AMENDED FINAL CLEANUP ACTION PLAN

South Wilbur Petroleum Contamination Site
Wilbur, WA

CSID 1949
FSID 7096

~~May 2003~~May 2013
Washington Department of Ecology
Toxics Cleanup Program
Eastern Regional Office
Spokane, WA

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1.0 INTRODUCTION

This report presents the Washington State Department of Ecology's proposed cleanup action for the South Wilbur Petroleum Contamination Site (Site), located in the area of the intersection of Front Avenue and Anne Street, just south of downtown Wilbur, Lincoln County, Washington (Figure 1). This Cleanup Action Plan (CAP) is required as part of the site cleanup process under the Model Toxics Control Act (MTCA), Ch. 70.105D RCW, implemented by the Washington State Department of Ecology (Ecology). The cleanup action decision is based on the Remedial Investigation/Feasibility Study (RI/FS) and other relevant documents in the administrative record.

This CAP outlines the following:

- The history of operations, ownership, and activities at the Site.
- The nature and extent of contamination as presented in the RI.
- Cleanup levels for the Site protective of human health and the environment.
- The selected remedial action for the Site.
- Any compliance monitoring and institutional controls required.

1.1 DECLARATION

Ecology has selected this remedy because it will be protective of human health and the environment. Furthermore, the selected remedy is consistent with the preference of the State of Washington as stated in RCW 70.105D.030(1)(b) for permanent solutions.

1.2 APPLICABILITY

Cleanup levels specified in this cleanup action plan are applicable only to the South Wilbur Petroleum Contamination Site. They were developed as a part of an overall remediation process under Ecology oversight using the authority of MTCA, and should not be considered as setting precedents for other sites.

1.3 ADMINISTRATIVE RECORD

The documents used to make the decisions discussed in this cleanup action plan are on file in the administrative record for the Site. Major documents are listed in the reference section. The entire administrative record for the Site is available for public review by appointment at Ecology's Eastern Regional Office, located at N. 4601 Monroe Street, Spokane, WA 99205-1295.

1.4 PREVIOUS WORK

The CAP presents a brief description and history of the South Wilbur Petroleum Contamination Site. Results from applicable studies and reports are summarized to provide background information pertinent to the CAP. These studies and reports include:

- Final Remedial Investigation/Feasibility Study (CH2MHill, 2002)
- Summary of Environmental Investigations, Washington State Department of Transportation, Old Wilbur Maintenance Facility, Wilbur, Washington (IT Corporation, 2000)
- Site Characterization with Geoprobe for the Washington State Department of Transportation Old Wilbur Maintenance Facility (WSDOT, 1998)
- Additional Site Characterization: Washington State Department of Transportation Old Wilbur Maintenance Facility (WSDOT, 1997)
- Site Characterization: Washington State Department of Transportation Old Wilbur Maintenance Facility (WSDOT, 1997)
  - Periodic Review, South Wilbur Petroleum Contamination Site (Ecology, 2012)

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2.0 SITE BACKGROUND

2.1 SITE HISTORY

The Site is located approximately one block south of downtown Wilbur, WA in Lincoln County (figure 1). It is comprised of three separate properties: the former Washington State Department of Transportation (WSDOT) Maintenance Facility, the Lincoln County Maintenance Facility, and the former Lincoln Mutual No. 3 fueling station. It is bounded to the north by Goose Creek, to the west by the Town Park, to the south by Front Avenue and a railroad yard, and to the east by Brace Street.

WSDOT operated its maintenance facility from the 1930s through the early 1970s, when major maintenance activities moved to Davenport. Major activities included vehicle maintenance, fueling, and storage of road maintenance supplies. By 1996, all remaining equipment and personnel had been relocated to a different facility, and the Town of Wilbur leased the property for equipment storage. Diesel fuel was stored in one 1,000 gallon underground storage tank (UST) and one 1,100 gallon aboveground storage tank (AST), while gasoline was stored in one 1,000-gallon UST. These tanks were decommissioned and removed in June 1991. An additional 5,000-gallon AST was used for storage of asphalt, and the now empty AST is still present on-site. In addition, a dry well, receiving liquids from a sump in the shop, was located just north of the shop building (CH2MHill, 2002). In 2001, the site was purchased by Lincoln County.

The Lincoln County maintenance facility was in operation from the 1930s through the present. Site activities were similar to the WSDOT facility, including vehicle fueling and maintenance and supply storage. Four USTs were located on the site, including an 8,000 gallon diesel UST, a 500 gallon waste oil UST, and two 500 gallon unleaded gasoline USTs. All of these tanks were decommissioned and removed between 1990 and 1992.

The former Lincoln Mutual No. 3 property was the location of a fueling station, and is estimated from aerial photographs to have operated from the 1950s through the 1980s. The site contained a fueling island, a 1,900 gallon diesel AST, and is presumed from photographs to have had two USTs near the fueling island. Fueling operations were discontinued prior to purchase by the present owners. Currently, the site building is used as office space and the surrounding land is now paved and used for parking. Figure 1 shows the locations of all properties and approximate locations of tanks or petroleum discharges.

2.2 SITE INVESTIGATIONS

A series of investigations have taken place to aid in determining the type, amount, extent, and source of the petroleum hydrocarbon contamination. The following chronologically lists the separate activities and investigations that have taken place at the three properties. Reports documenting these investigations can be found at Ecology's Eastern Regional Office in Spokane.

In 1990, three USTs on the Lincoln County maintenance facility property, two 1000 gallon unleaded gasoline and one 500 gallon waste oil, were decommissioned. It is not known if there were releases related to these tanks. In 1992, the Lincoln County Highway Department removed one 8,000 gallon diesel UST. Soil samples collected from the excavation showed diesel and BTEX compounds were not present above cleanup levels.

The WSDOT property was first investigated in June 1991, when a cleanup action report was submitted for the removal of 5 cubic yards of petroleum contaminated soil. The soil was discovered during the removal of a 1000 gallon gasoline UST and a 1000 gallon diesel UST. It was also noted in a June 1992 WSDOT investigation that a sump in the shop building was full of oily water.

