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Remedial Investigation Work Plan

Wishram, Washington

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Prepared for

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List of Acronyms

Acronym	Description
AO	Agreed Order
ARAR	applicable, relevant, and appropriate requirement
AST	aboveground storage tank
bgs	below ground surface
BNSF	BNSF Railway Company
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAP	Cleanup Action Plan
COC	chemical of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSM	conceptual site model
CWA	Clean Water Act
DOT	U.S. Department of Transportation
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
EPH	extractable petroleum hydrocarbon
ESC	ESC Laboratories
FS	feasibility study
GPR	ground penetrating radar
GPS	Global Positioning System
HASP	Health and Safety Plan
IDW	investigation-derived wastes
LIF	laser-induced fluorescence
LNAPL	light non-aqueous phase liquid
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
MNA	monitored natural attenuation
MTCA	Model Toxics Control Act
NAPL	non-aqueous phase liquid
NRC	National Response Center
NRWQC	National Recommended Water Quality Criteria
NTR	National Toxics Rule
NWTPH-DX	Northwest Total Petroleum Hydrocarbons as Diesel and Oil Extended
OHM	oil head monitoring
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl

Acronym	Description
PID	photoionization detector
PTS	PTS Laboratories
PVC	polyvinyl chloride
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RGW	reconnaissance groundwater
RI	remedial investigation
RMCAT	RMCAT Environmental Services, Inc.
SAP	Sampling and Analysis Plan
SOG	Standard Operating Guideline
SOW	Scope of Work
SP&S Railway	Spokane, Portland, and Seattle Railway
SVE	soil vapor extraction
SVOC	semi-volatile organic compound
UST	underground storage tank
VOC	volatile organic compound
WAC	Washington Administrative Code

Section 1: Introduction and Background

This Work Plan presents the scope of work for a remedial investigation (RI) at the BNSF Railway Company (BNSF) Wishram Railyard (site) located in Wishram, Washington (refer to Figure 1). The RI will be performed in accordance with the Washington State Department of Ecology (Ecology) Model Toxics Control Act (MTCA) regulations published in Washington Administrative Code (WAC) 173-340 (Ecology 2007). This work is being performed pursuant to an Agreed Order (AO, No. DE 12897) between Ecology and BNSF dated 7 October 2015.

The purpose of this RI is to identify the distribution of chemicals of concern (COCs) in soil and groundwater at the site and evaluate related fate and transport issues. The RI will also allow development of a conceptual site model (CSM) that will be used to support preparation of a feasibility study (FS). Based on these data (including data from subsequent phases as needed), the analytical results will be compared with cleanup levels and other applicable, relevant, and appropriate requirements (ARARs) identified for the site to evaluate the potential risks posed to human health and the environment and develop appropriate cleanup approaches in a Remedial Investigation / Feasibility Study (RI/FS) report.

This Work Plan is organized as follows:

- The remainder of Section 1 summarizes information regarding the site location and description, a summary of local geology and hydrogeology, previous environmental investigations and remedial activities, previous groundwater monitoring results, and presents a preliminary CSM. (Note: The final CSM will be based on the findings of the RI activities identified herein and will be presented in a RI/FS report.)

- Section 2 starts by presenting known data gaps and data needs resulting from past investigations. Then, identifies the RI objectives and general approach and goals for field activities described herein. RI activities will include both soil and groundwater investigations at specific locations of the site to address identified data gaps and data needs.

- Section 3 identifies details regarding the specific investigative activities that will be performed during the RI. This section also identifies the approximate sampling locations, number of samples to be collected, and analytical methods for each sample matrix. Additionally, this section references the Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP) developed for the site (Appendix A) and references Kennedy/Jenks Consultants Standard Operating Guidelines (SOGs) that have been updated for this project (Appendix B). Section 3 also references the Site Health and Safety Plan (HASP) developed for the site (Appendix C).

- Section 4 summarizes the procedures for personnel and equipment decontamination and procedures for disposal of investigation-derived wastes (IDW).

- Section 5 summarizes the reporting activities associated with the RI and identifies the schedule and duration of field activities identified in this Work Plan.

1.1 Site Location, Description, and History

Wishram is located in Klickitat County, Washington, approximately 13 miles northeast of The Dalles, Oregon, and 0.75 mile south of Washington State Route 14, within the southwestern quarter of Section 17, Township 2 north, Range 15, east of the Willamette Meridian. The site location is shown on Figure 1.

The railyard is approximately 2,000 feet long and ranges from 150 to 720 feet wide. The site encompasses the westernmost portion of the railyard, approximately 350 feet long (east to west) and 450 feet wide (north to south) and covers an area of approximately 3.6 acres. The site is bounded by the town of Wishram to the north, the railyard to the east, the Columbia River to the south and southwest, and railroad right-of-way to the west. Onsite structures include storage buildings, a maintenance shop (office and tool storage), two mainline tracks, and active track spur rails. Current site features are shown on Figure 2.

The Wishram Railyard was originally developed by the Spokane, Portland, and Seattle (SP&S) Railway between 1910 and 1912. SP&S merged with several other railroads in 1970 to become the Burlington Northern Railroad, which merged with the Santa Fe in 1995 to become what is now BNSF. The primary historical use of the railyard was railcar switching. Historically, locomotive fueling/watering and repairs also occurred at Wishram. Most of the track spurs, early structures, and infrastructure no longer remain. Prominent site features believed to have been present during some portions of the time between 1910 and the present are shown on Figure 3. Additional details regarding historical site activities, including historical plat maps, are presented in the report titled *Site Investigation, Wishram Railyard* (Kennedy/Jenks Consultants 2012) and the associated appendices.

1.2 Geology and Hydrogeology

The site lies on the northern bank of the Columbia River. Prior to damming of the river in 1957 (The Dalles Dam), significant erosion and deposition of sediments occurred along the Columbia River associated with seasonal flow conditions. Construction of the Wishram railyard started in the early 1900s through a series of large-scale earthmoving activities. Based on available information, the majority of subsurface soils beneath the site (primarily sand) were imported from other areas along the Columbia River (Grande 1992; Austin and Dill 1996).

Site soils consist of unconsolidated, fine to medium grained, poorly graded sands with variable amounts of silt (generally 0 to 25 percent). As indicted above, the unconsolidated sand is composed largely of fill-material; likely taken from nearby aeolian sand dunes and used to level the site grade (Grande 1992; Austin and Dill 1996). Previous investigations have confirmed the thickness of the unconsolidated sand unit to extend from ground-surface to approximately 10 to 95 feet below ground surface (bgs) (Kennedy/Jenks Consultants 2012; Dakota Technologies 2013). The thickness of the unconsolidated sand material is highly variable across the site resulting from varying depths of the underlying basalt bedrock surface, which in general, is encountered at shallower depths near the upland areas and deeper depths nearer the river. A bedrock depth map is included as Figure 4.

A discontinuous lens composed of sand with gravel has been encountered within the unconsolidated unit, above the bedrock, in a number of site soil borings, and is typically 1 to

3 feet thick (Kennedy/Jenks Consultants 2012). With the exception of this basal sand and gravel layer and a few discontinuous silt lenses, investigations at the site have encountered few variations in lithologic composition throughout the unconsolidated unit.

The underlying basalt bedrock has been identified at several boring locations. Based on available references and surrounding geologic outcroppings, the bedrock is composed of flood basalts of the Columbia River Plateau. Many of the geologic intraflow structures typical of flood basalts are exposed in outcrops near the site, including: 1) thick competent columnar basalt, 2) narrow hackly fanning columns, and 3) vesicular (gas bubble entrained) zones (Lindholm and Vaccaro 1988). Basalt fragments have been recovered from the terminus of a number of borings advanced to refusal, and as such, it is inferred that the bedrock is composed of flood basalts with similar intraflow structures as observed in the nearby outcroppings and as documented in the available literature.

Hydrogeologic conditions at the site are controlled by seasonal variation in groundwater recharge and short-term (daily) variations in the adjacent Columbia River stage. Both seasonal and daily stage variations can result in temporal reversals in the groundwater flow regime. The most commonly monitored flow condition is that of site groundwater flowing toward the Columbia River (Figure 5). However, during times of lower groundwater recharge, the groundwater flow regime can reverse, resulting in a hydraulic gradient away from the river, toward the upland (Figure 6).

Daily oscillations in the Columbia River stage (typically 1 to 2 feet) occur due to variable discharge rates from The Dalles Dam. Data logging pressure transducers have recorded site groundwater levels near the river fluctuating with the river stage, indicating site groundwater is in direct hydraulic communication with the Columbia River (Figure 7). The magnitude at which site groundwater responds to the changes in river stage dampens as a function of distance from the riverbank. As with seasonal groundwater recharge, daily variations in the hydraulic gradient direction (either toward the river or toward the upland areas) have been observed due to varying river levels. Although there are daily and seasonal variations in the hydraulic gradient, the net groundwater flow direction at the site appears to be toward the Columbia River.

1.3 Previous Environmental Investigation and Remediation

From 2002 through 2015, prior to the site being entered into an AO with Ecology, BNSF performed a series of voluntary independent investigations to characterize the distribution of impacted soil and groundwater as well as voluntary independent remediation activities. This work included multiple events of soil sampling, monitoring well installation, and groundwater monitoring (refer to Figure 8 for soil boring and monitoring well locations). Tables 1 through 3 summarize the results of past groundwater monitoring data collected from the site. Figures and tables showing historical analytical results for soil and reconnaissance groundwater are included for reference in Appendix D.

Through performance of past investigative activities completed at the site, the primary COCs identified for the site include petroleum hydrocarbons; with diesel- and oil-range hydrocarbons being the primary COC. Other associated COCs include polycyclic aromatic hydrocarbons (PAHs), including low concentrations of carcinogenic PAHs (cPAHs). In addition, benzene, toluene, ethylbenzene, and xylenes (BTEX) and some metals (primarily arsenic and lead) have been detected at low levels in site soil and/or groundwater.

The following section briefly summarizes past investigation and remediation activities that have occurred at the site.

In 2002, following the discovery of a 30,000-gallon, steel, single-walled underground storage tank (UST) adjacent to the western side of a former boiler house, soil sampling activities conducted by RMCAT Environmental Services, Inc. of Portland, Oregon (RMCAT) identified the presence of petroleum hydrocarbon concentrations in soil at concentrations above the MTCA Method A cleanup levels (Kennedy/Jenks Consultants 2003). The UST and approximately 750 tons of petroleum-containing soil were removed by RMCAT later in April 2002 (see Figure 3 for lateral extent of excavation area). Petroleum-containing soils were excavated to the top of the bedrock surface (to the extent practicable), which was at a depth of approximately 16 feet bgs. Confirmation sampling indicated a thin layer of soil containing diesel- and oil-range hydrocarbons at concentrations exceeding MTCA Method A soil cleanup levels (for industrial properties) remained in place just above bedrock to the north, east, and south of the excavated area. (Note: In accordance with MTCA, the Method A cleanup levels for diesel-range and oil-range hydrocarbons are the same under either the unrestricted or industrial land use scenarios).

In 2003, a UST site assessment was conducted to evaluate site hydrogeologic conditions and the extent of petroleum-containing soil south and potentially down hydraulic gradient of the 30,000-gallon UST (Kennedy/Jenks Consultants 2004a). A total of seven soil borings (WSB-1 through WSB-7) were advanced to depths ranging from 10 to 32 feet bgs (refer to Figure 8). Continuous core soil samples were collected for lithologic logging and selected samples were analyzed for diesel- and oil-range hydrocarbons. Of the seven borings, two borings (WSB-2 and WSB-5) contained concentrations of petroleum hydrocarbons greater than the MTCA Method A soil cleanup levels for industrial properties. In addition to soil sampling, a total of four monitoring wells (WMW-1 through WMW-4) were installed (see Figure 8). Groundwater samples collected from each of these wells contained diesel- and oil-range hydrocarbons at concentrations exceeding the MTCA Method A groundwater cleanup levels. (Note: WMW-2 and WMW-4 were destroyed or abandoned during later site operation activities).

In 2004, a site assessment evaluated soil and groundwater conditions at nine locations identified to have been potentially associated with the use and/or storage of COCs (Kennedy/Jenks Consultants 2004b). These locations included:

- Former 30,000-Barrel Oil aboveground storage tank (AST)
- Former 600-Gallon Fuel Oil and 10,000-Gallon Gasoline/Oil USTs
- Former 5,000-Gallon Oil UST at Depot
- Former 1,000-Gallon Gasoline UST and Oil House
- Former Transformer Storage Area
- Former Engine House and Turntable

- Former Power House
- Former 100,000-Gallon Diesel ASTs, Pump House, and former 500-Gallon Gasoline USTs
- Former Fueling Island and 5,000-Gallon Lubricating Oil AST.

Soil borings were advanced at 28 locations (WSB-04-XX series) in and around the locations listed above (refer to Figure 8). Soil samples were analyzed for petroleum hydrocarbons, BTEX, PAHs, and select metals. Samples collected from soil borings WSB-04-09, WSB-04-26, and WSB-04-37 contained petroleum hydrocarbon at concentrations above MTCA Method A cleanup levels for industrial properties. Soil analytical results from these investigations indicated four locations contained concentrations of diesel- or oil-range petroleum hydrocarbon above MTCA Method A industrial cleanup standard for soil. These locations include: 1) the Former Power House, 2) the Former Fueling Island, and 3) the former 5,000-gallon Lubricating Oil AST, and 4) the former 30,000-gallon UST near the Former Boiler House. A number of reconnaissance groundwater samples were collected from selected borings and analyzed for petroleum hydrocarbons, BTEX, and metals (refer to Appendix D). Boring location WSB-04-34 contained concentrations of arsenic exceeding the MTCA Method A cleanup level for groundwater, all other sample analytes at location WSB-04-34, and all analytes at all other wells, were below the cleanup standards for potable groundwater. As a source of arsenic is not known at the site, slightly elevated arsenic concentrations in groundwater appear to be attributed to natural background conditions caused by increased turbidity from the reconnaissance groundwater sampling techniques used to collect the samples and the results are likely not indicative of site conditions.

In addition, three monitoring wells (WMW-5, WMW-6 and WMW-7) were installed and included in the ongoing groundwater monitoring program.

In 2005, based on the findings of the 2004 site assessment, additional remediation activities were conducted at the site resulting in the removal and offsite disposal of approximately 3,600 tons of petroleum-containing soil and debris, removal and recycling of approximately 1,800 gallons of petroleum from the former 5,000-gallon lube oil UST and associated piping, and removal and recycling of 10 tons of metal (Kennedy/Jenks Consultants 2007). The excavations depths extended to the water table, typically encountered around 10 to 12 feet bgs. The approximate horizontal extent of the excavation is shown on Figure 3. Confirmation sampling of the excavation areas located west of the current Maintenance Shop indicated some soil containing diesel-range petroleum hydrocarbons at concentrations above the MTCA Method A industrial soil cleanup level was left in place below the water table.

In 2010, a supplemental investigation was performed (Kennedy/Jenks Consultants 2010a) to identify potential sources of residual light non-aqueous phase liquid (LNAPL) in the vicinity of monitoring well WMW-7. Accessible and previously identified potential sources of hydrocarbon in the vicinity of well WMW-7 had been removed during the 2005 excavation activities. The supplemental investigation included subsurface mapping surveys using ground penetrating radar (GPR), magnetic, and electromagnetic methods in an attempt to locate any previously unidentified USTs or other subsurface structures. The supplemental investigation also included a subsurface soil investigation, including collection and analysis of subsurface soils, to further delineate the distribution of petroleum-containing soils in this vicinity. The results of this investigation did not identify additional potential sources of hydrocarbon that would potentially contribute to LNAPL observed in well WMW-7. Based on available investigative results for the Maintenance Shop area, the primary source of residual petroleum hydrocarbons appears to be soil that is either submerged or immediately above bedrock in the vicinity of the former 30,000-gallon diesel UST.

