Table of Contents

1 Introduction 1-1
1.1 Purpose and Objectives 1-1

2 Background 2-1
2.1 Town and Site Description and History 2-1
2.1.1 Town Description 2-1
2.1.2 Site Description 2-2
2.1.3 Railyard Operational History 2-4
2.2 Natural Environment 2-6
2.2.1 Earth 2-6
2.2.2 Water 2-11
2.2.3 Air 2-18
2.2.4 Plants 2-20
2.2.5 Wildlife 2-24
2.2.6 Fish and Aquatic Biota 2-31
2.3 Built Environment 2-37
2.3.1 Land and Shoreline Use Plans 2-37
2.3.2 Public Services 2-39
2.3.3 Environmental Health 2-41
2.3.4 Transportation 2-42
2.4 Interim Cleanup Actions and Ongoing Site Maintenance 2-42
2.4.1 Barrier System 2-42
2.4.2 Oil Recovery Booms 2-43
2.4.3 Dust Suppression Application 2-44

3 Nature and Extent of Contamination 3-1
3.1 Soil Quality 3-2
3.1.1 Petroleum Hydrocarbons in Soil 3-4
3.1.2 Metals in Soil 3-6
3.2 Free Product 3-7
3.2.1 Location and Extent of Free Product 3-7
3.2.2 Physical Properties of Free Product 3-9
3.3 Groundwater Quality 3-10
3.3.1 Petroleum Hydrocarbons in Groundwater 3-10
3.4 Sediment Quality 3-13
3.4.1 Skykomish River Sediment 3-13
3.4.2 Former Maloney Creek Sediment 3-14
3.5 Surface Water Quality 3-16
3.6 Air Quality 3-17
3.7 Summary of the Nature and Extent of Contamination 3-18
3.8 Indicator Hazardous Substances 3-19

4 Conceptual Site Model 4-1
4.1 Source Characterization 4-1
4.2 Indicator Hazardous Substances and Impacted Media 4-1

Table of Contents

4.2.1 Metals 4-2
4.2.2 Total Petroleum and Polynuclear Aromatic Hydrocarbons ... 4-2
4.2.3 Characteristics and Behavior of Free and Residual Product.. 4-3
4.2.4 Influence of the Barrier Wall on Free Product ... 4-5
4.2.5 Dissolved Petroleum Hydrocarbons Groundwater ... 4-6
4.3 Conceptual Model Summary ... 4-6
4.4 Exposure Assessment ... 4-7
4.4.1 Current and Potential Land and Resource Uses ... 4-8
4.4.2 Potential Receptors ... 4-11
4.4.3 Transport Mechanisms ... 4-13
4.4.4 Potential Receptor Exposures ... 4-14
4.5 Summary ... 4-15
4.5.1 Soil ... 4-15
4.5.2 Groundwater ... 4-16
4.5.3 Sediment ... 4-16
4.5.4 Surface Water ... 4-16

5 Cleanup Standards ... 5-1
5.1 Indicator Hazardous Substances ... 5-2
5.2 Cleanup Levels ... 5-2
5.2.1 Soil ... 5-3
5.2.2 Groundwater ... 5-13
5.2.3 Sediment ... 5-15
5.2.4 Surface Water ... 5-16
5.3 Points of Compliance ... 5-18
5.3.1 Soil ... 5-18
5.3.2 Groundwater ... 5-19
5.3.3 Sediment ... 5-20
5.3.4 Surface Water ... 5-21
5.4 Other Potentially Applicable Requirements ... 5-21

6 Development of Remedial Alternatives ... 6-1
6.1 Technology Screening ... 6-1
6.2 Bench-Scale Testing of Cleanup Technologies ... 6-1
6.3 Approach to Developing Remedial Alternatives ... 6-2
6.3.1 Site Cleanup Zones ... 6-3
6.3.2 Points of Compliance ... 6-4
6.3.3 Remediation Levels ... 6-4
6.4 Description of Remedial Alternatives ... 6-5
6.4.1 Detailed Description of Remedial Approaches by Cleanup Zone ... 6-5
6.4.2 Description of Site-Wide Remedial Alternatives ... 6-27