In 1995, the Lincoln County Highway Department completed a limited Phase II Investigation on four Lincoln County maintenance facility properties, including the one in Wilbur. The investigation was intended to investigate potential petroleum contamination related to activities at each facility's wash pad. Results for the Wilbur site showed that adjacent to and just below the asphalt, to a depth of one foot below ground surface, no petroleum contamination was present.

In February 1995, a Phase I and Phase II Environmental Site Assessment was completed for the WSDOT property to determine potential sources and possible extent of contamination at the site. Further activities were conducted to locate the drywell that was connected to the sump, and samples were collected to determine the nature of the contaminants. The drywell was excavated in October of 1996 and the majority of contaminated soil was removed; however, gasoline contamination was still present in the bottom and north wall of the excavation.

In July 1996, the WSDOT performed a soil and groundwater investigation based on the results of the Phase I and II site assessment. Four monitoring wells were installed on-site to assess the quality of subsurface materials. Soil and groundwater samples were collected, and results indicated that soil was contaminated with gasoline to a depth of around 15 feet, and groundwater had concentrations of gasoline, and benzene, toluene, ethyl-benzene, and xylene (BTEX) exceeding cleanup levels.

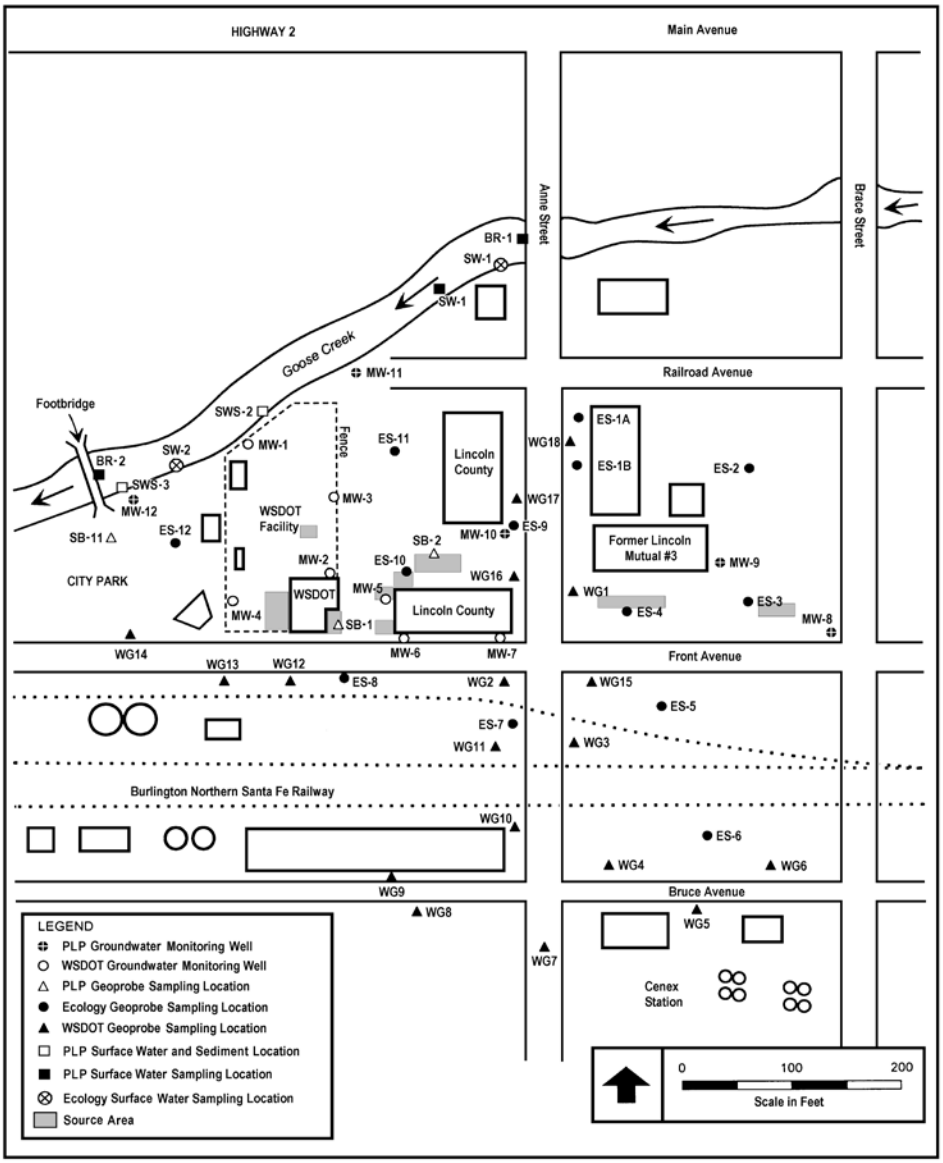

Figure 1. Site Map

Because of the nature of surrounding businesses, the WSDOT completed a second site characterization in May 1997 to investigate the extent of petroleum contamination. Three additional monitoring wells were installed on the Lincoln County maintenance facility property, and soil and groundwater samples were again collected. Results showed soil exceedances for gasoline, benzene, and xylene. Groundwater again showed levels of gasoline and BTEX compounds exceeding cleanup levels, and additionally diesel had one exceedance.
A third investigation was undertaken by WSDOT because the plume appeared to be larger than originally thought. A geoprobe was used to investigate areas upgradient of both properties. Groundwater and soil results again showed soil contaminated with gasoline and xylene, and groundwater contaminated with gasoline, benzene, toluene, and xylene. Areas shown to be impacted were located to the southeast and east of the site.

In 1999, Ecology completed a limited site investigation of the WSDOT property, the Lincoln County property, and the former Lincoln Mutual #3 property which lies upgradient of the two maintenance facilities. A strataprobe was used to install several soil borings surrounding the WSDOT property, with the majority being installed upgradient of both maintenance facilities to help characterize other potential sources. Soil sampling showed that gasoline contamination was present at depths greater than 8 feet. Groundwater samples had concentrations of gasoline, diesel, and BTEX compounds in various combinations exceeding cleanup levels.