In 2010, further soil removal was performed in association with removal of a concrete structure believed to be the foundation for the former 28,500-gallon oil service AST. As part of the concrete structure removal, an additional 628 tons of soil, concrete, and wood debris were excavated and disposed of at the Rabanco Regional Disposal Company landfill. Confirmation soil samples collected following the excavation activities confirmed residual hydrocarbon concentrations in the excavation area were below MTCA Method A soil cleanup levels for unrestricted land use (Kennedy/Jenks Consultants 2010b).

In 2012, investigation and remediation activities continued based on available data (Kennedy/Jenks Consultants 2012). Investigations focused on the southern side of the mainline tracks near the former fueling island and Power House. During this investigation, soil borings were advanced to depths of up to 68.5 feet bgs. Of the 14 deep borings (B-12-1 through B-12-14) advanced in the vicinity of the former Power House, eight encountered heavy oil non-aqueous phase liquid (NAPL) within the saturated zone (refer to Figure 9). The borings which encountered NAPL include: B-12-1, B-12-2, B-12-4, B-12-7, B-12-8, B-12-11, B-12-12, and B-12-13. The NAPL was typically encountered at depths greater than 25 feet bgs and extended to a maximum depth of 68.5 feet bgs at one location.

Soil samples collected from the heavy oil-impacted intervals of the borings indicated exceedances of MTCA Method A industrial soil cleanup levels for gasoline-, diesel, and oil-range hydrocarbons. Benzene exceeded MTCA Method A cleanup levels in two of the soil samples: B-12-2 and B-12-11 at respective depths of 12 feet and 36 feet bgs. The benzene detections were below the method reporting limit (MRL) but above the method detection limit (MDL); therefore, assigned a 'J' value by the laboratory (Kennedy/Jenks Consultants 2012). In addition, naphthalene, including 1- and 2-methylnaphthalene compounds, was detected in two samples at concentrations above the MTCA Method A soil cleanup level for industrial properties.

Soil borings and reconnaissance groundwater samples were collected along the length of the former fueling platform south of the mainline tracks (RB0 through RB4). Based on these and previous results, diesel impacts encountered along the former fueling platform appear to be sourced predominately from the residual LNAPL encountered north of the mainline tracks (and typically hydraulically upgradient of the former fueling platform).

To address residual hydrocarbon in soil north of the mainline tracks, an air sparging (AS) system and a soil vapor extraction (SVE) system were installed in 2012. The AS/SVE system consisted of three AS wells (AS-12-1, AS-12-2, and AS-12-3) and four SVE wells (SVE-12-1, SVE-12-2, SVE-2-3, and SVE-12-4) that were installed to remediate residual hydrocarbon in the area north of the mainline tracks (refer to Figure 8). Because of irregularities in the presence of LNAPL in well WMW-7, air sparging was discontinued in June 2012. Due to fluctuating groundwater levels within the unconsolidated aquifer in this northern portion of the site, the SVE system was modified to operate in biovent mode by injecting air (rather than pulling air) through the SVE wells. Bioventing with ambient air through the SVE wells has been ongoing since June 2012.

In 2013, a laser induced fluorescence (LIF) survey was conducted at the site to further delineate the heavy oil-affected areas. The LIF survey was conducted by Dakota Technologies, of Fargo North Dakota, using the TarGOST LIF system, developed specifically for coal tar and heavy oil detection (Dakota Technologies 2013). The LIF survey included 102 sample points at approximately 12.5- to 50-foot centers, but mostly spaced on 30- to 40-foot centers. The LIF tooling was advanced to refusal (the top of bedrock surface) using a Geoprobe direct-push rig. Using these data, the inferred heavy oil NAPL distribution was developed for the site. Soil samples were collected to qualitatively correlate the LIF signal response to laboratory soil analytical concentrations for petroleum hydrocarbon. The soil analytical data from this investigation are included in Table 4, boring locations are shown on Figure 9.

During the sampling efforts, three soil cores (D6-30/32, F2-34.3/36.3, and F6-28/30) were collected, preserved by freezing with dry ice, and submitted to PTS Laboratories (PTS) of California for mobility analysis. The analysis included: grain size analysis, pore fluid saturations, air/water drainage capillarity, free product mobility testing, residual saturation estimation, and effective porosity measurements. The results of the analyses are included as Appendix E. In addition to mobility analysis, a grab sample of the heavy oil NAPL was collected from soil boring (and LIF) location TG-D4 (refer to Figure 9) and submitted to PTS for analysis of the following physical properties: specific gravity, density, viscosity, and interfacial/surface tension (PTS 2013). Results of the fluid properties are also included in Appendix E.

During the LIF survey, on 13 July 2013, heavy oil droplets and an associated sheen were observed adjacent to the site in the Columbia River. BNSF reported the occurrence of the oil and sheen in surface water to the National Response Center (NRC) and Ecology on the same date. However, the LIF survey did not identify a clear migration pathway for potential heavy oil migration to the Columbia River through the unconsolidated sand aquifer. Following the observation of sheen in the river, monthly inspections for possible sheen along the riverbank area began in December 2013 and has been ongoing since then. (Note: Since monitoring began in December 2013, sheen has only been observed during two other monthly inspection events; July 2014 and June 2015).

In 2014, BNSF initiated additional investigations in the vicinity of the Power House to evaluate the potentially mobility of the saturated zone heavy oil. This work included advancing nine pilot soil borings (OHM-1 through OHM-4, MWD-1 through MWD-4, and B-14-1), including continuous core sampling, to assess the lithology in areas where oil head monitoring (OHM) wells are planned to be installed at the site. Soil samples were analyzed for diesel- and oil-range petroleum hydrocarbons using the Northwest Total Petroleum Hydrocarbons as Diesel and Oil Extended (NWTPH-DX) method (Table 5). The soil sample analytical results are discussed further below. The soil sampling locations are displayed on Figure 9.The boring logs have been compiled and are included in Appendix F. OHM locations were chosen using the soil analytical and LIF survey data, focusing on likely areas to monitor the heavy oil *in situ*. When installed as a part of this Work Plan, the wells will be designed to 1) monitor the oil head (thickness) on top of bedrock and 2) monitor dissolved phase and potential horizontal migration of the heavy oil toward the river. A detailed description of the OHM well installation activities that have been and will be performed during this RI is outlined in Section 3: RI Field Activities.

1.4 Heavy Oil Summary

Investigation of the heavy oil occurrence and distribution (i.e., generally deeper soils greater than 20 feet bgs) has been ongoing since 2012. These investigations included: initial soil boring and analytical sampling in 2012 (Kennedy/Jenks Consultants 2012), a LIF survey and sampling event described above in 2013, and advancing pilot soil borings for the OHM well installations described above in 2014. The current understanding of the heavy oil lateral distribution has been developed based on this past work and is displayed on Figure 9.

1.5 Shallow Groundwater Monitoring Summary

Groundwater monitoring efforts have been ongoing at the site from 2003 to present to monitor diesel impacts in shallow groundwater (the upper portion of the saturated zone). Currently, there are eight monitoring wells present at the site (WMW-1, WMW-3, WMW-5, WMW-7, WMW-8, WMW-9, WMW-10, and WMW-11). (Note: Monitoring wells WMW-2, WMW-4, and WMW-6 were either destroyed or abandoned during past site activities.) The monitoring frequency is currently semi-annual. Based on past monitoring results, dissolved petroleum hydrocarbons (diesel- and/or oil-range) have been detected relatively consistently at concentrations above the MTCA Method A groundwater cleanup levels in wells WMW-1, WMW-3, WMW-7, WMW-8, and WMW-11 (refer to Table 2). Groundwater petroleum hydrocarbon concentrations from wells WMW-9 and WMW-10 fluctuate from non-detectable concentrations to levels that exceed MTCA Method A groundwater cleanup levels, indicating these wells are likely near the periphery of impacted groundwater. Figure 10 displays the diesel- and oil-range petroleum hydrocarbon concentration in samples collected from each of the site groundwater monitoring wells during the September 2014 and April 2015 monitoring events. Figure 10 also displays the estimated distribution of diesel impacts in groundwater. Small amounts of LNAPL are intermittently encountered in wells WMW-8 and WMW-7. Recent measurements of apparent LNAPL thickness have fluctuated from not observed to 0.20 foot.

1.6 Known Current Data Gaps

The following section identifies the existing data gaps and how they will be addressed during this RI. A detailed description of the field activities that will be performed to fill the data gaps is included in Section 3: RI Field Activities.

Extent of light phase hydrocarbon. Soil and groundwater impacted by the light phase hydrocarbon (primarily diesel-range) has mostly been defined by past investigations and laboratory analysis. Ongoing semi-annual groundwater monitoring will be performed to assess changes in hydrocarbon distribution. During performance of the LIF survey in 2013, a diesel-like LIF response was identified below the water table in a few locations. Additional soil borings are planned to evaluate the potential for submerged diesel at these locations.

In addition, two shallow monitoring wells are planned for the western margins of diesel-affected areas (both north and south of the mainline tracks) to confirm the western extent of diesel-containing groundwater in these areas.

Mass flux of light phase hydrocarbon (dissolved diesel) to/from the river. Dissolved phase diesel impacts have been identified in groundwater monitoring wells nearest the river (within approximately 80 feet). The potential mass flux of dissolved diesel from site groundwater toward the river has not been assessed during prior investigation activities. To assess mass flux of diesel-range hydrocarbons in groundwater, a well transect, constructed parallel to the riverbank, will be installed. The well transect will include five additional shallow groundwater monitoring wells installed as close to the Columbia River as feasible.

Natural attenuation conditions nearest the river where surface/groundwater exchange may enhance biodegradation rates. The well transect (described above) will also be sampled for geochemical indicators of natural attenuation, as periodic river water influx may increase biodegradation rates of the dissolved diesel near the groundwater/surface water mixing zone.

Heavy oil mobility assessments. Previous RI activities included laboratory mobility assessments of the heavy oil within the unconsolidated sands (Appendix E). The assessments indicated potential for heavy oil mobility; however, the assessments are not indicative of *in situ* site conditions and only provide a physical measurement in a controlled condition. Additionally, the LIF data collected in 2013 did not reveal a migration pathway through the unconsolidated sand aquifer to the river. Additional mobility assessments will focus on the potential heavy oil migration pathway through the sand aquifer and the potential for migration into the bedrock unit. This will be evaluated using OHM wells. The OHM wells will be installed in areas where the heavy oil appears to be in contact with bedrock. Once the OHM wells are installed, oil NAPL thickness data will be collected, along with physical properties of the oil, to assess the potential for heavy oil to enter into the bedrock. OHM wells will also be installed in locations on the river-side edge of the heavy oil NAPL to monitor the potential advancement of oil towards the river.

Heavy oil dissolved phase assessments. Currently, the approximate extent of heavy oil NAPL has been delineated through LIF surveys and soil borings. To date, limited data has been collected to evaluate the potential for dissolved phase hydrocarbons associated with the heavy oil in site groundwater. Existing monitoring wells completed at the site are screened in the upper portion of the saturated zone where LNAPL and diesel-range hydrocarbons would be expected (i.e., smear zone). Prior to this Work Plan, there have not been monitoring wells completed in the lower portion of saturated zone to assess possible dissolved phase hydrocarbons resulting from the heavy oil. During the RI, deep riverside monitoring (RMD) wells will be constructed near the Columbia River and downgradient of the known heavy oil NAPL to assess the potential for dissolved phase hydrocarbons that may be associated with the heavy oil NAPL.

Additional hydraulic assessments. During past investigations, a general understanding of the interaction between river level fluctuations and the site groundwater gradient have been evaluated. However, additional information is needed to assess the effects of daily and seasonal stage fluctuations in the river on site groundwater flow conditions. In addition, information on the hydraulic parameters affecting groundwater flow (i.e., hydraulic conductivity) is necessary to assess groundwater seepage velocities. Specific activities for further characterization of site groundwater conditions are identified in Section 3.

Other potential sources of COCs and areas warranting further investigation. During past investigations, the majority of other possible sources of COCs have been evaluated at the site. However, a few potential areas exist where additional data is needed to further assess the potential for COCs in soil and groundwater. These other areas include:

- The former transformer storage area where transformers containing polychlorinated biphenyls (PCBs) may have been used or stored.
- The former 5,000-gallon oil UST where historical release may have occurred.
- The former oil house and 1,000-gallon gasoline UST where historical release may have occurred.
- The former Engine House/Machine Shop area where historical release may have occurred.
- The former 30,000 barrel oil AST where historical release may have occurred.
- Areas where LIF data suggest diesel-range hydrocarbon may be present below the water table.
- Two former repair shops where maintenance activities may have resulted in historical releases.
- A former oil house located in the eastern portion of the railyard where oil products may have been used or stored.
- The former Wash Rack area located west of the former Engine House/Machine Shop where historical release may have occurred.

Further investigations of these areas are outlined in the following sections.

1.7 Preliminary Conceptual Site Model

The preliminary CSM is described below and shown on Figures 11A and 11B. The preliminary CSM identifies the conceptual hydrocarbon distribution, expected migration pathways, potential receptors, existing remedial systems, wells, and other issues of interest. This preliminary CSM will be updated as more information is developed during this RI and will be presented in the RI/FS report.

Through the performance of previous site investigation activities, the following COC have been identified for the site:

- Petroleum hydrocarbon compounds, including gasoline-range, diesel-range and heavy oil-range hydrocarbons.
- Aliphatic and aromatic hydrocarbons, including BTEX.
- PAH compounds, including cPAH compounds.
- Metals, including arsenic and lead.

The primary exposure pathways for COC at the site are:

- Potential dermal exposure and ingestion of hydrocarbons by site workers performing subsurface activities where hydrocarbon or other COC may be present.

- Potential migration and discharge of COCs to the Columbia River, uptake by aquatic organisms and consumption of aquatic organisms by humans.

While cleanup levels for the site have not been developed at this time, MTCA Method A/C industrial soil cleanup standards established under WAC 173-340-745 will be used for initial data evaluation purposes. Industrial soil cleanup standards are appropriate for the site because access to the railyard is controlled and the potential exposure pathway for impacted soil is limited to an industrial worker scenario. However, site soil standards will also need to be protective of site groundwater and surface water standards (including applicable ARARs), which will be further evaluated during performance of the RI.

Potential groundwater standards for the site that will be used for initial data evaluation will be based on applicable MTCA Method A/B groundwater cleanup standards established under WAC 173-340-720 (including applicable ARARs). The specific cleanup standards for the site will be developed in cooperation with Ecology and presented in the RI/FS report.

Section 2: Remedial Investigation (RI) Objectives and Approach

The principal objective of the RI is to characterize the nature and extent of impacted soil and groundwater at the site, together with fate and transport, in order to evaluate the potential risks that the impacts pose to human health and the environment. The RI is also intended to develop adequate site information to conduct a FS that will evaluate and select a remedial approach to address site conditions. The results of the RI and FS will be summarized in RI/FS report following completion of these activities. Based on results of the RI/FS, a Cleanup Action Plan (CAP) will be developed for the site.

This Work Plan describes the performance of the specific activities that are identified in the Scope of Work (SOW) provided as Exhibit B of the AO. Based on the results of investigative activities identified herein, Ecology may require additional phases of work to be performed to complete the RI. In accordance with Task 2, Section D (*Detailed Schedule and Reporting*) of the SOW, additional phases of work, if required, will be identified in modifications or addendums to this Work Plan and submitted to Ecology for approval before performing the work.