7 MTCA and SEPA Evaluation of Remedial Alternatives ... 7-1
7.1 MTCA Requirements for Remedial Alternatives ... 7-1

Table of Contents

7.1.1 Threshold Requirements 7-1
7.1.2 MTCA "Other Requirements" 7-3
7.2 SEPA Requirements for Remedial Alternatives 7-5
7.3 No Action Alternative 7-6
7.4 Alternative SW1 7-6
7.4.1 Model Toxics Control Act 7-7
7.4.2 State Environmental Policy Act 7-7
7.5 Alternative SW2 7-10
7.5.1 Model Toxics Control Act 7-11
7.5.2 State Environmental Policy Act 7-11
7.6 Alternative SW3 7-13
7.6.1 Model Toxics Control Act 7-13
7.6.2 State Environmental Policy Act 7-14
7.7 Alternative SW4 7-17
7.7.1 Model Toxics Control Act 7-17
7.7.2 State Environmental Policy Act 7-18
7.8 Alternative PB1 7-22
7.8.1 Model Toxics Control Act 7-22
7.8.2 State Environmental Policy Act 7-23
7.9 Alternative PB2 7-25
7.9.1 Model Toxics Control Act 7-26
7.9.2 State Environmental Policy Act 7-26
7.10 Alternative PB3 7-29
7.10.1 Model Toxics Control Act 7-29
7.10.2 State Environmental Policy Act 7-29
7.11 Alternative PB4 7-32
7.11.1 Model Toxics Control Act 7-32
7.11.2 State Environmental Policy Act 7-33
7.12 Standard Alternative (STD) 7-36
7.12.1 Model Toxics Control Act 7-37
7.12.2 State Environmental Policy Act 7-37
7.13 Summary of Remedial Alternatives Evaluation 7-40
7.13.1 No Action 7-40
7.13.2 Standard Alternative 7-41
7.13.3 SW Alternatives 7-41
7.13.4 PB Alternatives 7-43

8 Selecting a Preferred Remedial Alternative 8-1
8.1 Threshold Requirements 8-1
8.1.1 Protect Human Health and the Environment 8-1
8.1.2 Comply With Cleanup Standards 8-4
8.1.3 Comply With Applicable Local, State and Federal Laws 8-5
8.1.4 Provide for Compliance Monitoring 8-6
8.2 Use Permanent Solutions to the Maximum Extent Practicable 8-6
8.2.1 Protectiveness 8-7

Table of Contents

8.2.2 Permanence 8-8
8.2.3 Cost 8-8
8.2.4 Effectiveness Over the Long-Term 8-9
8.2.5 Management of Short-Term Risks 8-11
8.2.6 Technical and Administrative Implementability 8-11
8.2.7 Consideration of Public Concerns 8-12
8.2.8 Permanence to the Maximum Extent Summary 8-12
8.3 Provide for a Reasonable Restoration Timeframe 8-16
8.4 Consider Public Concerns 8-20
8.5 SEPA Analysis 8-20
8.6 Preferred Alternative Selection 8-21

9 References 9-1

List of Tables

Table 2-1 South Fork Skykomish Rover Measurements

Table 2-2 Occurrence of Federal Threatened and Endangered Species in the Site Vicinity

Table 2-3 Salmonid Presence and Timing Within the South Fork and Former Maloney Creek Channel

Table 2-4 Typical Sound Levels Measured in the Environment and Industry

Table 3-1 Potentiometric Surface Elevations for Selected Wells – December 2002 to March 2003

Table 3-2 Petroleum Hydrocarbon Concentrations in Groundwater – January 2002 and January 2003

Table 3-3 PAH Concentrations in Groundwater

Table 3-4 BTEX Concentrations in Groundwater

Table 3-5 Summary of Final Indicator Hazardous Substances

Table 4-1 Indicator Hazardous Substances and Media

Table 4-2 Selected Physical Properties of Skykomish LNAPL Samples

Table 5-1 Proposed Cleanup Levels

Table 5-2 Comparison of Product Headspace Analytical Results to Proposed Ambient Air Cleanup Levels

Table 5-3 Potentially Applicable Requirements – Cleanup Levels

Table 5-4 Potentially Applicable Requirements – Treatment and Disposal

Table 5-5 Potentially Applicable Requirements – Other Remediation Activities

Table 6-1 Technologies Identified and Screened for Use in Developing Remedial Alternatives