A Remedial Investigation/Feasibility Study (RI/FS) was completed in 2001 by consultants to Lincoln County. The RI/FS further evaluated the nature and extent of soil and groundwater contamination at all three properties comprising the site. Samples were taken primarily from the three properties and areas immediately adjacent to the properties. Eight soil borings were installed, and soil samples were taken from several depths in these borings. Five of the eight borings were completed as temporary monitoring wells, and representative groundwater samples were taken. In addition, three surface water samples were collected from Goose Creek at locations bordering the site.

2.3 PHYSICAL SITE CHARACTERISTICS

2.3.1 Topography and Climate

The site is at an elevation of around 2150 feet and is relatively flat, with little elevation change from the northern site boundary to several blocks south of the site. Beyond that, the elevation changes rapidly, gaining 40 feet in elevation over a 200 foot distance. This embankment represents a division from the industrial/commercial area along the creek to the more residential area to the south. The creek itself runs in a ravine about 10 feet below site elevation.

The region is semi-arid, receiving between 10 and 15 inches of precipitation annually. The majority of the precipitation occurs in winter and early spring in the form of snow. The annual mean temperature is about 50˚F.

2.3.2 Regional Geology

The geology in the vicinity of the site consists of Wanapum Basalt, a subgroup of the Columbia River Basalt. It ranges from 200 to 400 feet in thickness and is Miocene in age. (CH2MHill,

2002) In the vicinity of the site, they are approximately 200 feet thick. These basalts are overlain by variable thicknesses of alluvium and/or loess.

2.3.3 Hydrogeology

The main groundwater producing unit is the Wanapum Basalt, where groundwater flows through joints, fractures, and interflows. Local water supply wells receive water from this unit, and flow is artesian in many places. Overlying the basalt in the vicinity of the site is a unit of saturated silts and clays. These materials have a higher permeability than the basalt below, but still are relatively impermeable compared to other unconsolidated aquifer materials. The range of hydraulic conductivities is estimated to be $3x10^{-4}$ ft/s to $1.5x10^{-4}$ ft/s. These correspond roughly to that of a silty sand. Groundwater in the shallow aquifer is not considered a source of drinking water because of its low hydraulic conductivity and low water quality. Hydraulic gradient at the site is fairly shallow, having been measured at approximately 0.004 ft/ft. Groundwater flows generally towards Goose Creek, with some slight variation in the angle depending on the season. In times of extremely high water in the creek, the flow can decrease significantly or even temporarily reverse such that water from Goose Creek recharges the groundwater system.

3.0 Nature and Extent of Contamination

3.1 Soil

Soil has been contaminated with petroleum compounds down to bedrock at all three properties. It is unknown exactly how much soil on each property is affected. Originally, petroleum contamination was located very near to the source of the release. Due to the low conductivity of the soils, movement occurred quite slowly. Precipitation infiltration caused petroleum contamination to move and spread, causing more soil to become contaminated and eventually contaminating groundwater. Over time, numerous releases from different facilities moved, spread, and overlapped, resulting in a plume of contaminated soil that varies in concentration and extent. Because soil contamination investigations only take samples at specific locations within the plume, it is difficult to estimate the exact size and nature of the plume.

Soil investigations have shown maximum gasoline concentrations at several thousand parts per million (ppm), maximum diesel at 6500 ppm, and concentrations of the petroleum components benzene, toluene, ethyl benzene, and xylene (BTEX) all significantly exceeding cleanup levels. Soil was analyzed for lead since the facilities were in operation during the time when leaded gasoline could have been used. However, soil results did not show the presence of lead.

3.2 Groundwater

Groundwater has been contaminated by petroleum compounds from releases at all three facilities. Petroleum releases from underground storage tanks and other surface disposal have migrated down through the soil column and into groundwater. Groundwater plumes from releases at all three facilities moved and mixed into one commingled plume. Due to the nature of groundwater, more mixing occurs so contaminant concentrations are slightly more evenly dispersed than in soil.

Groundwater investigations have focused on measuring the areal extent of the plume and the nature of the contamination. Historical data is available from the seven wells on the WSDOT and Lincoln County properties, and recent data is from all twelve monitoring wells on the site. Gasoline concentrations were over 100 ppm, diesel concentrations were almost 2000 ppm, and BTEX compounds were all well in exceedance of groundwater cleanup standards. Lead was again tested because of the possible presence of leaded gasoline, but none was detected in any groundwater samples.

3.3 Surface Water and Sediment

Goose Creek flows immediately adjacent to two of the three properties that comprise the site. The primary source of water for the creek is precipitation and surface runoff. Also, the shallow groundwater system supplies base flow to Goose Creek throughout most of the year. Flow is typically highest in the spring after snowmelt, and lowest in late summer.

Surface water has been tested twice during investigations at this site, once by Ecology and once during the RI/FS. During the study by Ecology, two locations were sampled, one upstream and one downstream of the site. The RI/FS sampled five locations along the creek, two upstream and three downstream. Two of those sites also had sediment samples collected from them. Sediment samples were collected from the bank adjacent to the site. Results of both investigations showed no detections of gasoline, diesel, or BTEX compounds in surface water or sediment. Therefore, there are no indicators or cleanup levels set for surface water or sediment.

3.4 Risks to Human Health and the Environment

The Site is composed of commercial-use properties with no anticipated future change of use. However, the WSDOT property is immediately adjacent to the city park which is host to numerous community activities including an annual fishing derby for children. Site groundwater discharges into Goose Creek. Although it is a Class B stream and is not considered a source of potable drinking water, it still has limited recreational and irrigation use. Also, the Lincoln County and Lincoln Mutual #3 properties are unfenced and open to passersby.

Exposures to human populations could occur through contact with contaminated surface or subsurface soils, groundwater, or surface water. These populations include on-site workers, passersby to the properties, and recreational users of the park and creek.

4.0 Cleanup Standards

MTCA requires the establishment of cleanup standards for individual sites. The two primary components of cleanup standards are cleanup levels and points of compliance. Cleanup levels determine the concentration at which a substance does not threaten human health or the environment. All media that exceeds a cleanup level is addressed through a remedy that prevents exposure to the media. Points of compliance represent the locations on the site where cleanup levels must be met.