2.1 Bank Characterization

The objective of further bank characterization will be to 1) confirm the occurrence of recently observed “tar-like nodules” along the riverbank and to sample those materials if present and 2) to perform sampling of observed oil droplets/sheen (if encountered) to assess their chemical composition. These data may provide information regarding the origin of “tar-like nodules” observed along the shallow water riverbank and their potential correlation to oil droplets/sheen observed in the river.

2.2 Soil Investigation

The objective for further soil characterization is to define the lateral and vertical distribution of impacted soils across the site. Previous investigations have yielded significant soil analytical results for the site. However, during review of past assessments, data gaps in completing a comprehensive soil investigation were identified (refer to Section 1.6). To augment the existing data set, additional soil sampling is warranted. The additional sampling will supplement the existing data set in the following ways:

- Confirming the general distribution of hydrocarbon compounds and NAPL in soil from known releases and defining those areas where petroleum hydrocarbon constituents may exceed potential soil cleanup levels for the site, including those necessary for protection of groundwater.

- Evaluating other areas of the site where hydrocarbon compounds or other COC may have been used, stored, or distributed to assess potential impacts to site media. These areas include the former transformer storage area, former UST areas, former AST areas, a former oil house used for oil storage, former repair shops, the former Wash Rack, and around the former Engine House/Machine Shop. See Section 3.5 for a detailed discussion of the sufficiency of previous site assessments and proposed additional investigation.

2.3 Groundwater Investigation

The objective for further groundwater characterization is to collect adequate information to complete an RI at the site and conduct an FS. Further definition of both groundwater chemistry and groundwater hydraulic conditions (i.e., groundwater flow gradients and river influence) is warranted to more fully evaluate fate and transport of COCs. Previous investigations at the site have yielded information about groundwater quality, but additional information is needed to support the RI, evaluate potential exposure pathways and assist with selection of remedial alternatives in the FS. Additional sampling and characterization will supplement the existing data set in the following ways:

- Evaluate potential for submerged NAPL accumulation in site wells.
- Assess possible dissolved COCs in groundwater resulting from the submerged heavy oil.
- Evaluate the composition and level of saturation of heavy oil identified at the site.
- Establish a monitoring well transect parallel to the adjacent Columbia River to assess dissolved concentrations of hydrocarbon compounds in site groundwater. The well transect will include the installation of five new shallow monitoring wells to adequately evaluate mass flux and natural attenuation in close proximity to the river.
- Establish a network of deep monitoring wells along the Columbia River to evaluate the potential for dissolved compounds associated with the heavy oil.
- Evaluate the distribution of diesel-range hydrocarbons in shallow groundwater along the western portions of the site.
- Evaluate the presence of other potential COCs in groundwater at specific locations identified in the AO or development of this Work Plan [e.g., PCBs, PAHs, volatile organic compounds (VOCs) and metals].
- Evaluate the presence or absence of LNAPL in existing and new monitoring wells.
- Evaluate the existing hydraulic data generated to date and collect additional information if needed to adequately characterize groundwater conditions and the interaction of site groundwater with the river.
- Evaluate natural attenuation parameters in selected monitoring wells.

The groundwater investigation will consist of reconnaissance groundwater (RGW) sampling, sampling of existing monitoring wells and installation and sampling of new permanent groundwater monitoring wells to assess the presence of impacted groundwater.

Additional characterization of hydraulic conditions will also be performed as part of the RI to provide more detailed information on groundwater flow, interaction of the Columbia River and site groundwater, and potential hydrocarbon migration. Hydraulic characterization activities will include:

- Measuring water levels manually to assess the magnitude and direction of the hydraulic gradient and direction of groundwater flow.
- Performing continuous water level monitoring using pressure transducers in select wells to evaluate the interaction between site groundwater and surface water in the Columbia River.
- Performing slug test(s) to assess the hydraulic conductivity of the saturated zone, as needed.

Section 3: RI Field Activities

The scope of work for this remedial investigation includes the following general tasks and several supportive tasks:

- Bank Characterization - Nodule and Oil Droplet Sampling (if present)
- Bank Characterization - Field Mapping of Oil Nodules (if present)
- Focused Upland Site Characterization – Heavy Oil
- Focused Upland Site Characterization – Diesel
- Previous Site Assessment Data Gaps
- Groundwater Hydraulic Characterization.

Specific field activities related to the implementation and performance of these tasks are described in the following sections. This section also includes discussions of investigation procedures, proposed sampling locations, sampling frequencies, and sample chemical analyses. Proposed sampling locations are shown on Figures 12 and 13 and proposed sample analyses are summarized in Table 6 and in the SAP/QAPP (Appendix A, Table 1).

SOGs for the field activities that will be performed during this RI are provided in Appendix B. These include:

- Borehole Logging
- Field Hydrocarbon Screening
- Well Construction and Development
- Water Level Monitoring
- Groundwater Sampling
- Direct-Push Soil Sampling
- Boring and Subsurface Soil Sampling
- Field Equipment Decontamination
- Sample Packing and Shipping
- Slug Testing
- Waste Handling

3.1 Pre-Field Activities

Invasive activities will be required to complete the scope of work outlined in this Work Plan. Prior to invasive activities, a utility survey will be performed to evaluate the potential for underground utilities at each proposed soil boring/well location. The utility survey will augment information provided by BNSF regarding potential underground utilities. The utility location procedures will include:

- Coordinating with the Washington Utility Notification Center (public property only).
- Coordinating with BNSF trades regarding utilities at proposed sampling locations.
- Coordinating with a private utility locator to identify possible underground lines on private property.
- Using an air-knife or similar tool (where appropriate) to assess possible underground utilities.

Note: When necessary, proposed boring/well locations will be adjusted in the field to accommodate possible underground or overhead utilities.

A site HASP that documents the specific procedures to be used to protect the health and safety of Kennedy/Jenks Consultants personnel during the site investigation is presented in Appendix C.

In parallel with the work required under this AO, BNSF will consult with Washington Department of Archaeology and Historic Preservation to identify sensitive sites in the Wishram Railyard area. If such sites are identified, BNSF will develop an appropriate plan for conducting the work described in this Work Plan.

BNSF will also consult with the Columbia River Gorge Commission to confirm the work proposed in this Work Plan is consistent with Commission regulations and does not require Commission approval.

3.2 Bank Characterization

3.2.1 Monthly Bank Monitoring

Monthly inspection of the Columbia River bank was initiated in December 2013 following observation of a sheen adjacent to the riverbank. Subsequent observations of oil sheen were observed in July 2014 and June 2015. Under the Agreed Order, monthly bank monitoring will continue until Ecology directs otherwise in an effort to evaluate the source of oil sheen adjacent to the site. Monthly bank monitoring will include:

- Inspection of the near-bank water surface for possible sheens along a 200-foot long section of the Columbia River where oil droplets and oil sheen have been previously observed.

- Inspections will also be conducted 1) when Kennedy/Jenks Consultants or BNSF environmental personnel are onsite for other purposes and 2) following two substantial storm events to evaluate conditions during times of increased infiltration that may lead to increased ground-to-surface water discharge.

- A log of monitoring activities, including photographs, will be maintained for each inspection event.

3.2.2 Field Mapping

Field mapping of the oil nodule presence will be performed, if nodules are present, to further evaluate the location and distribution of oil nodules along the rip/rap bank. The mapping activities will be timed to coincide with low-stage conditions in the Columbia River. Photographs will be taken and horizontal coordinates recorded of locations where the oil nodules are present. In addition, a written description will be kept regarding the occurrence frequency of the nodules at each location they are identified. The location coordinates for eastern and western extent of oil nodules will be collected using a hand-held Global Positioning System (GPS) device.

3.2.3 Nodule/Oil-Droplet Sampling

Attempts will be made to collect samples of the tar-like nodules observed along the rip/rap bank and any oil-droplets, if observed, in the Columbia River. If adequate sample volume can be collected of either material (when present), it will be submitted for the following analyses (in the following order of priority):

- Diesel and oil-range petroleum hydrocarbons using the NWTPH-Dx Method.

- Extractable Petroleum Hydrocarbons (EPH) using Ecology Methods.

- PAHs using EPA Method 8270.

- VOCs using EPA Method 8260.

Samples will be collected by Kennedy/Jenks Consultants field staff using clean instruments and containers (e.g., laboratory-provided standard sterilized 4-ounce jars). Sample location coordinates will be recorded using a hand-held GPS device. The results of tar-like nodule and oil-droplet sampling and analysis will provide insight regarding the relation (if any) of the nodules / oil-droplets to site NAPL.

3.3 Focused Upland Site Characterization – Heavy Oil

Heavy oil hydrocarbon is present within the saturated zone in the southern portion of the site. The heavy oil was first discovered in the saturated zone in 2012 and is present as NAPL in upland portions of the site within approximately 100 feet of the Columbia River (Figure 9).

To date, characterization of the heavy oil has included: continuous core soil borings, a LIF survey, collection and analysis of soil samples for chemical analysis, NAPL fluid properties testing, and laboratory mobility testing. It is not known whether the NAPL is currently mobile (actively migrating), and further if it is mobile, what the possible NAPL migration routes may be (i.e., through bedrock, unconsolidated sand aquifer or both).

This section of the Work Plan summarizes the approach to obtain the data necessary to assess the potential mobility and migration routes (if existing) of the heavy oil (as NAPL and dissolved phase) through the saturated zone. Assessment activities will be performed to evaluate the vertical and horizontal migration potential associated with the heavy oil.

3.3.1 Install Four Upland Oil Head Monitoring (OHM) Wells

To assess the potential for NAPL accumulation in upland areas of the site, four OHM wells (OHM-1 through OHM-4) will be constructed in locations where heavy oil accumulation is expected to exist on top of the bedrock surface (refer to Figure 12). By monitoring oil thickness and density at the specified locations, the potential for downward gravity-induced oil migration along the bedrock surface or into bedrock can be assessed. The proposed OHM well locations were selected using the results of previous LIF survey and soil boring data (i.e., areas where oil accumulation has been inferred from LIF data and/or observed in soil samples).

During July 2014, continuous-core pilot borings were advanced using direct-push drilling methods to confirm site stratigraphy and evaluate the presence of heavy oil NAPL at the proposed well locations. A Kennedy/Jenks Consultants geologist performed lithologic logging, analytical soil sampling, and petroleum field screening [photoionization detector (PID) and sheen tests]. Soils samples were analyzed for 1) diesel- and oil- range total petroleum hydrocarbons using Ecology Method NWTPH-Dx (extended) and 2) semi-volatile organic compounds (SVOCs) by EPA Method 8270. Soil samples collected from borings drilled and sampled for each of the OHM wells (OHM-1 through OHM-4) contained diesel- and oil-range petroleum hydrocarbons at concentrations exceeding the MTCA Method A cleanup levels for industrial properties. A summary of soil analytical results can be found in Table 5. Boring logs have been included in Appendix F, and show depths of soil samples collected. Based on this information and field observations during advancement of the well borehole, the well screen intervals will be determined (well screens are intended to span the length of suspected NAPL filled soil pores).

Boreholes for the upland OHM wells will be advanced using sonic drilling techniques. During advancement of the borehole, continuous-core sampling will be performed from the ground surface to the top of bedrock and will be compared to the pilot soil boring information collected in July 2014 for final well construction design. During advancement of the soil boring, soil samples will be collected for lithologic logging and field hydrocarbons screening. At each location, the boring will be advanced approximately 3 to 6 inches into the bedrock to accommodate a small sump at the bottom of the well. The sump will allow the well screen to be completed flush with the surrounding bedrock formation. Well screens are expected to be constructed of 40-slot stainless steel wire-wrapped well construction materials. The larger slot size will allow for high viscosity NAPL (if present) to enter the well without excessive capillary resistance. The filter packs of each well will consist of 10/16 silica sand.

3.3.2 Install Riverside Wells

To assess possible lateral migration of heavy oil and dissolved hydrocarbon compounds toward the river, installation of four deep riverside monitoring wells (RMD-1 through RMD-4) is proposed (refer to Figure 12). In July 2014, continuous-core pilot borings were advanced at previously proposed deep well locations (MWD-1 through MWD-4) using direct-push drilling methods and logged, sampled, and field screened for petroleum hydrocarbons (utilizing field methods referenced above) from the ground surface to the top of the bedrock. Soils were analyzed for 1) diesel- and oil- range total petroleum hydrocarbons using Ecology Method NWTPH-Dx and 2) SVOCs by EPA Method 8270. Soil samples collected from one of the borings (MWD-3 at 39 feet bgs and 42.5 feet bgs) contained concentrations of diesel- and oil-range petroleum hydrocarbons in exceedance of the MTCA Method A soil cleanup levels. All other hydrocarbon concentrations and PAH concentrations were either below detectable levels or below their respective MTCA Method A/B soil cleanup levels. A summary of the soil analytical results is provided in Table 5. Boring logs have been compiled and are included in Appendix F. [Note: To address Ecology's comments on the Draft Work Plan, the original proposed deep well locations (MWD-1 through MWD-4) have been moved shoreward (closer to the river) in this Work Plan to assess possible dissolved hydrocarbon concentrations associated with the heavy oil. The new proposed deep riverside wells (designated RMD-1 through RMD-4) will provide better information regarding possible dissolved hydrocarbon compounds (if any) potentially entering the Columbia River. These wells will also be paired with new shallow wells installed in the same area to provide information on possible vertical gradients.]

Well construction for the deep riverside wells will be dependent on whether or not submerged heavy-oil NAPL is encountered in the well borehole. If appreciable NAPL is encountered in the riverside borings, OHM wells may be installed (as outlined in Section 3.3.1) to assess the potential for oil accumulation at these locations. If NAPL is not encountered in the riverside borings, monitoring wells will be constructed at the locations using 2-inch polyvinyl chloride (PVC) well construction materials instead of stainless steel used in the OHM construction. Based on conditions encountered in the MWD-X series pilot borings, the construction of the monitoring wells in locations RMD-1 through RMD-4 is expected to consist of approximately 20 feet of 40-slotted screen installed from approximately 30 to 50 feet bgs. The annular space around the well screen (the filter pack) will consist of 10/16 silica sand. This screen interval will enable monitoring of deeper groundwater conditions that may be impacted by dissolved compounds associated with the submerged heavy oil.

The final locations of the riverside wells may be limited by drilling conditions, bank access, and related site conditions. The actual well locations and construction details for the above wells will be determined in the field based on conditions encountered while advancing the well borehole.

3.3.3 Water Level/NAPL Monitoring

Following installation of the upland OHM and deep riverside wells, it is anticipated that oil may be present in some wells, but not present in others. If oil is not present in the wells, pressure transducers will be installed in selected wells (see Section 3.7) to allow continuous monitoring of water levels for a period of at least 12 months. These wells were selected to provide spatial coverage of the site and to support possible future groundwater modeling efforts (if performed). The data will allow evaluation of the hydraulic gradient in the vicinity of the heavy oil NAPL to identify possible advective groundwater forces acting on the heavy oil. In conjunction with monitoring the selected wells with transducers, river stage elevations will be obtained from the Columbia River using a pressure transducer placed in the river.

The thickness of NAPL in the OHM and riverside wells (if present) will also be monitored once every 2 weeks for a period of 2 months. The top of the NAPL accumulation in the well will be identified using an oil-water interface probe. Attempts will be made to monitor the bottom of the NAPL accumulation in the well (assuming it is less dense than water) by first lowering tubing to the bottom of the well and pumping to identify whether groundwater is present beneath the NAPL, or whether NAPL is present on the bedrock surface. Following this, the tubing intake will be raised in 1-foot increments with fluid pumping at each increment to identify at what elevation the bottom of the NAPL is encountered. If this approach is unsuccessful, alternative approaches will be attempted.