Table 6-2 Points of Compliance for Site Media

Table 6-3 Remedial Alternative Points of Compliance and Remediation Levels

Table 6-4 Remedial Alternatives Matrix

Table 6-5 Summary Description of Remedial Alternatives

Table 7-1 Remedial Alternatives and Cleanup Standards

List of Tables

Table 7-2 SEPA and MTCA "Other Requirements"

Table 7-3 Summary of Impact Analysis Relative to No Action Alternative

Table 7-4 Definitions of "Adverse Impacts" Relative to No Action Alternative

Table 7-5 Summary of Significant Unavoidable Impacts Relative to No Action Alternative (by alternative)

Table 7-6 Summary Costs of Remedial Alternatives

Table 8-1 Benefit Analysis for Disproportionate Cost Analysis

List of Figures

Figure 1-1 Regional Location Map
Figure 1-2 Steps to Site Cleanup Under MTCA
Figure 1-3 Block Flow Diagram of MTCA Feasibility Study

Figure 2-1 General Site Layout and Site Boundary
Figure 2-2 Historical Buildings
Figure 2-3 Geologic Cross-Section W-E
Figure 2-4 Shoreline Hydrocarbon Seeps
Figure 2-5 Conceptual Site Model for Former Maloney Creek Channel
Figure 2-6 Topography of Area South of the River
Figure 2-7 Maloney Creek Catchment Area
Figure 2-8 Skykomish Stormwater Flow
Figure 2-9 FEMA 100- and 500-Year Flood Boundaries
Figure 2-10 Hydrographs of 2A-W-1 and 1A-W3
Figure 2-11 Groundwater Surface Elevation Map – 01/31/02 and 02/01/02
Figure 2-12 Habitat Types and Land Cover
Figure 2-13 Western End of Former Maloney Creek Wetland, North of Channel – December 2002
Figure 2-14 Western End of Former Maloney Creek Wetland, South of Channel – December 2002
Figure 2-15 Upstream End of Former Maloney Creek Channel – March 2003
Figure 2-16 Notable Buildings and Features
Figure 2-17 Zoning and Land Use Areas
Figure 2-18 A-Weighted Noise Level (dB) at 50 Feet
Figure 2-19 Location of the Subsurface Barrier Wall and Product Recovery System

Figure 3-1 Extent of Free Product
Figure 3-2 Site Cleanup Zones
Figure 3-3 TPH-D Distribution in Vadose Zone Soil
Figure 3-4 Interpolated TPH-D Distributed in Smear Zone Soil
Figure 3-5 Arsenic Concentrations in Soil
Figure 3-6 Lead Concentrations in Soil

List of Figures

Figure 3-7 PCB Concentrations in Soil
Figure 3-8 Product Thickness and Fluid Level Elevation versus Time: MW-36
Figure 3-9 Free Product and Dissolved TPH in Groundwater
Figure 3-10 Extent of TPH Throughout the Site
Figure 3-11 Extent of TPH in Former Maloney Creek Area

Figure 4-1 Conceptual Model of LNAPL Occurrence
Figure 4-2 Schematic Cross-Section Through Free Product Plumes
Figure 4-3 Exposure Pathway Conceptual Model

Figure 5-1 Approach to Setting Method B Cleanup Levels

Figure 6-1 Site Cleanup Zones
Figure 6-2 Basis for Areal Definition of Site Cleanup Zones
Figure 6-3 Levee Surface Sediment Removal Area
Figure 6-4 Levee Enhanced Bioremediation System Layout
Figure 6-5 Levee Ozone Sparging System Layout
Figure 6-6 Levee Ozone Sparging Typical Cross-Section
Figure 6-7 Levee *In Situ* Flushing Typical Cross-Section
Figure 6-8 Levee Estimated Extents of Excavation Cleanup Levels
Figure 6-9 Former Maloney Creek Channel Surface Sediment Removal Area
Figure 6-10 Former Maloney Creek Channel Enhanced Bioremediation Layout
Figure 6-11 Former Maloney Creek Channel Estimated Extent of Excavation
Figure 6-12 NE Developed Zone Enhanced Bioremediation System Layouts
Figure 6-13 NE Developed Zone Estimated Extent of Excavations
Figure 6-14 South Developed Zone Estimated Extent of Excavations
Figure 6-15 NW Developed Zone Estimated Extent of Surface Metals Excavations
Figure 6-16 NW Developed Zone Free Product Recovery Trench Locations
Figure 6-17 NW Developed Zone Enhanced Bioremediation System Layouts
Figure 6-18 NW Developed Zone *In Situ* Flushing System Layouts
Figure 6-19 NW Developed Zone Estimated Extent of Excavations
Figure 6-20 Railyard Estimated Extent of Surface Soil Excavations