4.1 OVERVIEW

The process for establishing cleanup levels involves the following:

- Determining which method to use.
- Developing cleanup levels for individual contaminants in each media.
- Determining which contaminants contribute the majority of the overall risk (indicators) in each media.
- Adjusting the cleanup levels downward based on total site risk.

The MTCA Cleanup Regulation provides three options for establishing cleanup levels: Methods A, B, and C.

- Method A may be used to establish cleanup levels at routine sites or sites with relatively few hazardous substances.
- Method B is the standard method for establishing cleanup levels and may be used to establish cleanup levels at any site.
- Method C is a conditional method used when a cleanup level under Method A or B is technically impossible to achieve or may cause significantly greater environmental harm. Method C also may be applied to qualifying industrial properties.

The MTCA Cleanup Regulation defines the factors used to determine whether a substance should be retained as an indicator for the Site. When defining cleanup levels at a site contaminated with several hazardous substances, Ecology may eliminate from consideration those contaminants that contribute a small percentage of the overall threat to human health and the environment. WAC 173-340-703(2) provides that a substance may be eliminated from further consideration based on:

- The toxicological characteristics of the substance which govern its ability to adversely affect human health or the environment relative to the concentration of the hazardous substance.
- The chemical and physical characteristics of the substance which govern its tendency to persist in the environment and through the environment.
- The chemical and physical characteristics of the substance which govern its tendency to move into and through the environment.
- The natural background concentration of the substance.
- The concentration of the substance at the site.
- The frequency of detection.

4.2 Site Cleanup Levels

The RI/FS has documented the presence of contamination in groundwater and soil at the Site. Cleanup levels will be developed for these media. Since the groundwater is nonpotable, these cleanup levels are established under the criteria of WAC 173-340-720(6).

Under WAC 173-340-704(1), Method A may be used at a site undergoing a routine cleanup action. Since the site has a relatively small number of contaminants with obvious cleanup levels and no environmental impact statement or ecological evaluation is required, Method A cleanup levels will be used at the site.

Tables 1 and 2 show the indicator substance screening of analytes for which Site soil and groundwater were tested.

4.3 Point of Compliance

The MTCA Cleanup Regulation defines the point of compliance as the point or points where cleanup levels shall be attained. Once cleanup levels are met at the point of compliance, the Site is no longer considered a threat to human health or the environment.

The point of compliance for groundwater is defined in WAC 173-340-720(8). Groundwater points of compliance are established for the entire Site from the top of the saturated zone to the lowest affected portion of the aquifer, which is bedrock at this Site. At this Site, it is practicable to meet cleanup levels using a standard point of compliance.

WAC 173-340-740(6) gives the point of compliance requirements for soil. For sites where cleanup levels are based on the protection of groundwater, the point of compliance is established in all soils throughout the site. The Method A cleanup levels for petroleum and BTEX compounds are based on the protection of groundwater, so this point of compliance will apply.

5.0 Cleanup Action Selection

5.1 Remedial Action Objectives

The remedial action objectives are statements describing the actions necessary to protect human health and the environment through eliminating, reducing, or otherwise controlling risks posed through each exposure pathway and migration route. They are developed considering the characteristics of the contaminated medium, the characteristics of the hazardous substances present, migration and exposure pathways, and potential receptor points.

Groundwater and soil have been contaminated by the former Site activities. People may be exposed to contaminated groundwater via ingestion, inhalation of volatile chemicals, or dermal contact. Soil exposure would occur through dermal contact or inhalation of dust. Potential populations include on-site workers, trespassers, residents of nearby neighborhoods, passersby, and off-site workers.

Given these potential exposure pathways, the following are the remedial action objectives for the Site:

- Prevent or minimize direct contact or ingestion of contaminated soil by humans.
- Prevent or minimize direct contact or ingestion of contaminated groundwater by humans.
- Prevent or minimize further contamination of groundwater.
- Protect beneficial uses of Goose Creek.

5.2 CLEANUP ACTION ALTERNATIVES

Cleanup alternatives to meet these remedial action objectives are evaluated as part of the RI/FS for the site. The feasibility study evaluated four options for soil (excavation, onsite treatment, containment, and offsite disposal) and two options for groundwater (interception and treatment). These options were combined to form four alternatives for addressing all contaminated media at the site. The following four alternatives are as proposed by Lincoln County.

5.2.1 Alternative 1: No Action

The no action alternative is a baseline to address the criteria for comparison to action alternatives. This represents the site with no active measures towards site cleanup. This alternative would include fencing around all properties, institutional controls including deed restrictions, and natural attenuation. Fencing and signs on properties would need to be continuously maintained, and groundwater monitoring would take place to assess the effectiveness of natural attenuation.

5.2.2 Alternative 2: Source Removal with Natural Attenuation

This alternative would primarily address soil with no engineered treatment of groundwater. Contaminated soil in the source areas would be excavated and backfilled with clean material, while groundwater would only be addressed through natural attenuation. Excavated soil would either be transported to a permitted disposal facility, or would be transported to an appropriate off-site location to be land treated. Land treatment involves the addition of oxygen, nutrients, and moisture and manually aerating to remove volatile contaminants. The baseline no action alternative measures would also be included, such as fencing, institutional controls, and groundwater monitoring.

5.2.3 Alternative 3: Source Removal with Engineering Controls

Groundwater, along with soil, would be more actively addressed through this alternative. Contaminated soil in source areas would be excavated and backfilled with clean material, as in alternative two. In addition, measures would be taken to prevent the infiltration of water through soils and thereby minimize the leaching and mobilization of contaminants into groundwater. These measures would include an impermeable barrier over areas where soil was excavated, with a means to control and divert stormwater. A phytoremediation barrier would be planted along the north and west sides of the site to assist the natural attenuation processes in groundwater that would be considered a component of the alternative. Fencing, institutional controls, and groundwater monitoring would still be a component of this alternative.

