that confuse me. I would think that they should be constant head boundaries or at the very least general head boundaries. This would allow flow into and out of the domain on a regional level with the river influences superimposed.

Response: Groundwater flow must be partly driven by the river as the river is the discharge point for shallow groundwater flow. The model was conservatively constructed to represent only the upper 40 to 50 feet of the aquifer. Flow in this region of the aquifer is inferred to discharge to the river based on water level measurements and groundwater level contours of the measurement data.

I differ in my interpretation of the Skykomish River valley near Skykomish. The town is situated on an alluvial fan from Maloney Creek, which forces the main channel of the River against the hills along the north bank of the river. The alluvial fan is bounded to the east and west by topography. In addition, if the slope of hills that bound the alluvial fan are extended to the north in the subsurface, it is clear that the valley along the south bank of the river must be very narrow. Therefore, any regional flow down the river valley would be minor.

Based on these considerations and the greater uncertainty associated with selecting a constant head or defining a general head boundary beyond the limits of data available at the site, the south overbank area of the Skykomish River was treated as a no-flow boundary.

To: Halah Voges
Date: July 17, 2001
Page: 3

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