List of Figures

Figure 6-21 Railyard Free Product Recovery Trench Locations

Figure 6-22 Railyard Enhanced Bioremediation System Layout

Figure 6-23 Railyard *In Situ* Flushing System Layout

Figure 6-24 Railyard Estimated Extent of Excavations

Figure 6-25 Site-Wide Remedial Alternative SW1 Layout

Figure 6-26 Site-Wide Remedial Alternative SW2 Layout

Figure 6-27 Site-Wide Remedial Alternative SW3 Layout

Figure 6-28 Site-Wide Remedial Alternative SW4 Layout

Figure 6-29 Site-Wide Remedial Alternative PB1 Layout

Figure 6-30 Site-Wide Remedial Alternative PB2 Layout

Figure 6-31 Site-Wide Remedial Alternative PB3 Layout

Figure 6-32 Site-Wide Remedial Alternative PB4 Layout

Figure 6-33 Site-Wide Remedial Alternative STD Layout

Figure 8-1 Remedial Alternatives Ranked By Permanence

Figure 8-2 Remedial Alternative Costs

Figure 8-3 Unit Equivalent Soil Removal Cost

Figure 8-4 Long Term Effectiveness Equivalent Volumes By Alternative Sorted By Permanence

Figure 8-5 Benefit and Cost By Remedial Alternative Ranked By Permanence

Figure 8-6 Benefit vs. Cost

Figure 8-7 Incremental Benefit/Incremental Cost By Remedial Alternative Ranked By Cost

Figure 8-8 Incremental Benefit versus Cost Savings Relative to STD

Figure 8-9 Incremental Benefit versus Cost Savings Relative to PB3

Figure 8-10 Free Product Removal Timeframe

Figure 8-11 Groundwater Restoration Timeframe

Figure 8-12 Soil Restoration Timeframe

Figure 8-13 Environmental Impacts By Remedial Alternatives Ranked By Permanence

List of Appendices

Appendix A Environmental Impact Analysis

Appendix B Results of Supplemental Sediment Sampling-Toxicity Evaluation and Sediment Cleanup Levels (February 24, 2003)

Appendix C Wetland Detailed Study

Appendix D Selection of Indicator Hazardous Substances

Appendix E Technical Memo No.1 (Revision 1) – EPH/VPH Data Set for Skykomish Site (September 6, 2002)

Appendix F Leach Testing and Response to Comments

- Appendix F-1 Report of Leach Testing to Derive Soil Cleanup Levels to Protect Groundwater (April 10, 2003)
- Appendix F-2 Response to Ecology Comments on Leach Testing

Appendix G Technical Memo 2 – Site-Specific Input Parameters for TPH Four Phase Model (November 22, 2002) and Related F_{oc} Correspondence, Work Plans, Results and Ecology Approval

Appendix H Calculation of Surface Water CULs Protective of Human Health via Fish/Shellfish Consumption

Appendix I Groundwater Cleanup Levels for TPH Protective of Ecological Resources in Surface Water (January 17, 2003)

Appendix J Screening of Remedial Technologies

- Appendix J-1 Screening of Remedial Technologies
- Appendix J-2 Biodegradation Processes

Appendix K Soil Volumes, Equivalent Soil Volumes, Benefit and Environmental Impact Calculations

Appendix L Detailed Cost Estimates

Appendix M List of Potentially Affected Properties (Excluding Railyard)