Analyte	PQLs, mg/kg	Frequency of Detection	Maximum Concentration, mg/kg	Method A Concentration, mg/kg	Screening Result
TPH-gasoline	6	0.51	3340	30	**indicator**
TPH-diesel	30	0.11	6500	2000	**indicator**
Benzene	0.00008	0.15	9.8	0.03	**indicator**
Toluene	0.00015	0.21	110	7	**indicator**
Ethyl benzene	0.00015	0.38	30	6	**indicator**
Xylene	0.00015	0.36	190	9	**indicator**
Lead	20	0.05	140	250	below cleanup level
PQL - practical quantitation limit for appropriate method					
mg/kg - milligrams per kilogram					

Table 1. Indicator Substance Screening, Soil

Analyte	PQLs, µg/L	Frequency of Detection	Maximum Concentration, µg/L	Method A Concentration, µg/L		Screening Result
				Groundwater	Surface Water[1]	
TPH-gasoline	0.05	0.80	110,000	**800**		**indicator**
TPH-diesel	0.25	0.34	1,900,000	**500**		**indicator**
Benzene	0.5	0.76	2400	**5**	71	**indicator**
Toluene	1.0	0.73	2800	**1000**	200,000	**indicator**
Ethyl benzene	1.0	0.76	200,000	**700**	29,000	**indicator**
Xylene	1.0	0.78	17,500	**1000**		**indicator**
Lead	0.002	0.11	3	15	**2.52**[2]	below cleanup level[3]
PQL - practical quantitation limit for appropriate method						
µg/L - micrograms per liter						
bold - selected cleanup level						
[1] - surface water levels based on National Toxics Rule values for Human Health for Consumption of Organism only						
[2] - concentration dependant on hardness (100 mg/L estimated here)						
[3] - maximum concentration does not significantly exceed Method A cleanup level						

Table 2. Indicator Substance Screening, Groundwater

5.2.4 Alternative 4: Source Removal with Engineering Controls and Enhanced Bioremediation

This alternative addresses both contaminated media at the site. Contaminated soil in source areas would be excavated and backfilled with clean material as in the previous alternatives. However, in this alternative the clean backfill is mixed with an oxygen-releasing compound to enhance the biological degradation of the contaminants. Installation of an impermeable barrier over the surface and a phytoremediation barrier would also be included, as would institutional controls and groundwater monitoring.

5.3 REGULATORY REQUIREMENTS

The MTCA Cleanup Regulation sets forth the minimum requirements and procedures for selecting a cleanup action. A cleanup action must meet each of the minimum requirements specified in WAC 173-340-360(2), including certain threshold and other requirements. These requirements are outlined below.

5.3.1 Threshold Requirements

WAC 173-340-360(2)(a) requires that the cleanup action shall:

- Protect human health and the environment.
- Comply with cleanup standards (see Section 4.0).
- Comply with applicable state and federal laws (see Section 5.3.5).
- Provide for compliance monitoring.

5.3.2 Other Requirements

In addition, WAC 173-340-360(2)(b) states that the cleanup action shall:

- Use permanent solutions to the maximum extent practicable.
- Provide for a reasonable restoration time frame.
- Consider public concerns.

WAC 173-340-360(3) describes the specific requirements and procedures for determining whether a cleanup action uses permanent solutions to the maximum extent practicable. A permanent solution is defined as one where cleanup levels can be met without further action being required at the Site other than the disposal of residue from the treatment of hazardous substances. To determine whether a cleanup action uses permanent solutions to the maximum extent practicable, a disproportionate cost analysis is conducted. This analysis compares the costs and benefits of the cleanup action alternatives and involves the consideration of several factors, including:

- Protectiveness.
- Permanent reduction of toxicity, mobility and volume.

- Cost.
- Long-term effectiveness.
- Short-term effectiveness.
- Implementability.
- Consideration of public concerns.

The comparison of benefits and costs may be quantitative, but will often be qualitative and require the use of best professional judgment.

WAC 173-340-360(4) describes the specific requirements and procedures for determining whether a cleanup action provides for a reasonable restoration time frame.

5.3.3 Groundwater Cleanup Action Requirements

At sites with contaminated groundwater, WAC 173-340-360(2)(c) requires that the cleanup action meet certain additional requirements. For nonpermanent groundwater cleanup actions, the regulation requires that the following two requirements be met:

1) Treatment or removal of the source of the release shall be conducted for liquid wastes, areas of high contamination, areas of highly mobile contaminants, or substances that can't be reliably contained.
2) Groundwater containment (such as barriers) or control (such as pumping) shall be implemented to the maximum extent practicable.

5.3.4 Cleanup Action Expectations

WAC 173-340-370 sets forth the following expectations for the development of cleanup action alternatives and the selection of cleanup actions. These expectations represent the types of cleanup actions Ecology considers likely results of the remedy selection process; however, Ecology recognizes there may be some sites where cleanup actions conforming to these expectations are not appropriate.

- Treatment technologies will be emphasized at sites with liquid wastes, areas with high concentrations of hazardous substances, or with highly mobile and/or highly treatable contaminants.
- To minimize the need for long-term management of contaminated materials, hazardous substances will be destroyed, detoxified, and/or removed to concentrations below cleanup levels throughout sites with small volumes of hazardous substances.
- Engineering controls, such as containment, may need to be used at sites with large volumes of materials with relatively low levels of hazardous substances where treatment is impracticable.
- To minimize the potential for migration of hazardous substances, active measures will be taken to prevent precipitation and runoff from coming into contact with contaminated soils or waste materials.

- When hazardous substances remain on-site at concentrations which exceed cleanup levels, they will be consolidated to the maximum extent practicable where needed to minimize the potential for direct contact and migration of hazardous substances.
- For sites adjacent to surface water, active measures will be taken to prevent/minimize releases to that water; dilution will not be the sole method for demonstrating compliance.
- Natural attenuation of hazardous substances may be appropriate at sites under certain specified conditions (see WAC 173-340-370(7)).
- Cleanup actions will not result in a significantly greater overall threat to human health and the environment than other alternatives.

5.3.5 Applicable, Relevant, and Appropriate, and Local Requirements

WAC 173-340-710(1) requires that all cleanup actions comply with all applicable state and federal law. It further states the term "applicable state and federal laws" shall include legally applicable requirements and those requirements that Ecology determines "…are relevant and appropriate requirements." This section discusses applicable state and federal law, relevant and appropriate requirements, and local permitting requirements which were considered and were of primary importance in selecting cleanup requirements. If other requirements are identified at a later date, they will be applied to the cleanup actions at that time.