The rate of NAPL accumulation in wells may be slow depending on the thickness of the oil mass and due to its measured high viscosity (7,390 centistokes at 50 degrees Fahrenheit). Attempts will be made to collect one sample of the submerged NAPL from each OHM well for submittal to PTS for testing of fluid properties that may affect potential mobility and possible migration pathways, including: specific gravity, density, viscosity, capillarity, and interfacial/surface tension.

3.3.4 Additional Unsaturated Zone Soil Boring

A heavy oil waveform was encountered in the unsaturated zone (approximately 6 to 7 feet bgs) during the 2013 LIF investigations. This waveform was encountered at survey locations TG-CR-04, TG-CR-4.5, and TG-CR-05. Soil samples were not previously collected from these locations for visual inspection or analytical evaluation. One soil sample will be collected at a depth of approximately 6 to 7 feet bgs from a single boring drilled in the vicinity of LIF survey location, TG-CR-4.5. GPS coordinates from the 2013 LIF location will be used to locate the boring in the field. The soil sample will be analyzed using NWTPH-Dx, SVOCs by EPA Method 8270, and VOCs by EPA Method 8260.

3.4 Focused Upland Site Characterization – Diesel-Affected Areas

A lighter, predominately diesel-range petroleum hydrocarbon is present as LNAPL in the northern portion of the site. The associated dissolved phase impacts from the LNAPL source zone extend to the south, toward the Columbia River (see Figure 12). The lighter hydrocarbon distribution, as LNAPL and the dissolved phase, has been monitored in groundwater since 2003 (Table 1). Soil sampling has indicated that the impacted soil distribution associated with the lighter hydrocarbon is similar to that of the distribution of groundwater impacts.

Past investigation activities to evaluate the distribution of the lighter hydrocarbon have included continuous core soil borings, LNAPL thickness monitoring, and groundwater sampling [including monitored natural attenuation (MNA) parameters]. Previous excavation activities in the vicinity of the Maintenance Shop have removed the accessible petroleum-containing soil associated with the light phase hydrocarbon (Kennedy/Jenks Consultants 2003, 2007) and residual impacts in this area are currently being managed by a bioventing remediation system installed north of the mainline tracks.

3.4.1 Additional Soil Borings

The TarGOST LIF survey, performed in 2013, indicated localized areas at the site that may contain submerged diesel, as identified by a characteristic ‘diesel-like’ waveform signature from the LIF results. Soil sampling conducted immediately following the LIF survey included collection of a sample (TG-E0) to assess the presence and composition of the potentially submerged diesel. The analytical results of the sample (hydrocarbon composition and chromatogram interpretation presented in Table 4 and Appendix G, respectively) indicate submerged diesel may be present in an area beneath the LNAPL smear zone.

During the RI, two additional soil borings will be drilled with soil samples (one from each boring) collected from the suspected submerged diesel affected soil to confirm its presence and evaluate the composition of potentially submerged diesel hydrocarbon. The proposed soil boring locations will be adjacent to LIF survey locations TG-B2 and TG-E0 as shown on Figure 13. The approximate locations of the 2013 LIF survey points will be located using GPS coordinates made at the time of the LIF survey. Recovered soil samples will be analyzed for petroleum hydrocarbons by NWTPH-Dx and for PAHs using EPA Method 8270. Borings will be advanced with continuous-core soil logging using a geoprobe or other suitable drilling methods.

3.4.2 Shallow Well Transect

Currently, the shallow zone monitoring well network indicates dissolved phase diesel-range hydrocarbons have been detected within approximately 80 feet of the Columbia River. These existing wells were constructed as close as possible to the Columbia River (without modifying the existing ground surface topography or use of a track-mounted limited access drilling rig). Available water level data suggest there is likely aquifer recharge occurring from the Columbia River caused by stage variations in the river. This recharge may increase natural attenuation rates adjacent to the Columbia River (at riverfront areas). To evaluate the potential for mass flux of diesel-range hydrocarbons from upland areas to the riverfront areas and to assess natural attenuation conditions closer to the river, a transect of five new shallow wells, WMW-14 through WMW-18, will be installed in close proximity to the Columbia River (refer to Figure 13).

Well construction of the new wells will be consistent with current site monitoring wells using 2-inch PVC well construction materials and a 10- to 15-foot well screen. Well borings will be advanced using a geoprobe or other suitable drilling methods (either sonic or hollow-stem auger) with soil sampling occurring either continuously (or at 2.5-foot intervals if wells are installed using hollow-stem auger drilling techniques). Soil samples will be collected for soil logging purposes and possible laboratory analysis if field screening indicates the potential presence of COCs in soil. If field indications suggest the presence of hydrocarbons, up to one sample from each well location may be submitted for analysis of diesel and oil-range hydrocarbons using NWTPH-Dx Method. Following installation, the wells will be developed using the methods outlined in Appendix B: Standard Operating Guidelines (SOGs).

Once installed, the shallow transect wells will initially be sampled on a quarterly basis over the duration of 1 year (four events). Following the four quarterly monitoring events, the wells will be incorporated into the semi-annual groundwater monitoring program. The quarterly monitoring events will be consistent with the ongoing semi-annual monitoring program which is outlined below in Section 3.5 and identifies the chemical constituents and analytical methods to be utilized in groundwater assessments.

The mass flux analysis will be performed utilizing the open-sourced software application *The Mass-Flux Toolkit* (Farhat, et al. 2011). A mass flux analysis along this transect is intended to provide insight regarding the overall fate and transport (if any) of dissolved-phase diesel compounds to the river. In addition, the mass flux analysis along this transect will provide information regarding biodegradation via natural attenuation due to influx of bio-available electron acceptors from the river (e.g., oxygen, nitrites/nitrates, sulfide, iron, manganese, and methane).

3.4.3 Additional Shallow Groundwater Monitoring Wells

The western-most shallow groundwater monitoring wells at the site currently include WMW-8, WMW-9, and WMW-10. Occasionally, LNAPL has been measured in well WMW-8 and dissolved phase petroleum hydrocarbons have been detected in wells WMW-9 and WMW-10. To delineate the western extent of petroleum hydrocarbon in groundwater, two additional shallow wells (WMW-12 and WMW-13) will be installed to the west of wells WMW-8, WMW-9, and WMW-10. The locations of the additional shallow groundwater monitoring wells are shown on Figure 13.

The additional shallow groundwater monitoring wells will be installed in a manner consistent with current site monitoring wells, as outlined in the previous section. Once installed, the additional shallow groundwater monitoring wells will be incorporated into the semi-annual groundwater monitoring program, as outlined in Section 3.5 (below).

3.5 Previous Site Assessment Data Gaps

Although the bulk of the fueling activities took place in the western half of the site, other structures and storage tanks existed that may have been potential sources for COCs into the subsurface. Investigations will be performed during the RI to assess known data gaps using a variety of investigative techniques. The following areas will be investigated during this RI.

Former Oil House and 1,000-gallon Gasoline UST. Analytical results from a previous soil sample (WSB-04-20) contained gasoline at a concentration of 4.48 milligrams per kilograms (mg/kg). To evaluate potential impacts to groundwater at this location, two additional borings will be advanced near the former 1,000-gallon gasoline UST (see Figures 3 and 13) and two reconnaissance groundwater samples will be collected and analyzed for the following compounds:

- Gasoline-range hydrocarbons using NWTPH Methods.
- Diesel- and oil-range hydrocarbons using NWTPH Methods.
- BTEX using EPA Method 8260B.

- Naphthalene and PAHs using EPA Method 8270.
- Total and dissolved lead using EPA Method 6000 series.

Based on the field screening of soils, at least one soil sample from each boring will be submitted for analysis of gasoline-range hydrocarbons, diesel- and oil-range hydrocarbons, PAHs [including carcinogenic PAHs (cPAHs)] and BTEX using the methods identified above.

Former 5,000-gallon Oil UST. Soil sampling conducted near this former UST indicated oil-range hydrocarbons were present at concentrations up to 110 mg/kg just above the water table. As part of the RI, one additional boring will be advanced (see Figure 13) and a reconnaissance groundwater sample will be collected for analysis of diesel- and oil-range organics, naphthalenes, total and dissolved lead, and PAHs using the analytical methods identified above (see Figure 13). Based on the field screening of soils, at least one soil sample will be submitted for analysis of diesel- and oil-range hydrocarbons using the method identified above.

Former Engine House/Machine Shop. Soil and reconnaissance groundwater samples had previously been collected in and around the vicinity of the Former Engine House/Machine Shop in 2004. One reconnaissance groundwater sample (WSB-04-34), located potentially downgradient of the Former Engine House contained arsenic at 6.48 micrograms per liter (µg/L), slightly above the MTCA Method A groundwater cleanup level of 5 µg/L. Although the source of arsenic was likely caused by turbidity in the reconnaissance sample, seven additional soil borings will be advanced and reconnaissance groundwater samples will be collected near the Former Engine House/Machine Shop area during the RI. The proposed boring locations are show on Figure 13. Eight (8) reconnaissance groundwater samples (including 7 shallow samples and one deep sample) will be submitted for analysis of VOCs (including BTEX and chlorinated solvents) using EPA Method 8260, total and dissolved Resource Conservation and Recovery Act (RCRA) metals using EPA Method 6000/7000 series, PAHs using EPA Method 8270, and gasoline-, diesel- and oil-range petroleum hydrocarbons using NWTPH Methods.

Based on the field screening of soils, at least one soil sample from each of the seven borings will be submitted for analysis of gasoline-range hydrocarbons, diesel- and oil-range hydrocarbons, VOCs (including BTEX and chlorinated solvents), PAHs, and total RCRA metals using the methods identified above.

Former Transformer Storage Area. During previous site assessment activities, two soil samples were obtained from the former transformer area but only one was analyzed for PCBs. PCB concentrations in the sample were not detected at concentrations above the laboratory reporting limit. During the RI, two additional soil borings (see Figure 13) will be advanced near the former transformer storage area and two soil samples will be collected from each boring and analyzed for PCBs using EPA Method 8082 (or equivalent method). Soil samples will be collected at approximately 3 to 5 feet bgs and 10 to 12 feet bgs in each boring. If PCB concentrations in soil are above 1 mg/kg, then an additional boring will be drilled and a groundwater sample will be collected and analyzed for PCBs.

Former 30,000-barrel AST. During the public review period of the AO, Ecology received comments regarding the potential presence of residual oil associated with the former 30,000-barrel AST. As part of the RI, up to three additional soil borings will be drilled near the former 30,000-barrel AST. Soil borings will be advanced to either 25 feet or the top of bedrock, whichever is encountered first (the bedrock depth is expected to be less than 15 feet bgs in this area). Two soil samples from each boring will be collected and analyzed for diesel- and oil-range petroleum hydrocarbons using the NWTPH-Dx Method and PAHs by EPA Method 8270. Additional soil samples may be collected from each boring if field screening indicates petroleum hydrocarbon compounds may be present. Sample depths will be based on field screening as applicable.

Additional Site Feature Investigations. During review of historical site maps, aerial photographs and literature, additional site features have been identified that warrant further investigation. Six additional borings are proposed during the RI to investigate these features at the locations identified in the table below and shown on Figure 13.

Area/Description	Planned Investigation Activities	Number of New Soil Borings/Wells	Total Number of Samples to be Collected for Analysis
Former Repair Shop (East)	Direct-push drilling, installation of temporary well, reconnaissance groundwater sampling, soil sample analysis based on field screening	2	2 RGW 2 Soil
Former Repair Shop (West)	Direct-push drilling, installation of temporary well, reconnaissance groundwater sampling, soil sample analysis based on field screening	1	1 RGW 1 Soil
Former Wash Rack	Direct-push drilling, installation of temporary well, reconnaissance groundwater sampling, soil sample analysis based on field screening	1	1 RGW 1 Soil
Former Oil House (East of Store House)	Direct-push drilling, installation of temporary well, reconnaissance groundwater sampling, soil sample analysis based on field screening	2	2 RGW 2 Soil

Soil and reconnaissance groundwater samples collected from each boring will be analyzed for gasoline-, diesel- and oil-range petroleum hydrocarbons using NWTPH Methods, PAHs by EPA Method 8270, VOCs (including BTEX compounds) by EPA Method 8260, and total and dissolved (water samples only) RCRA metals by EPA Method 6000/7000 series. At least one soil sample will be submitted for analysis from each soil boring. Additional soil samples may be submitted for analysis depending on the field screening results.

Semi-Annual Groundwater Monitoring. Groundwater monitoring has occurred on a regularly scheduled basis (typically semi-annual during March and September) since groundwater monitoring wells were first installed at the site in 2003 (see Tables 1, 2, and 3). Following installation and development of all new wells that do not contain NAPL, baseline sampling will be performed (excluding shallow transect wells). As part of the RI, groundwater monitoring will continue in the established monitoring well network and will be expanded to include new monitoring wells installed during RI activities that do not have measurable NAPL.

Chemical analyses of groundwater samples will include:

- Gasoline-range petroleum hydrocarbons (by NWTPH-Gx). (Note: In accordance with the AO, Ecology may decide that further analysis of gasoline-range hydrocarbons can be discontinued if dissolved phase gasoline-range hydrocarbons are not detected in groundwater).

- Diesel- and oil-range petroleum hydrocarbons (by NWTPH-Dx).

- BTEX compounds (by EPA Method 8260B).

- On a semi-annual basis for 2 years (four events), groundwater samples collected from each of the wells will be analyzed for geochemical indicators of natural attenuation (NA). These include nitrate, nitrite, ammonia, sulfate, sulfide, dissolved iron, manganese, and methane (refer to Table 3 for analytical methods to be utilized).

- The first round of groundwater samples from the two proposed shallow monitoring wells WMW-12 and WMW-13, which will be located to the west of the current monitoring well network (refer to Figure 10), and two of the shallow transect wells (WMW-16 and WMW-18) will be analyzed for compounds commonly found in creosote mixtures, including: naphthalene, ortho-, meta-, and para-cresol (o-, m-, and p-cresol, respectively); and polycyclic aromatic hydrocarbon (PAH) compounds that are typically associated with creosote (by EPA Method 8270).

New deep monitoring wells that do not contain NAPL will also be included in the semi-annual monitoring program as long as NAPL is not encountered in the well casings. In addition to the analytes identified above, groundwater samples from deep wells (that do not encounter NAPL) will also be analyzed for PAHs (by EPA Method 8270).

During one monitoring event, groundwater samples from all existing and new wells will be analyzed for total and dissolved lead using EPA Method 6000 series. These analyses will provide a baseline of lead concentrations in groundwater. If elevated concentrations of lead are not detected, further monitoring for lead will be discontinued.

All groundwater samples collected during semi-annual monitoring will be collected using low-flow sampling techniques in accordance with the SOG for groundwater sampling (Appendix B).

<u>Quarterly Groundwater Monitoring</u>. Groundwater samples will be collected on a quarterly basis for 1 year (four events) from each of the five (5) new shallow transect wells (WMW-14 through WMW-18). Quarterly chemical analysis of these groundwater samples will include gasoline-range petroleum hydrocarbons (by NWTPH-Gx), diesel- and heavy oil-range petroleum hydrocarbons (by NWTPH-Dx), BTEX compounds (by EPA Method 8260), NA parameters (various methods), and total and dissolved lead (by EPA Method 6000 series). These are the same analyses as outlined in the semi-annual groundwater monitoring section above. During at least the first quarterly monitoring event, groundwater samples collected from wells WMW-17 and WMW-18 will also be analyzed for total and dissolved arsenic (by EPA Method 6000 series) and PAHs (by EPA Method 8270). If elevated concentrations of arsenic and/or PAHs are not detected, further monitoring for these analytes will be discontinued. Following 1 year of quarterly

monitoring (four events), the new shallow transect wells be placed on a semi-annual monitoring schedule consistent with the other site monitoring wells.