Appendix N FS/EIS Distribution List

List of Acronyms

ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
BMP	Best Management Practices
BNSF	The Burlington Northern and Santa Fe Railway Company
BNRR	Burlington Northern Railroad
BTEX	benzene, toluene, ethylbenzene, and xylenes
BTU	British Thermal Unit
CAO	Critical Areas Ordinance
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm	centimeter
cm/sec	centimeters per second
CO	carbon monoxide
cP	centipoise
cPAH	carcinogenic polynuclear aromatic hydrocarbon
CSM	Conceptual Site Model
CWA	Clean Water Act
cy	cubic yard
dB	decibel (measurement of noise volume)
dBA	decibels at equivalent A-weighted sound levels
dbh	diameter at breast height
DO	dissolved oxygen
DOD	United States Department of Defense
DOE	United States Department of Energy
dynes/cm	dynes per centimeter
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
EPH	extractable petroleum hydrocarbon
EPH/VPH	extractable and volatile petroleum hydrocarbon fractions
f_{oc}	fraction of organic carbon

List of Acronyms

FRTR	Federal Remediation Technologies Roundtable
FS	Feasibility Study
FS/EIS	Feasibility Study and Environmental Impact Statement
ft^2	square feet
g/kg	grams per kilogram
GNR	Great Northern Railroad
gpm	gallons per minute
HDPE	high-density polyethylene
IHS	Indicator Hazardous Substances
LD50	lethal dose for 50 percent kill
LNAPL	light nonaqueous phase liquid
MACT	maximum acceptable concentration threshold
MCL	maximum contaminant level
MCLG	maximum contaminant level goal (formerly RMCL)
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
msl	mean sea level
MTCA	Model Toxics Control Act
NAAQS	National Ambient Air Quality Standards
NAPL	nonaqueous phase liquid
NMFS	National Marine and Fisheries Service
NO_x	nitrous oxides
NRWQC	National Recommended Water Quality Criteria
ORP	oxygen reduction potential
OSHA	Occupational Safety and Health Administration
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
pH	measure of acidity or alkalinity
POC	point of compliance
Poise	A unit of [dynamic] viscosity. One poise is the viscosity of a liquid in which a force of one dyne is necessary to maintain a velocity

List of Acronyms

	differential of one centimeter per second per centimeter over a surface one. [Poise is a measure of absolute or dynamic viscosity.]
PPE	personal protective equipment
ppm	parts per million
PQL	practical quantitation level
PSCAA	Puget Sound Clean Air Agency
RCW	Revised Code of Washington
RI	Remedial Investigation
RI/FS	Remedial Investigation and Feasibility Study
SAP	Sampling and Analysis Plan
scfm	standard cubic feet per minute
SDWA	Safe Drinking Water Act
SEPA	State Environmental Policy Act
site	BNSF Skykomish site
SMS	Sediment Management Standards
SOW	Scope of Work
Stokes	A unit of kinematic viscosity (dynamic viscosity divided by the density). In the SI system the accepted unit is square meter per second (m^2/s). To convert one stokes to (m^2/s) multiply by 1.0×10^{-4}.
SVOC	semivolatile organic compound
su	standard unit
TEE	terrestrial ecological evaluation
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TPH-D	total petroleum hydrocarbons – diesel
TPH-Dx	total petroleum hydrocarbons – diesel extended
TPH-MO	total petroleum hydrocarbons – motor oil
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
µmhos/cm	micromhos per centimeter
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service

List of Acronyms

USFS	United States Forest Service
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbon
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WDOH	Washington State Department of Health
WET	whole effluent toxicity
WSDOT	Washington State Department of Transportation
ºC	degrees Celsius
ºF	degrees Fahrenheit

List of MTCA Definitions

Free Product	[173-340200]	"a NAPL that is present in the soil…gw or sw as a distinct separate layer. Under the right conditions, if sufficient free product is present, free product is capable of migrating independent of the direction of flow of the gw or sw."
NAPL	[---200]	"a hazardous substance that is present in the soil, groundwater, surface water as a liquid not dissolved in water. The term includes both LNAPL and DNAPL."
Residual Saturation	[---747(10)(b)]	"When a NAPL is released to the soil, some of the NAPL will be held in the soil pores or void spaces by capillary force. …., the concentration of hazardous substances in the soil at equilibrium conditions is called residual saturation. At concentrations above residual saturation, the NAPL will continue to migrate due to gravimetric and capillary forces and may eventually reach the gw, provided a sufficient volume of NAPL is released."