MTCA provides an exemption from the procedural requirements of several state laws and from any laws authorizing local government permits or approvals for remedial actions conducted under a consent decree, order, or agreed order. [RCW 70.105D.090] However, the substantive requirements of a required permit must be met. The procedural requirements of the following state laws are exempted:

- Ch. 70.94 RCW, Washington Clean Air Act.
- Ch. 70.95 RCW, Solid Waste Management, Reduction, and Recycling.
- Ch. 70.105 RCW, Hazardous Waste Management.
- Ch. 75.20 RCW, Construction Projects in State Waters.
- Ch. 90.48 RCW, Water Pollution Control.
- Ch. 90.58 RCW, Shoreline Management Act of 1971.

WAC 173-340-710(4) sets forth the criteria that Ecology evaluates when determining whether certain requirements are relevant and appropriate for a cleanup action. Table 3 lists the state and federal laws that contain the applicable or relevant and appropriate requirements that apply to the cleanup action at the South Wilbur Petroleum Contamination Site. Local laws, which may be more stringent than specified state and federal laws, will govern where applicable.

5.3.6 Terrestrial Ecological Evaluation

As soil is an affected media at the site, the cleanup action must go through a terrestrial ecological evaluation. The terrestrial ecological evaluation process set forth in MTCA is used to determine whether the cleanup action is protective of the environment. The requirements and procedures

Cleanup Action Implementation	
Ch. 18.104 RCW; Ch. 173-160 WAC	Water Well Construction; Minimum Standards for Construction and Maintenance of Water Wells
Ch. 173-162 WAC	Rules and Regulations Governing the Licensing of Well Contractors and Operators
Ch. 70.105D RCW; Ch. 173-340 WAC	Model Toxics Control Act; MTCA Cleanup Regulation
Ch. 43.21C RCW; Ch. 197-11 WAC	State Environmental Policy Act; SEPA Rules
29 CFR 1910	Occupational Safety and Health Act
Groundwater and Surface Water	
42 USC 300	Safe Drinking Water Act
33 USC 1251; 40 CFR 131; Ch. 173-201A WAC	Clean Water Act of 1977; Water Quality Standards
Ch. 70.105D RCW; Ch. 173-340 WAC	Model Toxics Control Act; MTCA Cleanup Regulation
40 CFR 141; 40 CFR 143	National Primary Drinking Water Standards; National Secondary Drinking Water Standards
Ch. 246-290 WAC	Department of Health Standards for Public Water Supplies
Ch. 173-154 WAC	Protection of Upper Aquifer Zones
Ch. 173-218 WAC	Underground Injection Control
Air	
42 USC 7401; 40 CFR 50	Clean Air Act of 1977; National Ambient Air Quality Standards
Ch. 70.94 RCW; Ch. 43.21A RCW; Ch. 173-400 WAC	Washington Clean Air Act; General Regulations for Air Pollution
Ch. 173-460 WAC	Controls for New Sources of Air Pollution
Ch. 173-470 WAC	Ambient Air Quality Standards for Particulate Matter
SCAPCA Regulation 1 Article VI	Control of Fugitive Emissions
Ch. 70.105D RCW; Ch. 173-340 WAC	Model Toxics Control Act; MTCA Cleanup Regulation
40 CFR Part 28	Criteria for Municipal Solid Waste Landfills

Table 3. Applicable or Relevant and Appropriate Requirements for the Cleanup Action

for conducting a terrestrial ecological evaluation are set forth in WAC 173-340-7490 through WAC 173-340-7494. If a site meets one of the following four criteria, it may be excluded from evaluation:

- All contaminated soil is or will be located below the point of compliance.
- All contaminated soil is or will be covered by buildings, paved surfaces, or other physical barriers.
- There is less than 1.5 acres of undeveloped land on the site or within 500 feet of the site (1/4 acre if specific contaminants are present).
- Concentrations of hazardous substances in soil do not exceed natural background levels.

At this site, all contaminated soil in source areas will be excavated unless it is under a building. Therefore, the first exclusion will be met and no terrestrial ecological evaluation will be done.

5.4 Evaluation of Cleanup Action Alternatives

The requirements and criteria outlined in Section 5.3 are used to conduct a comparative evaluation of alternatives one through four and to select a cleanup action from those alternatives. Table 4 provides a summary of the ranking of the alternatives against the various criteria.

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Threshold Criteria				
Protection of Health & Environment	No	Yes	Yes	Yes
Compliance with Cleanup Standards	No	Yes	Yes	Yes
Compliance with State & Federal Laws	No	Yes	Yes	Yes
Provision for Compliance Monitoring	No	Yes	Yes	Yes
Other Requirements				
Use of Permanent Solutions (disproportionate cost analysis)	Ranks 4	Ranks 3	Ranks 2	Ranks 1
Protectiveness	Low	Medium	Med-High	High
Permanent Reduction	Low	Medium	Medium	Medium
Cleanup Cost (estimated)	$365,000	$244,000	$289,000	$216,000
Long-term Effectiveness	Low	Medium	Medium	Medium
Short-term Effectiveness	High	Medium	Medium	Medium
Implementability	Yes	Yes	Yes	Yes
Consider Public Concerns	Yes	Yes	Yes	Yes
Provide Reasonable Time Frame	No	Yes	Yes	Yes
Consider Public Comments	Yes	Yes	Yes	Yes

Table 4. Evaluation of Cleanup Action Alternatives

5.4.1 Threshold Requirements

5.4.1.1 Protection of Human Health and the Environment

Alternative 1 provides no additional protection to human health and the environment, and allows for contaminated soil to remain on-site and continue leaching contaminants to groundwater. Alternative 2 would eliminate the risk due to contaminated soil by removing the direct contact pathway, the inhalation pathway, and the source for leaching to groundwater. Alternative 3 would provide additional protection from dermal and inhalation pathways, and would inhibit contaminant mobilization by reducing precipitation infiltration. Alternative 4 would provide the highest level of protection by enhancing the removal of residual groundwater contamination.