3.6 Laboratory Analyses

Soil and groundwater samples will be submitted under chain-of-custody protocol to ESC Laboratories (ESC) of Mt. Joliet, Tennessee, (or equivalent laboratory) and will be analyzed on a standard turn-around basis (approximately 3 weeks). Sample handling, packing and shipping procedures are presented in the SOGs provided in Appendix B.

Laboratory analyses will be conducted in accordance with the SAP/QAPP presented in Appendix A. Table 6, and Table 1 of the SAP/QAPP summarizes the analytical methods to be used during sample analyses. Additional soil sample analyses may be made based on field screening results or initial analytical results to provide further characterization of site conditions.

In contrast with samples collected in previous investigation and monitoring activities, during this RI, samples submitted for diesel and heavy oil-range total petroleum hydrocarbon analysis by method NWTPH-Dx will not be analyzed using the silica gel cleanup preparation method; with the exception that a limited number of duplicate samples will be submitted for NWTPH-Dx analysis using silica gel cleanup for comparison to pre-RI data.

3.7 Well Surveying and Hydraulic Characterization

All new monitoring wells and OHM wells installed during this RI will be surveyed by a licensed surveyor in Washington to determine their vertical elevation (using NAVD88 datum) and horizontal position (using Washington State Plane Coordinates, NAD 83/91). Surveyed points will be collected using an accuracy of 0.02 foot. All site monitoring wells will be tied to the same vertical datum. In addition, the approximate horizontal position of all soil borings will be estimated using a hand-held GPS unit.

In addition to the monitoring of the OHM wells discussed in Section 3.3.3, continuous water level monitoring at selected monitoring wells that do not contain NAPL will be performed for a period of 1 year using pressure transducers to develop an understanding of the interaction of site groundwater and the Columbia River fluctuations. This information will be used to understand the seasonal groundwater flow trends at the site. Transducers will be deployed in existing wells WMW-1, WMW-3, WMW-5, WMW-8, WMW-9, WMW-10, and WMW-11. Transducers will also be deployed in three (3) of the five (5) new shallow transect wells [west (WMW-14), middle (WMW-16), and east (WMW-18) locations]. A pressure transducers will also be installed in one deep riverside well (RMD-2) to assess possible vertical gradients between the shallow zone (monitored with WMW-16) and the deeper portion of the saturated zone. In addition, one pressure transducer will be deployed in the Columbia River to collect river stage data adjacent to the site. The pressure transducers will be programmed to record water levels once every 2 hours. A single pressure transducer will be concurrently programmed and deployed out of water to record barometric pressure. HOBO ® brand U20-00104 model pressure transducers (or equivalent) will be used to collect the data set.

Slug tests will be performed in accordance with SOGs (refer to Appendix B) in seven shallow wells across the site to estimate the hydraulic conductivity of the unconsolidated sand aquifer.

Wells selected for testing and the rationale for selection are summarized in the following table:

Slug Testing

Well Designation	Total Depth	Screened Interval	Rationale for Selection
Two new shallow transect wells (WMW-15 and WMW-18)	Approximately 22 feet	Approximately 7 to 22 feet	Riverfront shallow transect wells will provide information on the hydraulic conductivity for shallow soils near the Columbia River.
Two deep riverside wells (RMD-1 and RMD-4)	Approximately 50 feet	Approximately 30 to 50 feet deep.	Riverfront deep wells will provide information on the hydraulic conductivity for deeper soils near the Columbia River.
WMW-5	25 feet	15 to 25 feet	Provide hydraulic conductivity information in the eastern/central portion of the site.
WMW-7	20 feet	10 to 20 feet	Provide hydraulic conductivity information in the northern portion of the site.
WMW-9	23.5 feet	8.5 to 23.5 feet	Provide hydraulic conductivity information in the western portion of the site.

Approximately three rising-head and three falling-head tests will be performed at each well location where slug tests are performed, assuming the static water table is above the screened interval. If the static water table occurs within the screened interval (shallow wells), approximately three rising-head slug tests will be performed. Slug test data will be analyzed using *Aqtesolv* processing software (or similar software) using standard solution methods for unconsolidated water-table aquifers. Based on the analysis of these data, a mean hydraulic conductivity value will be estimated for each well location tested. The hydraulic conductivity data will be used in multiple data evaluations, including mass flux analyses, and other potential fate and transport calculations.

Section 4: Decontamination Procedures and Control of Investigation-Derived Wastes

4.1 Decontamination

Decontamination of sampling equipment helps minimize cross-contamination among sampling locations and helps ensure the integrity of samples collected at each sampling location. Equipment decontamination will vary depending on equipment used. Equipment decontamination procedures that will be followed by Kennedy/Jenks Consultants personnel and its subcontractors are detailed in the SOGs provided in Appendix B.

4.2 Control of Investigation-Derived Wastes

Because wastes derived during this investigation may be contaminated, it will be containerized pending receipt of analytical results. IDW includes purge water from groundwater monitoring well development and sampling, soil cuttings from boreholes (when produced), and decontamination wastes. These materials will be placed in U.S. Department of Transportation (DOT)-approved 55-gallon drums and temporarily stored onsite. All drums will be labeled with its contents, the date and origin/location of collection, and level of personal protective equipment used during waste production (e.g., Level D).

Final disposal of the IDW will be completed by Kennedy/Jenks Consultants on behalf of BNSF. Handling and disposal of IDW procedures that will be followed by Kennedy/Jenks Consultants personnel and its subcontractors are described in the SOGs presented in Appendix B.

Section 5: Reporting and Schedule

5.1 Reporting

During performance of the RI activities, monthly reports will be provided to Ecology on or before the 15th of each month in accordance with Section VII (H) of the AO. The monthly reports will summarize the substantive activities performed since the last reporting, problems that may have been encountered, and planned activities for the following month.

In accordance with Section VII (F) of the AO, following completion of the RI activities (including any subsequent follow-up phases of investigation activities requested by Ecology), a RI report will be prepared that summarizes the results of past investigations and the investigation results in accordance with Task 4 of the SOW. The RI will include:

- A summary of site conditions, including site location, current site use, historical site use, and other physical attributes of the site.
- A summary of past site uses and practices contributing to current site conditions.
- A description of the site geology and hydrogeologic setting. This will include a description of groundwater flow and the interaction of site groundwater and surface water.
- A description of contaminant distribution in soil and groundwater resulting from the investigative activities performed during the RI.
- A revised and updated CSM based on the available information for the site, including a description of exposure pathways to potential human and ecological receptors.
- A summary of the contaminant fate and transport mechanisms for site COC.
- A tabulated summary of all analytical data collected during this RI including presentation of the data on maps to display the distribution of impacted site media.
- Appendices for key information developed during the RI. At a minimum, this will include all analytical reports, boring and well construction logs, field monitoring/sampling reports, and other relevant documentation for investigation-derived results.
- Other relevant information that may be required in accordance with MTCA (WAC 173-340-350 and other relevant sections).

In addition, Section VII (F) requires BNSF to prepare a FS conforming to WAC 173-340-350. The FS will evaluate a range of remedial alternatives and provide recommendations for proposed remedial action (or interim actions) to address site conditions and support Ecology’s eventual selection of an appropriate remedial action for the site. In consultation with Ecology, BNSF will determine whether to produce a combined RI/FS report, or to produce these reports sequentially.

5.2 Schedule

The RI activities described in this Work Plan, including subsequent phases if required, will be performed in accordance with the schedule (Exhibit C) provided in the AO for the site. The following table summarizes the planned schedule for performing the specific work activities identified in this Work Plan. As with all field work, the actual schedule may vary depending on field conditions (including appropriate weather conditions), subcontractor availability, and a variety of other factors that may be beyond BNSF's control.

Field Work Duration

Field Activity Category	Duration to Complete Field Activities[a, b]
Bank Monitoring (Monthly Bank Inspection, Nodule Mapping and Nodule Sampling)	• Ongoing for monthly monitoring. • 1 month for other activities if favorable water level conditions in the Columbia River are present.
Soil and Groundwater Investigations activities: • Pre-field activities • Soil Investigations (Soil boring, including reconnaissance groundwater sampling) • Installation of upland and Riverside OHM wells and performance of OHM monitoring activities • Installation of shallow zone monitoring well transect • Well survey	• 4 to 5 months
Performance of hydraulic monitoring activities	• 12 months following completion of well installation.
Performance of groundwater monitoring	• Ongoing semi-annual for 2 years (four monitoring events) following completion of well installation (typically September and March). Four quarterly events will be performed at wells (WMW-14 through WMW-18); then semi-annual thereafter.
Prepare RI/FS report	• Within 120 days of receiving validated analytical data from final phase of sampling events under Work Plan and modifications or addenda hereto.

Notes:

(a) Approximate months to complete field work following approval of the Work Plan by Ecology.
(b) Approximate duration does not include completion of sample analyses, follow-up field activities/analyses, subsequent phases of investigation, or data analysis/interpretation. Sample chemical analyses typically require 3 to 4 weeks for receipt of preliminary analytical results.

Based on the estimated field work duration, primary RI activities are estimated to take up to 5 months for completion of most of the field work, with water level and groundwater quality monitoring activities extending for 1 year and 2 years, respectively, following completion of well installation.

Preliminary analytical results from the above investigations will be tabulated and provided to Ecology at regular intervals to update Ecology on the results of recent investigation activities and guide future phases that may be developed in consultation with Ecology in accordance with the SOW Task 2 (D).

For the reader's convenience, Table 7 contains the schedule of deliverables and other actions as provided in Exhibit C of the AO.

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Tables

TABLE 1

GROUNDWATER ELEVATION RESULTS
Wishram, Washington

Well ID	Date	Well Elevation (TOC)	Depth to LNAPL[a] (feet)	Depth to Groundwater (feet)	LNAPL Thickness (feet)[b]	Groundwater Elevation (feet above datum)	Corrected Groundwater Elevation[c] (feet above datum)
WMW-1	9/17/03	172.51[d]	--[e]	15.88	--	156.63	156.63
	4/15/04	172.51	--	10.46	--	162.05	162.05
	7/13/04	172.51	--	10.78	--	161.73	161.73
	11/9/06	172.51	--	9.60	--	162.91	162.91
	7/3/07	172.51	--	9.85	--	162.66	162.66
	8/16/07	172.51	--	10.55	--	161.96	161.96
	4/16/08	172.51	--	10.10	--	162.41	162.41
	8/21/08	172.51	--	10.59	--	161.92	161.92
	3/12/09	172.51	--	10.15	--	162.36	162.36
	9/10/09	172.51	--	10.44	--	162.07	162.07
	7/7/11	172.51	--	9.96	--	162.55	162.55
	3/12/12	172.48[f]	--	10.36	--	162.12	162.12
	3/14/12	172.48	--	10.28	--	162.20	162.20
	9/10/12	172.48	--	10.27	--	162.21	162.21
	10/12/12	172.48	NM[g]	10.32	--	162.16	162.16
	3/14/13	172.48	--	10.71	--	161.77	161.77
	11/6/13	172.48	--	10.69	--	161.79	161.79
	4/9/14	172.48	--	10.32	--	162.16	162.16
	9/29/14	172.48	--	10.57	--	161.91	161.91
	4/27/15	172.48	--	10.22	--	162.26	162.26
WMW-2[h]	9/18/03[i]	173.12[d]	--	--	--	--	--
	4/15/04	173.12	LNAPL[j]	10.81	LNAPL	162.31	162.31
	7/13/04	173.12	--	11.08	0.00 (F)	162.04	162.04
WMW-3	9/17/03	173.03[d]		16.37	--	156.66	156.66
	4/16/04	173.03	--	10.32	--	162.71	162.71
	7/13/04	173.03	10.64	10.65	0.01	162.38	162.39
	11/9/06	173.03	--	10.20	--	162.83	162.83
	7/3/07	173.03	--	10.08	--	162.95	162.95
	8/16/07	173.03	--	10.65	--	162.38	162.38
	4/16/08	173.03	--	10.14	--	162.89	162.89
	8/21/08	173.03	--	10.89	--	162.14	162.14
	3/12/12	173.03[f]	--	10.58	--	162.45	162.45
	3/14/12	173.03	--	10.67	--	162.36	162.36
	9/11/12	173.03	--	10.85	--	162.18	162.18
	3/14/13	173.03	--	11.12	--	161.91	161.91
	11/6/13	173.03	--	11.29	--	161.74	161.74
	4/9/14	173.03	--	10.76	--	162.27	162.27
	9/29/14	173.03	--	11.25	--	161.78	161.78
	4/27/15	173.03	NM	NM	NM	NM	NM
WMW-4[k]	9/18/03[k]	173.18[d]	--	--	--	--	--
	4/15/04	173.18	--	11.10	--	162.08	162.08
	7/13/04	173.18	--	11.40	--	161.78	161.78
WMW-5	4/16/04	172.60[d]	--	10.12	--	162.48	162.48
	7/13/04	172.60	--	10.40	--	162.20	162.20
	11/9/06	172.60	--	11.00	--	161.60	161.60
	7/3/07	172.60	--	9.79	--	162.81	162.81
	8/16/07	172.60	--	10.35	--	162.25	162.25
	4/16/08	172.60	--	9.91	--	162.69	162.69
	8/21/08	172.60	--	10.53	--	162.07	162.07
	3/12/09	172.60	--	10.09	--	162.51	162.51
	9/10/09	172.60	--	10.62	--	161.98	161.98
	7/7/11	172.60	--	9.80	--	162.80	162.80
	3/12/12	172.67[f]	--	10.18	--	162.49	162.49
	3/14/12	172.67	--	10.24	--	162.43	162.43
	9/11/12	172.67	--	10.37	--	162.30	162.30
	3/14/13	172.67	--	10.68	--	161.99	161.99
	11/6/13	172.67	--	10.79	--	161.88	161.88
	4/9/14	172.67	--	10.32	--	162.35	162.35
	9/29/14	172.67	--	10.72	--	161.95	161.95
	4/27/15	172.67	--	10.28	--	162.39	162.39

TABLE 1

GROUNDWATER ELEVATION RESULTS
Wishram, Washington

Well ID	Date	Well Elevation (TOC)	Depth to LNAPL(a) (feet)	Depth to Groundwater (feet)	LNAPL Thickness (feet)(b)	Groundwater Elevation (feet above datum)	Corrected Groundwater Elevation(c) (feet above datum)
WMW-6(l)	4/16/04	173.08(d)	LNAPL	10.46	LNAPL	162.62	162.62
	7/13/04	173.08	10.82	10.83	0.01	162.25	162.26
WMW-7	4/16/04	174.12(d)	--	10.43	0.00 (S)	163.69	163.69
	7/13/04	174.12	10.97	11.04	0.07	163.08	163.14
	7/3/07	174.12	10.40	10.58	0.18	163.54	163.69
	8/16/07	174.12	LNAPL	11.00	LNAPL	163.12	163.12
	4/16/08	174.12	10.50	10.66	0.16	163.46	163.60
	8/21/08	174.12	11.59	12.19	0.60	161.93	162.44
	3/12/09	174.12	11.31	11.45	0.14	162.67	162.79
	9/10/09	174.12	12.10	13.60	1.50	160.52	161.80
	7/7/11	174.12	11.10	11.10	<0.01	163.02	163.02
	3/12/12	174.13(f)	11.52	11.66	0.14	162.47	162.59
	3/14/12	174.13	11.56	11.74	0.18	162.39	162.54
	9/11/12	174.13	12.08	12.17	0.09	161.96	162.04
	3/14/13	174.13	12.10	12.18	0.08	161.95	162.02
	11/6/13	174.13	12.66	12.76	0.10	161.37	161.46
	4/9/14	174.13	--	11.81	--	162.32	162.32
	9/29/14	174.13	--	12.72	--	161.41	161.41
	4/27/15	174.13	--	11.85	--	162.28	162.28
WMW-8	3/12/12	173.80(d)	--	11.11	--	162.69	162.69
	3/14/12	173.80	--	11.17	--	162.63	162.63
	9/11/12	173.80	11.70	11.78	0.08	162.02	162.09
	10/12/12	173.80	NM	12.94	--	160.86	160.86
	3/14/13	173.80	11.67	11.82	0.15	161.98	162.11
	11/6/13	173.80	12.16	12.36	0.20	161.44	161.61
	4/9/14	173.80	--	11.36	--	162.44	162.44
	9/29/14	173.80	12.21	12.31	0.10	161.49	161.49
	4/27/15	173.80	11.38	11.40	0.02	162.40	162.42
WMW-9	3/12/12	173.21(f)	--	10.83	--	162.38	162.38
	3/14/12	173.21	--	10.86	--	162.35	162.35
	9/11/12	173.21	--	11.07	--	162.14	162.14
	10/12/12	173.21	NM	11.15	--	162.06	162.06
	3/14/13	173.21	--	11.33	--	161.88	161.88
	11/6/13	173.21	--	11.47	--	161.74	161.74
	4/9/14	173.21	--	10.96	--	162.25	162.25
	9/29/14	173.21	--	11.42	--	161.79	161.79
	4/27/15	173.21	LNAPL	10.90	LNAPL	162.31	162.31
WMW-10	3/12/12	173.07(f)	--	10.91	--	162.16	162.16
	3/14/12	173.07	--	10.82	--	162.25	162.25
	9/11/12	173.07	--	10.82	--	162.25	162.25
	10/12/12	173.07	NM	10.94	--	162.13	162.13
	3/14/13	173.07	--	11.28	--	161.79	161.79
	11/6/13	173.07	--	11.24	--	161.83	161.83
	4/9/14	173.07	--	10.89	--	162.18	162.18
	9/29/14	173.07	--	11.18	--	161.89	161.89
	4/27/15	173.07	10.74	10.75	0.01	162.32	162.33

TABLE 1

GROUNDWATER ELEVATION RESULTS
Wishram, Washington

Well ID	Date	Well Elevation (TOC)	Depth to LNAPL[a] (feet)	Depth to Groundwater (feet)	LNAPL Thickness (feet)[b]	Groundwater Elevation (feet above datum)	Corrected Groundwater Elevation[c] (feet above datum)
WMW-11	3/12/12	173.00[f]	--	10.90	--	162.10	162.10
	3/14/12	173.00	--	10.81	--	162.19	162.19
	9/11/12	173.00	--	10.78	--	162.22	162.22
	3/14/13	173.00	--	11.23	--	161.77	161.77
	11/6/13	173.00	--	11.10	--	161.90	161.90
	4/9/14	173.00	--	10.84	--	162.16	162.16
	9/29/14	173.00	--	11.08	--	161.92	161.92
	4/27/15	173.00	--	10.69	--	162.31	162.31

Notes:

(a) LNAPL = light non-aqueous phase liquid

(b) The following symbols indicate observed conditions of groundwater:
LNAPL = presence of LNAPL (thickness not measured); (S) = sheen; (F) = film

(c) Corrected groundwater elevation was determined by taking the product between (1) the measured apparent LNAPL thickness and (2) its density, then adding this value (1X2) to the measured groundwater elevation.

(d) Groundwater elevations are based on a wellhead top-of-casing (TOC) survey conducted in 2003.
of 100 feet, which was established at a temporary benchmark located near the Wishram Post Office.

(e) "--" indicates not applicable.

(f) Groundwater elevations are based on a wellhead TOC survey conducted in 2012 and tied to North American Vertical Datum-1988 (NAVD88).

(g) NM = not measured

(h) Monitoring well WMW-2 was removed during excavation in November 2005.

(i) Monitoring well was dry.

(j) LNAPL observed in well, but no depth or thickness measurement provided.

(k) Monitoring well WMW-4 destroyed in summer 2006.

(l) Monitoring well WMW-6 was removed in 2006.

TABLE 2

TOTAL PETROLEUM HYDROCARBON AND BTEX RESULTS
Wishram, Washington

Well ID	Date	TPH (mg/L)[a]			BTEX (µg/L)[b]			
		Gasoline-Range	Diesel-Range	Oil-Range	Benzene	Toluene	Ethylbenzene	Total Xylenes
WMW-1	9/17/03	NA[c]	**0.593/0.605**[d]	<0.500/<0.500[e]	<0.500/<0.500	<0.500/<0.500	<0.500/<0.500	<1.00/1.02
	4/15/04	0.329	0.426	<0.500	<0.500	<0.500	<0.500	2.33
	7/13/04	0.306	0.411/0.424	<0.500/<0.500	<0.500	<0.500	2.33	<1.00
	11/9/06	<0.250	<0.236	<0.472	<2.50	<2.50	<2.50	<5.00
	7/3/07	0.0934	**5.96**	**0.523**	<0.500	<0.500	<0.500	<1.00
	8/16/07	0.152	0.328	<0.521	<0.500	<0.500	<0.500	<1.00
	4/16/08	0.191	<0.243	<0.485	<0.500	<0.500	<0.500	1.10
	8/21/08	0.180	**3.47**	<0.476	<0.500	<0.500	<0.500	<1.00
	3/12/09	0.206	**2.26**	<0.490	<0.500	<0.500	<0.500	<1.00
	9/10/09	0.350	**1.50**	<0.25	<1.0	<1.0	<1.0	<3.0
	7/7/11	0.217	**0.95**	<0.38	<1.0	<1.0	<1.0	<3.0
	3/13/12	0.31 B	**2.4 Y**	**2.0 Y**	<1.0	<1.0	<1.0	1.67 J
	9/11/12	0.13/0.13[f]	**5.3/5[f]**	**2.6/2.8[f]**	<0.50/<0.50	<5.0/<5.0	<0.50/<0.50	<1.5/<1.5
	3/14/13	0.20/0.22	**3.4/2.5**	**1.4/<1.2**	<0.50/<0.50	<5.0/<5.0	<0.50/<0.50	<1.5/1.6
	11/6/13	0.140/0.160	**4.1/3.9**	**3.6/3.6**	<1.0/<1.0	<5.0/<5.0	<1.0/<1.0	<3.0/<3.0
	4/9/14	0.11	**3.1**	**1.3**	<0.50	<5.0	<0.50	<1.5
	9/30/14	0.11/0.12[f]	**3.4/3[f]**	**1.6/1.4[f]**	<1.0/<1.0[f]	<5.0/<5.0[f]	<1.0/<1.0[f]	<3.0/<3.0[f]
	4/27/15	<0.100	**3.5**	**4.0**	<1.0	<5.0	<1.0	<3.0
WMW-2[g]	9/18/03[h]	NA	**4.17**	**2.45**	**5.71**	23.5	5.84	11.8
	4/15/04	0.750	**0.844**	<0.500	**17.4**	3.66	17.4	37.2
	7/13/04	0.166	**1.77**	**0.518**	**10.9**	4.02	8.02	12.5
WMW-3	9/17/03	NA	0.253	<0.500	<0.500	<0.500	<0.500	<1.00
	4/16/04	NA	<0.250	<0.500	NA	NA	NA	NA
	7/13/04	0.190	0.306	<0.500	<0.500	<0.500	<0.500	<1.00
	11/9/06	0.209	**0.659**	<0.500	<0.500	<0.500	<0.500	<1.00
	7/3/07	0.203	**3.18**	<0.532	<0.500	<0.500	<0.500	<1.00
	8/16/07	0.291	**1.28**	<0.495	<0.500	<0.500	<0.500	1.43
	4/16/08	0.212	<0.248	<0.495	<0.500	<0.500	<0.500	<1.00
	8/21/08	0.199	**0.730**	<0.485	<0.500	<0.500	<0.500	<1.00
	3/14/12	0.22 B	**3.3 Y**	0.38 Y	<1.0	<1.0	<1.0	1.25 J
	9/11/12	<0.10/<0.10[f]	**15/13[f]**	**3.9/3.5[f]**	<0.50/<0.50[f]	<5.0/<5.0[f]	<0.50/<0.50[f]	<1.5/<1.5[f]
	3/15/13	0.18/0.15	**7.5/9.2**	**<5.0/<5.0**	<0.50/<0.50[f]	<5.0/<5.0[f]	<0.50/<0.50[f]	<1.5/<1.5[f]
	11/6/13	0.130/0.120	**12.0/17.0**	**5.8/8.3**	<1.0	<5.0	<1.0	<3.0
	4/9/14	0.11/0.11[f]	**4.2/5.4[f]**	**1.6/2.2[f]**	<0.50/<0.50[f]	<5.0/<5.0[f]	<0.50/<0.50[f]	<1.5/<1.5[f]
	9/30/14	0.11/0.11[f]	**8.2/7.2[f]**	**3.2/2.1[f]**	<1.0/<1.0[f]	<5.0/<5.0[f]	<1.0/<1.0[f]	<3.0/<3.0[f]
	4/27/15	NA	NA	NA	NA	NA	NA	NA
WMW-4[i]	9/18/03	NA	0.409	<0.500	<0.500	<0.500	<0.500	<1.00
	4/15/04	<0.0800	<0.250	<0.500	<0.500	<0.500	<0.500	<1.50
	7/13/04	0.0843	<0.250	<0.500	<0.500	<0.500	<0.500	<1.00
WMW-5	4/16/04	<0.0800/<0.0800	<0.250/<0.250	<0.500/<0.500	<0.500/<0.500	<0.500/<0.500	<0.500/<0.500	<1.50/<1.50
	7/13/04	<0.0800/<0.0800	<0.250	<0.500	<0.500/<0.500	<0.500/<0.500	<0.500/<0.500	<1.00/<1.00
	11/9/06	<0.0500/<0.0500	<0.250/<0.248	<0.500/<0.495	<0.500/<0.500	<0.500/<0.500	<0.500/<0.500	<1.00/<1.00
	7/3/07	<0.0500	<0.248	<0.495	<0.500	<0.500	<0.500	<1.00
	8/16/07	<0.050	<0.250	<0.500	<0.500	<0.500	<0.500	<1.00
	4/16/08	<0.050	<0.245	<0.490	<0.500	<0.500	<0.500	<1.00
	8/21/08	<0.050	<0.240	<0.481	<0.500	<0.500	<0.500	<1.00
	3/12/09	<0.0500	<0.245	<0.490	<0.500	<0.500	<0.500	<1.00
	9/10/09	0.063	<0.12	<0.25	<1.0	<1.0	<1.0	<3.0
	7/7/11	<0.0500	<0.077	<0.38	<1.0	<1.0	<1.0	<3.0
	3/12/12	0.024 JB/<0.050	<0.12	0.051 J	<1.0/<1.0	<1.0/<1.0	<1.0/<1.0	<3.0/<3.0
	9/11/12	<0.10/<0.10[f]	<0.10/0.11[f]	<0.25/<0.25[f]	<0.50/<0.50[f]	<5.0/<5.0[f]	<0.50/<0.50[f]	<1.5/<1.5[f]
	3/15/13	<0.10/<0.10[f]	<0.10/0.10[f]	<0.25/<0.25[f]	<0.50/<0.50[f]	<5.0/<5.0[f]	<0.50/<0.50[f]	<1.5/<1.5[f]
	11/16/13	<0.100/<0.100	<0.100/0.200	<0.250/**0.660**	<1.0/<1.0	<5.0/<5.0	<1.0/<1.0	<3.0/<3.0
	4/8/14	<0.1/<0.1[f]	<0.1/<0.1[f]	<0.25/<0.25[f]	<0.50/<0.50[f]	<5.0/<5.0[f]	<0.50/<0.50[f]	<1.5/<1.5[f]
	9/29/14	<0.1	<0.1	<0.25	<1.0	<5.0	<1.0	<3.0
	4/27/15	<0.1	0.14	0.38	<1.0	<5.0	<1.0	<3.0
WMW-6[j]	4/16/04	0.212	0.454	<0.500	<0.500	<0.500	<0.500	<1.50
	7/13/04	0.0942	<0.250	<0.500	<0.500	<0.500	<0.500	<1.00

TABLE 2

TOTAL PETROLEUM HYDROCARBON AND BTEX RESULTS
Wishram, Washington

		TPH (mg/L)(a)			BTEX (µg/L)(b)			
Well ID	Date	Gasoline-Range	Diesel-Range	Oil-Range	Benzene	Toluene	Ethylbenzene	Total Xylenes
WMW-7	4/16/04	**1.79**	**1.22**	<0.500	<5.00	<5.00	<5.00	<15.0
	7/13/04	0.316	**0.677**	<0.500	<0.500	<0.500	<0.500	<1.00
	7/3/07	0.380/0.423	**1.56/1.75**	<0.500/<0.532	<0.500/<0.500	<0.500/<0.500	0.772/0.786	<1.00/<1.00
	8/16/07	0.454	**0.548**	<0.500	<0.500	<0.500	1.04	<1.00
	4/16/08	0.415/0.454	**0.661/0.685**	<0.490/<0.495	<0.500/<0.500	<0.500/<0.500	0.713/0.731	<1.00/<1.00
	8/21/08	0.284/0.284	**0.652/0.632**	<0.476/<0.476	<0.500/<0.500	<0.500/<0.500	<0.500/<0.500	<1.00/<1.00
	3/12/09	0.385/0.390	**1.90/5.29**	<0.485/<0.490	<0.500/<0.500	<0.500/<0.500	<0.500/<0.500	<1.00/<1.00
	9/10/09(k)	NA	NA	NA	NA	NA	NA	NA
	7/7/11(k)	NA	NA	NA	NA	NA	NA	NA
	3/12/12(k)	NA	NA	NA	NA	NA	NA	NA
	11/6/13kj)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	4/9/14	N/A	**3.4**	**1.2**	N/A	N/A	N/A	N/A
	9/30/14	<0.1	**4**	**1.7**	<1.0	<5.0	<1.0	<3.0
	4/27/15	<0.1	**4.9**	**2.2**	<1.0	<5.0	<1.0	<3.0
WMW-8	3/13/12	0.42 B	**0.85 Y**	0.074 J	<1.0	<1.0	<1.0	1.15 J
	9/11/12	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	3/14/13	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	11/6/13	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	4/9/14	0.15	**4.4**	**1.2**	<0.50	<5.0	<0.50	<1.5
	9/29/14	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WMW-9	3/13/12	0.010 JB	0.23 Y / 0.071 J	0.30 Y / 0.081 J	<1.0	<1.0	<1.0	<3.0
	9/11/12	<0.10	0.49	**0.89**	<0.50	<5.0	<0.50	<1.5
	3/14/13	<0.10	**0.63**	0.45	<0.50	<5.0	<0.50	<1.5
	11/6/13	<0.100	**2.10**	**1.60**	<1.0	<5.0	<1.0	<3.0
	4/8/14	<0.1	0.38	<0.25	<1.0	<5.0	<1.0	<3.0
	9/29/14	<0.1	**1.5**	0.32	<1.0	<5.0	<1.0	<3.0
	4/27/15	<0.1	**1.4**	**2.4**	<1.0	<5.0	<1.0	<3.0
WMW-10	3/13/12	0.022 JB	<0.12	0.063 J	<1.0	<1.0	<1.0	<3.0
	9/11/12	<0.10	0.38	<0.25	<0.50	<5.0	<0.50	<1.5
	3/14/13	<0.10	0.43	0.45	<0.50	<5.0	<0.50	<1.5
	11/6/13	<0.100	0.25	**0.83**	<1.0	<5.0	<1.0	<3.0
	4/8/14	<0.1/<0.1	<0.1/<0.1	<0.25/<0.25	<0.50/<0.50	<5.0/<5.0	<0.50/<0.50	<1.5/<1.5
	9/29/14	<0.1	<0.1	<0.25	<1.0	<5.0	<1.0	<3.0
	4/27/15	<0.1	0.2	**0.52**	<1.0	<5.0	<1.0	<3.0
WMW-11	3/14/12	0.31 B	**3.7 Y**	**0.96 Y**	<1.0	<1.0	<1.0	<3.0
	9/11/12	<0.10/<0.10	**5.1/5**	**2.9/3**	<0.50/<0.50	<5.0/<5.0	<0.50/<0.50	<1.5/<1.5
	3/14/13	<0.10/<0.10	**4.0/3.8**	**4.0/3.6**	<0.50/<0.50	<5.0/<5.0	<0.50/<0.50	<1.5/<1.5
	11/6/13	<0.100/<0.100	**7.3/7.2**	**5.7/5.4**	<1.0/<1.0	<5.0/<5.0	<1.0/<1.0	<3.0/<3.0
	4/8/14	<0.1	**5.8**	**4**	<0.50	<5.0	<0.50	<1.5
	9/30/14	<0.1/0.1	**5.2/4.8**	**2.2/2.1**	<1.0/<1.0	<5.0/5.0	<1.0/1.0	<3.0/3.0
	4/27/15	<0.1/<0.1	**5.4/9.5**	**2.5/7.2**	<1.0/<1.0	<5.0/5.0	<1.0/1.0	<3.0/3.0
MTCA Method A GW(l)		0.8	0.5	0.5	5	1,000	700	1,000

Notes:

(a) TPH - total petroleum hydrocarbons, measured as:
Gasoline-range hydrocarbons analyzed by the Northwest Total Petroleum Hydrocarbons as Gasoline (NWTPH-Gx) Method.
Diesel- and oil-range TPH analyzed by the Northwest Total Petroleum Hydrocarbons as Diesel Extended (NWTPH-Dx) Method with silica gel cleanup.