5.4.1.2 Compliance with Cleanup Standards

Alternative 1 would likely not meet cleanup standards in either soil or groundwater. Alternative 2 would involve the excavation of all soils exceeding cleanup levels, so soil levels will be met. Groundwater levels would take time to achieve as no active measures would be implemented to remediate groundwater. Alternatives 3 and 4 would also achieve soil and groundwater cleanup levels as would alternative 2, but groundwater levels would be met in shorter time frames.

5.4.1.3 Compliance with State and Federal Laws

Alternative 1 would not be in compliance with state and federal laws because MTCA cleanup levels in groundwater and soil would continue to be exceeded. Alternatives 2, 3, and 4 would all achieve cleanup levels but over varying time frames.

5.4.1.4 Provision for Compliance Monitoring

Compliance monitoring would not take place under alternative 1. Alternatives 2, 3, and 4 would have compliance monitoring plans as part of the remedial action, and therefore would meet this criteria.

5.4.2 Other Requirements

5.4.2.1 Use of Permanent Solutions to the Maximum Extent Practicable

As discussed previously, to determine whether a cleanup action uses permanent solutions to the maximum extent practicable, the disproportionate cost analysis specified in the regulation is used. The analysis compares the costs and benefits of the cleanup action alternatives and involves the consideration of several factors. The comparison of costs and benefits may be quantitative, but will often be qualitative and require the use of best professional judgment.

Costs are disproportionate to the benefits if the incremental costs are disproportionate to the incremental benefits. Based on the analysis described below, it has been determined that alternative 4 has the highest ranking for use of a permanent solution to the maximum extent practicable, followed by alternatives 2, 3, and 1. Alternatives 2 and 3 are relatively equal, and in

such cases the alternative with the lower cost ranks higher. However, alternative 4 is higher in ranking than all the others.

- Protectiveness

Alternative 1 would not provide any protection to the public from existing soil and groundwater contamination, as it would not mitigate any exposure nor reduce contaminant levels to below cleanup levels. Alternatives 2, 3, and 4 would all be protective.

- Permanent Reduction of Toxicity, Mobility and Volume

Alternative 1 would not cause a permanent reduction of the toxicity, mobility, and volume of contaminants at the site. Alternatives 2, 3, and 4 would all involve the removal of all soil exceeding the cleanup level, and as such would result in a permanent solution. Contaminants in groundwater in these three alternatives would also be permanently reduced in volume, toxicity, and mobility.

- Cleanup Costs

Costs are approximated based on a fate and transport model that was run to estimate the remediation time for each alternative. Costs for each task included in each alternative are accumulated for the estimated length of time from the model.

Activities involved in alternative 1 include the installation of signs and fencing, and the continuation of groundwater monitoring to track contaminant levels. Modeling has shown that with no soil or groundwater treatment, it would take at least 27 years or more to achieve cleanup levels. Costs would exceed $480,000 to implement institutional controls and monitor the site.

Alternative 2 would include institutional controls, plus the additional cost of soil excavation and groundwater monitoring. Because the source would be removed during excavation, modeling has shown that the time to achieve cleanup levels would be approximately 9 years. Therefore, total costs are estimated at $244,000 which includes excavation and nine years of groundwater monitoring.

The same costs as alternative 2 would be included in alternative 3, with the addition of surface capping, surface water controls, and plants. With these additional measures, the total cost of alternative 3 is estimated to be $289,000.

Alternative 4 would include the same measures as alternative 3, but would involve the addition of the oxygen-releasing compound with the clean backfill. Modeling shows this should reduce the time to achieve cleanup levels from 9 years to 3 years. So the additional cost of the oxygen-releasing compound should be offset by the reduction in monitoring costs. Estimated total costs for this alternative are $216,000.

- Long-Term Effectiveness

Alternative 1 would not be effective in the long-term as contaminated soil and groundwater would not be reduced in a reasonable time frame, and risks to human health and the environment would not be mitigated.

Alternatives 2, 3, and 4 would all provide a similar level of long-term effectiveness. The primary difference is in the time required to achieve cleanup levels, which would be least for alternative 4 and most with alternative 2.

- Short-Term Effectiveness

Alternative 1would be effective in the short-term because no additional risks would be introduced by its implementation. Alternatives 2 through 4 would introduce minor risks by the excavation and handling of contaminated soil. However, these risks would be effectively managed through standard operating procedures, minimizing handling of contaminated soil, and by keeping soil containerized during storage and transport.

- Implementability

All four alternatives are implementable at the Site. In the case of alternative 1, no action would be taken and institutional controls would be easily set up. For alternatives 2 through 4, actions that would be taken are excavation, backfilling, paving, fencing, and institutional controls, all of which are implementable based on site conditions. Paving and fencing would be limited by existing structures which would not be removed for this work.

- Consider Public Concerns

All four alternatives would provide opportunity for members of the public to review and comment on any proposals or plans.

5.4.2.2 Provide a Reasonable Restoration Time Frame

WAC 173-340-360(4) describes the specific requirements and procedures for determining whether a cleanup action provides for a reasonable restoration time frame, as required under subsection (2)(b)(ii). The factors used to determine whether a cleanup action provides a reasonable restoration time frame are set forth in WAC 173-340-360(4)(b).

Based on fate and transport modeling, alternative 1 would require a minimum of 27 years to achieve cleanup levels in soil and groundwater. The assumptions are that the areas of soil contamination are not expected to increase, i.e., there will be no new releases, the hydraulic conditions will not significantly change, there is currently an equilibrium between soil and groundwater contamination, and active biological degradation is occurring. This would not be considered a reasonable restoration time frame.

Using the same assumptions as alternative 1, alternative 2 is expected to meet cleanup levels in soil and groundwater within 9 years. Alternative 3 would likely achieve cleanup levels in a

slightly faster time frame, but because of the uncertainties in the fate and transport model, the restoration time frame is estimated to also be 9 years. These two alternatives are considered to have a reasonable restoration time frame.

Alternative 4 would enhance the restoration time frame due to the addition of oxygen to the groundwater system causing increased biological degradation of contaminants. It is expected to result in the achievement of cleanup levels within an estimated 3 years. This is considered to be a reasonable restoration time frame.