(b) BTEX = benzene, toluene, ethylbenzene, and total xylenes, analyzed by EPA Method 8021B or 8260B.

(c) NA = not analyzed.

(d) Where two values are displayed, the second is the analytical result for a field blind duplicate sample.

(e) "<" indicates the compound was not detected at a concentration greater than the laboratory method reporting limit (MRL).

(f) Duplicate sample collected using HydraSleeve sampling system.

(g) Monitoring well WMW-2 was removed during excavation in November 2005.

(h) Monitoring well was dry. Sample collected from purge water drum.

(i) Monitoring well WMW-4 was destroyed in 2006.

(j) Monitoring well WMW-6 was removed in 2006.

(k) Well not sampled due to the presence of light non-aqueous phase liquid (LNAPL).

(l) Washington State Department of Ecology Model Toxics Control Act (MTCA) Method A groundwater cleanup levels (WAC 173-340) dated 12 October 2007.

mg/L = milligrams per liter
µg/L = micrograms per liter
"J" = Laboratory data flag indicating an estimated concentration below the MRL but above the method detection limit (MDL).
"Y" = Laboratory data flag indicating that the chromatographic response resembles a typical fuel pattern.
"B" = Laboratory data flag indicating that the compound was also detected in the method blank.

Analyte concentrations exceeding the indicated cleanup level are shown in bold.

TABLE 3

FIELD AND NATURAL ATTENUATION PARAMETERS
Wishram, Washington

		Field Monitored Water Parameters				Field Natural Attenuation Parameters		Natural Attenuation Parameters						
Well ID	Date	Temperature (°C)(a,b)	pH(a)	Conductivity (mS/cm)(a,c)	Turbidity (NTU)(d)	Dissolved Oxygen (mg/L)(a,e)	ORP (mV)(f,g)	Nitrate/Nitrite (mg/L)(h)	Ammonia (mg/L)(i)	Sulfate (mg/L)(j)	Sulfide (mg/L)(k)	Dissolved Iron (mg/L)(l)	Manganese (mg/L)(m)	Methane (µg/L)(n)
WMW-1	3/13/12	15.26	6.81	0.599	8.7	0.49	-111	<0.010(o)	0.48	<1.2	6.4	12	--	4,760
	11/16/13	17.90	6.81	0.655	21.2	0.26	-113	<0.100	0.460	<5.000	<0.050	<0.100	--	3,400
	9/30/14	18.99	6.85	0.578	yellow	1.85	182	<0.1	0.39	<5	<0.05	0.75	--	4,700
	4/27/15	20.68	7.11	0.636	--	6.5	--	<0.100	0.344	<5.000	<0.050	<0.100	--	3,990
WMW-3	3/14/12	15.84	6.77	1.035	11.7	0.65	7	0.013	0.60	7.3	2.8	5.3	--	1,760
	11/16/13	17.80	6.92	1.120	14.1	0.33	-120	<0.100	0.640	<5.000	<0.050	<0.100	--	900
	9/30/14	19.39	6.94	1.010	none	1.86	164	<0.100	0.510	<5.000	<0.050	0.240	--	3,600
	4/27/15	NS(p)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	--	NS
WMW-5	3/12/12	14.42	7.43	0.466	0.8	1.16	239	2.0 / 1.9(q)	<0.10 / <0.10	20 / 20	1.5 / 1.5	<0.040 / 0.013 J	--	<5.00 / <5.00
	11/16/13	16.20	7.68	0.468	16.2	0.31	112	1.800	<0.100	22.000	<0.050	<0.100	--	<10
	9/29/14	17.93	7.46	0.494	clear	1.60	91	1.9	<2.5	21	<0.05	<0.1	--	<10
	4/27/15	15.86	7.88	0.534	clear	1.18	229.5	2.270	<0.250	25.900	<0.050	<0.100	--	<10.0
WMW-7	3/12/12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	--	NS
	9/30/14	18.45	6.90	1.03	clear	2.08	133	0.99	<2.5	10	<0.05	1.5	--	64
	4/27/15	16.05	7.16	1.04	clear	0.25	223	<0.100	<0.250	<5.000	<0.050	<0.100	--	529
WMW-8	3/13/12	14.62	7.03	0.925	11.5	0.61	42	0.012	<0.10	17	2.0	0.31	--	126
	11/16/13	17.00	7.14	1.320	73.7	0.96	-56	<0.100	<0.100	9.400	<0.050	<0.100	--	140
	11/16/13	17.00	7.14	1.320	73.7	0.96	-56	<0.100	<0.100	9.400	<0.050	<0.100	--	140
WMW-9	3/13/12	14.56	7.14	0.617	19.8	0.50	235	4.8	<0.10	33	2.1	0.0097 J	--	<5.0
	11/16/13	17.60	7.33	0.765	17.1	0.32	55	2.700	<0.100	30.000	<0.050	<0.100	--	<10
	9/29/14	18.82	7.16	0.902	clear	1.70	80	1.8	<0.25	45	<0.05	<0.1	--	<10
	4/27/15	16.72	7.50	0.911	clear	1.65	326	3.820	<0.250	81.400	<0.050	<0.100	--	<10.0
WMW-10	3/13/12	12.01	7.41	0.761	14.6	1.45	236	5.0	<0.10	33	6.4	<0.040	--	30
	11/16/13	16.50	7.33	0.664	30.8	0.81	94	16.000	<0.100	38.000	<0.050	<0.100	--	<10
	9/29/14	17.78	7.22	0.620	clear	2.25	103	8	<250	16	<0.05	<0.1	--	<10
	4/27/15	15.95	7.57	0.621	clear	1.86	341.2	7.780	<0.250	20.300	<0.050	<0.100	--	<10.0
WMW-11	3/14/12	15.03	6.84	1.032	9.7	0.47	-74	0.0050 J	0.58	62	7.2	2.9	--	220
	11/16/13	17.20	7.20	1.140	45.4	0.30	-128	<0.100	0.620	<5.000	<0.050	<0.100	--	1,100
	9/30/14	17.77	7.07	1.08	clear	1.83	196	<0.1/<0.1	0.54/0.55	<5/<5	<0.05/0.05	0.12/0.17	--	500/460
	4/27/15	17.12	7.44	1.247	clear	0.24	436.1	<0.100/<0.100	0.407/0.460	<5.000/<5.000	<0.050/<0.050	<0.100/<0.100	--	1,110/1,080

Notes:

(a) Measured using a YSI 556 Multiprobe.
(b) °C = Degrees Celsius
(c) mS/cm = millisiemens per centimeter
(d) NTU = nephelometric turbidity units
(e) mg/L = milligrams per liter
(f) mV = millivolts
(g) ORP = oxidation reduction potential. ORP was measured using an ExStik™ waterproof ORP meter.
(h) Method: U.S. Environmental Protection Agency (EPA) 353.2.
(i) Method: EPA 350.1/350.3.
(j) Method: EPA 300.0.
(k) Method: EPA 376.2.
(l) Methods: 2012 - EPA Method 200.8; 2013, 2014, and 2015 - EPA Method 6010.
(m) Analysis for manganese to begin in 2016 using EPA Method 6000 series.
(n) Method: RSK175. µg/L = micrograms per liter.
(o) "<" indicates the compound was not detected at a concentration greater than the method reporting limit (MRL).
(p) NS = not sampled due to the presence of light non-aqueous phase liquid (LNAPL).
(q) Where two values are displayed, the second is the analytical result for a field blind duplicate sample.
"--"= Not measured, not available, not applicable
"J" = Laboratory data flag indicating an estimated concentration below the MRL but above the method detection limit (MDL).

TABLE 4

JULY - AUGUST 2013
DIRECT-PUSH SUBSURFACE SOIL ANALYTICAL RESULTS
Wishram, Washington

Analyte	Sample Designation [Boring ID - Depth (feet below ground surface)]							MTCA Method A/B Cleanup Level
	TG-A6	**TG-CR1**	**TG-CR2**	**TG-CR3**	**TG-D0**	**TG-D1**	**TG-D2**	
	36 feet	**32 feet**	**12 feet**	**12 feet**	**12 feet**	**12 feet**	**24 feet**	
TPH (mg/kg)[b]								
Diesel-range Hydrocarbons	**30,000**	**5,300**	**16,000**	**17,000**	**30,000**	**43,000**	**16,000**	2,000[c] / NA
Oil-range Hydrocarbons	**38,000**	280	1,800	1,400	**33,000**	**10,000**	**46,000**	2,000[c] / NA
EPH (mg/kg)[d]								
C8 - C10 Aliphatics	500	--- [e]	---	---	---	---	---	NA [f]
C10 - C12 Aliphatics	2,500	---	---	---	---	---	---	NA
C12 - C16 Aliphatics	10,000	---	---	---	---	---	---	NA
C16 - C21 Aliphatics	10,000	---	---	---	---	---	---	NA
C21 - C34 Aliphatics	17,000	---	---	---	---	---	---	NA
C8 - C10 Aromatics	<120 U	---	---	---	---	---	---	NA
C10 - C12 Aromatics	240	---	---	---	---	---	---	NA
C12 - C16 Aromatics	1,900	---	---	---	---	---	---	NA
C16 - C21 Aromatics	8,800	---	---	---	---	---	---	NA
C21 - C34 Aromatics	16,000	---	---	---	---	---	---	NA
PAHs (mg/kg)[g]								
Naphthalene	---	---	---	---	**8.7**	**9.4**	---	5[h] / 1,600
2-Methylnaphthalene	---	---	---	---	**230**	**410**	---	5[h] / 320
1-Methylnaphthalene	---	---	---	---	**140**	**260**	---	5[h] / 5,600
2-Chloronaphthalene	---	---	---	---	<2.2	<2.3	---	5[h] / NA
Acenaphthylene	---	---	---	---	3.3	3.8	---	NA[g] / NA
Acenaphthene	---	---	---	---	14	18	---	2.1E+05[i] / 4,800
Fluorene	---	---	---	---	21	24	---	1.4E+05[i] / 3,200
Phenanthrene	---	---	---	---	41	41	---	NA / NA
Anthracene	---	---	---	---	8.1	2.9	---	1.1E+06[i] / 2.4E+04
Fluoranthene	---	---	---	---	4	2.2	---	1.4E+05[i] / 3,200
Pyrene	---	---	---	---	19	3.8	---	1.1E+05[i] / 2,400
Benzo(g,h,i)perylene	---	---	---	---	1.1	<0.68	---	NA / NA
cPAHs (mg/kg)[j]								
Benzo(a)anthracene	---	---	---	---	**4.3**	<0.68	---	NA / 1.37
Chrysene	---	---	---	---	10	1.5	---	NA / 137
Benzo(b)fluoranthene	---	---	---	---	**1.9**	<0.68	---	NA / 1.37
Benzo(j)fluoranthene	---	---	---	---	<0.66	<0.68	---	NA / NA
Benzo(a)pyrene	---	---	---	---	2.6	<0.68	---	0.10 / 0.137
Indeno(1,2,3-cd)pyrene	---	---	---	---	<0.66	<0.68	---	NA / 1.37
Dibenz(a,h)anthracene	---	---	---	---	<0.66	<0.68	---	NA / 0.37
Total cPAHs (mg/kg)[k]								
Non-Detects Included[l]	---	---	---	---	**3.42**	0.53	---	2.00
Non-Detects Excluded[m]	---	---	---	---	**3.32**	0.02	---	2.00

TABLE 4

JULY - AUGUST 2013
DIRECT-PUSH SUBSURFACE SOIL ANALYTICAL RESULTS
Wishram, Washington

	Sample Designation [Boring ID - Depth (feet below ground surface)]							
	TG-D4	**TG-D5**	**TG-D6**			**TG-E0**	**TG-E1**	**MTCA Method**
Analyte	**37 feet**	**33 feet**	**17 feet**	**29 feet**	**48 feet**	**22 feet**	**23 feet**	**A/B Cleanup Level**
TPH (mg/kg)(b)								
Diesel-range Hydrocarbons	**7,100**	**24,000**	1,000	**27,000**	**3,800**	**8,800**	**24,000**	2,000(c) / NA
Oil-range Hydrocarbons	**8,000**	**32,000**	1,400	**31,000**	**4,900**	**2,800**	**39,000**	2,000(c) / NA
EPH (mg/kg)(d)								
C8 - C10 Aliphatics	660	550	34	250	<130 U	---	---	NA (f)
C10 - C12 Aliphatics	2,600	2,300	590	1,900	340	---	---	NA
C12 - C16 Aliphatics	7,300	7,000	2,600	7,000	2,000	---	---	NA
C16 - C21 Aliphatics	7,700	8,000	3,000	7,900	2,400	---	---	NA
C21 - C34 Aliphatics	12,000	13,000	4,900	12,000	3,500	---	---	NA
C8 - C10 Aromatics	<120 U	<120 U	<130 U	<120 U	<130 U	---	---	NA
C10 - C12 Aromatics	220	330	<130 U	180	<130 U	---	---	NA
C12 - C16 Aromatics	1,600	2,200	480	1,800	430	---	---	NA
C16 - C21 Aromatics	7,300	7,200	2,600	7,900	2,200	---	---	NA
C21 - C34 Aromatics	12,000	12,000	4,500	14,000	3,700	---	---	NA
PAHs (mg/kg)(g)								
Naphthalene	<1.3	<4.4	<0.13	---	<1.3	---	---	5(h) / 1,600
2-Methylnaphthalene	1.7	**52**	<0.13	---	1.3	---	---	5(h) / 320
1-Methylnaphthalene	<1.3	**36**	<0.13	---	1.8	---	---	5(h) / 5,600
2-Chloronaphthalene	<1.3	<4.4	<0.13	---	<1.3	---	---	5(h) / NA
Acenaphthylene	<0.39	<1.3	<0.038	---	<0.38	---	---	NA(g) / NA
Acenaphthene	<0.39	4.9	0.088	---	0.46	---	---	2.1E+05(i) / 4,800
Fluorene	0.71	16	0.047	---	1.5	---	---	1.4E+05(i) / 3,200
Phenanthrene	1.4	22	0.044	---	2.4	---	---	NA / NA
Anthracene	<0.39	7.7	<0.038	---	0.62	---	---	1.1E+06(i) / 2.4E+04
Fluoranthene	<0.39	<1.3	<0.038	---	<0.38	---	---	1.4E+05(i) / 3,200
Pyrene	<0.39	4.4	0.055	---	0.53	---	---	1.1E+05(i) / 2,400
Benzo(g,h,i)perylene	<0.39	<1.3	<0.038	---	<0.38	---	---	NA / NA
cPAHs (mg/kg)(j)								
Benzo(a)anthracene	<0.39	<1.3	<0.038	---	<0.38	---	---	NA / 1.37
Chrysene	<0.39	3.6	0.067	---	0.5	---	---	NA / 137
Benzo(b)fluoranthene	<0.39	1.7	<0.038	---	<0.38	---	---	NA / 1.37
Benzo(j)fluoranthene	<0.39	<1.3	<0.038	---	<0.38	---	---	NA / NA
Benzo(a)pyrene	<0.39	<1.3	<0.038	---	<0.38	---	---	0.10 / 0.137
Indeno(1,2,3-cd)pyrene	<0.39	<1.3	<0.038	---	<0.38	---	---	NA / 1.37
Dibenz(a,h)anthracene	<0.39	<1.3	<0.038	---	<0.38	---	---	NA / 0.37
Total cPAHs (mg/kg)(k)								
Non-Detects Included(l)	0.29	1.12	0.03	---	0.29	---	---	2.00
Non-Detects Excluded(m)	0.00	0.21	0.00	---	0.01	---	---	2.00