5.4.3 Groundwater Cleanup Action Requirements

Cleanup actions that address groundwater must meet the specific requirements described in Section 5.3.3 in addition to those listed above. At this Site, groundwater will be actively addressed through treatment with an oxygen-releasing compound. No other groundwater treatment technologies, such as pump and treat or air sparging, are considered feasible at this Site due to Site conditions. Once an oxygen-releasing compound is added to the soil, it is expected that no further action will be required to achieve cleanup levels in groundwater. Therefore, it is Ecology's determination that this technology represents a permanent solution for groundwater cleanup, to the maximum extent practicable at the Site.

5.4.4 Terrestrial Ecological Evaluation

As noted above, alternatives 1 through 3 are considered protective of the environment. This determination is based on a terrestrial ecological evaluation conducted under the procedures specified in the regulation. Under the terrestrial ecological evaluation process, no further evaluation is required if Ecology determines that a site meets one of the four criteria listed in Section 5.3.6.

Under alternatives 2 through 4, contaminated soil would be excavated. Ecology has determined that since all soil contaminated with hazardous substances will be removed from the Site, the potential for exposure to plants or wildlife will be eliminated.

5.4.5 Cleanup Action Expectations

Specific expectations of cleanup levels are outlined in WAC 173-340-370 and are described in Section 5.3.4. Among those, alternatives 2 through 4 would address these expectations in the following manner:

- The use of an oxygen-releasing compound will provide treatment of discrete areas of hazardous substances.
- Hazardous substances will be removed through soil excavation.
- The installation of an asphalt cap and stormwater controls will prevent contact with contaminated materials.
- Treatment of contaminated groundwater with an oxygen-releasing compound and the installation of a phytoremediation barrier will minimize any discharge of contaminated groundwater to surface water in excess of cleanup levels.

- At this Site, there is evidence that natural attenuation is occurring, the source will be removed through soil excavation, compliance monitoring will be conducted to monitor the cleanup action, and the presence of residual contamination in groundwater should not present an unacceptable risk.

5.5 DECISION

Based on the analysis described above, alternative 4 has been selected as the proposed remedial action for the South Wilbur Petroleum Contamination Site. The alternative meets each of the minimum requirements for remedial actions.

Alternative 4 meets each of the threshold requirements. Furthermore, alternative 4 uses permanent solutions to the maximum extent practicable. The cost of alternative 4 is less than alternatives 1 through 3 and provides a higher level of protection for human health and the environment. Alternative 4 also provides a reasonable restoration time frame.

6.0 PROPOSED REMEDIAL ACTION

The proposed cleanup action for the Site includes the excavation of soils contaminated with petroleum hydrocarbons at concentrations above cleanup levels, and backfilling with clean soils and an oxygen-releasing compound. Excavated soils will either be transported to a permitted disposal facility, or will be transported to an appropriate off-site location to be land treated. Engineering controls in the form of asphalt paving, stormwater controls, and a phytoremediation barrier on the north and west sides of the site, will be installed to minimize contaminant migration in groundwater. In addition to these cleanup actions, groundwater monitoring will be required to ensure that reductions in groundwater contaminant concentrations are occurring. Institutional controls will also be required as long as cleanup levels have not been achieved.

In addition, based on the recommendations of Ecology's April 2012 Periodic Review, supplemental work will take place to assist in achievement of groundwater cleanup levels. Chemical and biological oxidants designed specifically to accelerate natural attenuation of petroleum constituents will be introduced into the shallow subsurface. Application methods for oxidants must be compatible with the low permeability environment and should be able to place oxidants in contact with residual source areas below buildings.

6.1 GROUNDWATER MONITORING

Groundwater monitoring will include the quarterly sampling of all twelve monitoring wells for all groundwater indicators. Groundwater monitoring shall continue until cleanup levels are achieved. In addition, dissolved oxygen will be measured on at least a quarterly basis to help determine the effectiveness of the oxygen-releasing compound. If any wells need to be removed to complete the cleanup action, or if any wells are determined to be compromised due to the cleanup action, then they shall not be sampled and may be replaced if necessary.

6.2 INSTITUTIONAL CONTROLS

Institutional controls are measures undertaken to limit or prohibit activities that may interfere with the integrity of a cleanup action or result in exposure to hazardous substances at the site. Such measures are required to assure both the continued protection of human health and the environment and the integrity of the cleanup action whenever hazardous substances remain at the site as concentrations exceeding the applicable cleanup level. Institutional controls are also specifically required to protect terrestrial plants and animals based on the terrestrial ecological evaluation. Institutional controls can include both physical measures and legal and administrative mechanisms. WAC 173-340-440 provides additional information on institutional controls, and the conditions under which they may be removed.

Institutional controls are an important component of the cleanup action plan for the South Wilbur Petroleum Contamination Site. Residual contamination in groundwater will remain at the site. Both physical controls and legal and administrative mechanisms will be used to ensure the current and future residents do not come into contact with residual contamination and the integrity of the cleanup action is maintained. Institutional controls will take the form of fences and signs at the property, and restrictive covenants placed with the deed. The restrictive covenants will limit site use with the purpose of minimizing disturbance to the asphalt paving, and will also prevent any excavation, well installation, or withdrawal of water for any purpose other than monitoring on the property.

6.3 FINANCIAL ASSURANCES

WAC 173-340-440 states that financial assurance mechanisms shall be required at sites where the selected cleanup action includes engineered and/or institutional controls. Financial assurances are not required if a PLP can demonstrate that sufficient financial resources are available and in place to provide for long-term effectiveness of engineered and/or institutional controls required in the CAP.

6.4 FIVE YEAR REVIEW

As long as groundwater cleanup levels have not been achieved, WAC 173-340-420 states that at sites where a cleanup action requires an institutional control, a periodic review shall be completed no less frequently than every five years after the initiation of a cleanup action. Since institutional controls will be required, five year reviews shall take place at this Site. Groundwater monitoring data shall be reviewed to continue to assess the effectiveness of the groundwater treatment and engineering controls in reducing contaminant concentration. If concentrations of contaminants in groundwater are not decreasing, then further remedial action will be considered.

7.0 REFERENCES CITED

CH2MHill, 2002, Lincoln County Remedial Investigation/Feasibility Report South Wilbur Petroleum Contamination Site