TABLE 4

JULY - AUGUST 2013
DIRECT-PUSH SUBSURFACE SOIL ANALYTICAL RESULTS
Wishram, Washington

Analyte	Sample Designation [Boring ID - Depth (feet below ground surface)]							MTCA Method A/B Cleanup Level
	TG-E8	**TG-F1**	**TG-F2**	**TG-F6**		**CR-6**	**NT-10**	
	24 feet	**25 feet**	**36 feet**	**25 feet**	**29 feet**	**25 feet**	**10 feet**	
TPH (mg/kg)(b)								
Diesel-range Hydrocarbons	**31,000**	450	320	**2,200**	**23,000**	<5	<4.8	2,000(c) / NA
Oil-range Hydrocarbons	**41,000**	480	370	**3,800**	**29,000**	<12	<12	2,000(c) / NA
EPH (mg/kg)(d)								
C8 - C10 Aliphatics	230	---	16	17	420	---	---	NA (f)
C10 - C12 Aliphatics	1,900	---	54	<12 U	2,400	---	---	NA
C12 - C16 Aliphatics	8,600 E	---	230	1,600	9,400 E	---	---	NA
C16 - C21 Aliphatics	9,300 E	---	240	2,600	11,000 E	---	---	NA
C21 - C34 Aliphatics	16,000 E	---	400	4,000	17,000 E	---	---	NA
C8 - C10 Aromatics	<110 U	---	<2.6 U	<62 U	<120 U	---	---	NA
C10 - C12 Aromatics	340	---	4	<62 U	250	---	---	NA
C12 - C16 Aromatics	2,600	---	40	300	2,200	---	---	NA
C16 - C21 Aromatics	7,600	---	220	2,200	8,600	---	---	NA
C21 - C34 Aromatics	14,000	---	350	3,800	14,000	---	---	NA
PAHs (mg/kg)(g)								
Naphthalene	---	---	---	<0.48	---	---	---	5(h) / 1,600
2-Methylnaphthalene	---	---	---	<0.48	---	---	---	5(h) / 320
1-Methylnaphthalene	---	---	---	<0.48	---	---	---	5(h) / 5,600
2-Chloronaphthalene	---	---	---	<0.48	---	---	---	5(h) / NA
Acenaphthylene	---	---	---	<0.14	---	---	---	NA(g) / NA
Acenaphthene	---	---	---	0.34	---	---	---	2.1E+05(i) / 4,800
Fluorene	---	---	---	<0.14	---	---	---	1.4E+05(i) / 3,200
Phenanthrene	---	---	---	<0.14	---	---	---	NA / NA
Anthracene	---	---	---	<0.14	---	---	---	1.1E+06(i) / 2.4E+04
Fluoranthene	---	---	---	<0.14	---	---	---	1.4E+05(i) / 3,200
Pyrene	---	---	---	0.34	---	---	---	1.1E+05(i) / 2,400
Benzo(g,h,i)perylene	---	---	---	<0.14	---	---	---	NA / NA
cPAHs (mg/kg)(j)								
Benzo(a)anthracene	---	---	---	<0.14	---	---	---	NA / 1.37
Chrysene	---	---	---	<0.14	---	---	---	NA / 137
Benzo(b)fluoranthene	---	---	---	0.24	---	---	---	NA / 1.37
Benzo(j)fluoranthene	---	---	---	<0.14	---	---	---	NA / NA
Benzo(a)pyrene	---	---	---	<0.14	---	---	---	0.10 / 0.137
Indeno(1,2,3-cd)pyrene	---	---	---	<0.14	---	---	---	NA / 1.37
Dibenz(a,h)anthracene	---	---	---	<0.14	---	---	---	NA / 0.37
Total cPAHs (mg/kg)(k)								
Non-Detects Included(l)	---	---	---	0.12	---	---	---	2.00
Non-Detects Excluded(m)	---	---	---	0.02	---	---	---	2.00

TABLE 4

JULY - AUGUST 2013
DIRECT-PUSH SUBSURFACE SOIL ANALYTICAL RESULTS
Wishram, Washington

Notes:

(a) Model Toxics Control Act (MTCA; WAC 173-340) Method A industrial soil cleanup levels (Ecology 2007).

(b) Samples were analyzed for diesel- and oil-range total petroleum hydrocarbons (TPH) by Washington State Department of Ecology (Ecology) Method NWTPH-Dx(extended), and gasoline-range TPH by Ecology Method NWTPH-G.

(c) Cleanup level is for diesel-range + oil-range TPH.

(d) Extractable petroleum hydrocarbons (EPH) analyzed by Ecology Method NWTPH/EPH.

(e) "---" denotes that the sample was not analyzed for the indicated analyte.

(f) "NA" denotes no cleanup level established.

(g) Samples were analyzed for polycyclic aromatic hydrocarbons (PAHs) by U.S. Environmental Protection Agency (EPA) Method 8270C in selected ion monitoring (SIM) mode.

(h) Cleanup level is for the total of naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene.

(i) MTCA Method C industrial soil cleanup level from Ecology's online CLARC database (Method A cleanup level not available).

(j) Samples were analyzed for carcinogenic polycyclic aromatic hydrocarbons (cPAHs) by EPA Method 8270C in SIM mode.

(k) Total cPAHs are based on benzo(a)pyrene equivalent values. Individual detected cPAH concentrations were multiplied by benzo(a)pyrene toxicity equivalency factors (TEFs) prior to summation (per WAC 173-340-708).

(l) A value of 1/2 the laboratory method reporting limit (MRL) was used for total cPAH summation for non-detected cPAH analytes for TEF summation.

(m) Non-detected cPAH analytes were excluded from the TEF summation for total cPAHs.

(n) If two values are presented in notation XX / YY, XX value represents a result without use of a silica gel cleanup. YY values represent a result with use of a silica gel cleanup.

"<" denotes that the analyte was not detected at a concentration above the indicated laboratory MRL.

mg/kg = milligrams per kilogram

"J" = Laboratory data flag indicating an estimated concentration below the MRL but above the method detection limit (MDL).

"Y" = Laboratory data flag indicating that the chromatographic response resembles a typical fuel pattern.

"B" = Laboratory data flag indicating that the compound was also detected in the method blank.

Analyte concentrations exceeding the indicated cleanup level are shown in bold.

TABLE 3-A. TEFs for cPAHs

cPAH Analyte	TEF
Benzo(a)anthracene	0.1
Chrysene	0.01
Benzo(b)fluoranthene	0.1
Benzo(h)fluoranthene	0.1
Benzo(a)pyrene	1
Indeno(1,2,3-cd)pyrene	0.1
Dibenz(a,h)anthracene	0.1

TABLE 5

JULY 2014 DIRECT-PUSH SUBSURFACE SOIL ANALYTICAL RESULTS
Wishram, Washington

Analyte	Sample Designation [Boring ID - Depth (feet below ground surface)]																					MTCA Method A Industrial Soil Cleanup Level[a]
	MWD-1		MWD-2			MWD-3			MWD-4		OHM-1					OHM-2			OHM-3		OHM-4	
	25 feet	33 feet	20 feet	33 feet	43 feet	39 feet	42.5 feet	69.5 feet	35 feet	70 feet	19 feet	36 feet	43 feet	50 feet	75 feet	17 feet	34 feet	36.5 feet	4 feet	34 feet	25 feet	
Collection Date	7/24/14	7/24/14	7/25/14	7/23/14	7/23/14	7/24/14	7/25/14	7/25/15	7/22/14	7/23/14	7/29/14	7/30/14	7/30/14	7/30/14	7/30/14	7/28/14	7/28/14	7/28/14	7/28/14	7/28/14	7/28/14	
TPH (mg/kg)[b]																						
Diesel-Range Hydrocarbons	1,000[c]	44	U (5.2)[d]	900	U (5.5)	**4,600[e]**	**2,400**	74	U (5.5)	U (4.4)	**2,600**	**29,000**	**18,000**	**22,000**	**2,400**	**7,600**	**42,000**	**29,000**	**26,000**	**5,400**	**5,500**	2,000 / NA [h] [i]
Oil-Range Hydrocarbons	73	U (13)	U (13)	930	U (14)	**5,100**	**2,700**	89	U (14)	U (11)	**2,800**	**29,000**	**22,000**	**23,000**	**2,500**	**8,100**	**44,000**	**30,000**	**20,000**	**5,600**	**5,600**	2,000 / NA
SVOC (mg/kg)[f]																						
Acenaphthene	--[j]	U (0.042)	--	U (0.089)	--	--	0.55	--	--	--	--	U (2)	--	--	--	--	--	--	--	U (4.4)	--	NA / 4,800
Acenaphthylene	--	U (0.042)	--	U (0.089)	--	--	U (0.41)	--	--	--	--	U (2)	--	--	--	--	--	--	--	U (4.4)	--	NA / NA
Anthracene	--	U (0.042)	--	U (0.089)	--	--	0.68	--	--	--	--	U (2)	--	--	--	--	--	--	--	U (4.4)	--	1.1E+06 / 2.4E+04
Benzidine	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / NA
Benzo(a)anthracene	--	U (0.042)	--	U (0.089)	--	--	U (0.41)	--	--	--	--	U (2)	--	--	--	--	--	--	--	U (4.4)	--	NA / 1.37
Benzo(a)pyrene	--	U (0.042)	--	U (0.089)	--	--	U (0.41)	--	--	--	--	U (2)	--	--	--	--	--	--	--	U (4.4)	--	0.1 / 0.137
Benzo(b)fluoranthene	--	U (0.042)	--	U (0.089)	--	--	U (0.41)	--	--	--	--	U (2)	--	--	--	--	--	--	--	U (4.4)	--	NA / 1.37
Benzo(k)fluoranthene	--	U (0.042)	--	U (0.089)	--	--	U (0.41)	--	--	--	--	U (2)	--	--	--	--	--	--	--	U (4.4)	--	NA / 13.7
Benzo(g,h,i)perylene	--	U (0.042)	--	U (0.089)	--	--	U (0.41)	--	--	--	--	U (2)	--	--	--	--	--	--	--	U (4.4)	--	NA / NA
Benzylbutyl phthalate	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / NA
Bis(2-chlorethoxy)methane	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / NA
Bis(2-chloroethyl)ether	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 0.909
Bis(2-chloroisopropyl)ether	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / NA
Bis(2-ethylhexyl)phthalate	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 71.4
4-Bromophenyl-phenylether	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / NA
4-Chloro-3-methylphenol	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / NA
2-Chloronaphthalene	--	U (0.042)	--	U (0.089)	--	--	U (0.41)	--	--	--	--	U (2)	--	--	--	--	--	--	--	U (4.4)	--	NA / NA
2-Chlorophenol	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 400
4-Chlorophenyl-phenylether	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / NA
Chrysene	--	U (0.042)	--	U (0.089)	--	--	U (0.41)	--	--	--	--	U (2)	--	--	--	--	--	--	--	U (4.4)	--	NA / 137
3,3-Dichlorobenzidine	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 2.22
2,4-Dichlorophenol	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 240
2,4-Dimethylphenol	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 1,600
4,6-Dinitro-2-methylphenol	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / NA
2,4-Dinitrophenol	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 160
2,4-Dinitrotoluene	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 3.23
2,6-Dinitrotoluene	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 0.667
Dibenz(a,h)anthracene	--	U (0.042)	--	U (0.089)	--	--	U (0.41)	--	--	--	--	U (2)	--	--	--	--	--	--	--	U (4.4)	--	NA / 0.137
Diethyl phthalate	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 6.4E+04
Dimethyl phthalate	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / NA
Di-n-butyl phthalate	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / NA
Di-n-octyl phthalate	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 800
Fluoranthene	--	U (0.042)	--	U (0.089)	--	--	U (0.41)	--	--	--	--	U (2)	--	--	--	--	--	--	--	U (4.4)	--	1.4E+05 / 3,200
Fluorene	--	U (0.042)	--	U (0.089)	--	--	1.5	--	--	--	--	3.6	--	--	--	--	--	--	--	U (4.4)	--	1.4E+05 / 3,200
Hexachloro-1,3-butadiene	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 12.8
Hexachlorobenzene	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 0.625
Hexachlorocyclopentadiene	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 480
Hexachloroethane	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 25
Indeno(1,2,3-cd)pyrene	--	U (0.042)	--	U (0.089)	--	--	U (0.41)	--	--	--	--	U (2)	--	--	--	--	--	--	--	U (4.4)	--	NA / 1.37
Isophorone	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 1,050
2-Methylphenol (o-Cresol)	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 4,000
3&4-Methylphenol (m&p-Cresol)[g]	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 4,000
Naphthalene	--	U (0.042)	--	U (0.089)	--	--	U (0.41)	--	--	--	--	2.6	--	--	--	--	--	--	--	U (4.4)	--	5 / 1,600
Nitrobenzene	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 160
2-Nitrophenol	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / NA
4-Nitrophenol	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / NA
n-Nitrosodimethylamine	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 0.0196
n-Nitrosodi-n-propylamine	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 0.143
n-Nitrosodiphenylamine	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 204
Pentachlorophenol	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 2.5
Phenanthrene	--	U (0.042)	--	U (0.089)	--	--	1.2	--	--	--	--	3.9	--	--	--	--	--	--	--	U (4.4)	--	NA / NA
Phenol	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 2.4E+04
Pyrene	--	U (0.042)	--	U (0.089)	--	--	0.71	--	--	--	--	U (2)	--	--	--	--	--	--	--	U (4.4)	--	1.1E+05 / 2,400
1,2,4-Trichlorobenzene	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 34.5
2,4,6-Trichlorophenol	--	U (0.42)	--	U (0.90)	--	--	U (4.1)	--	--	--	--	U (21)	--	--	--	--	--	--	--	U (44)	--	NA / 80
TOTAL SOLIDS (%)																						
SVOC Sample	--	78.7	--	73.9	--	--	81.2	--	72.5	--	75.6	80.1	--	--	--	--	--	--	--	74.8	--	NA / NA
TPH Sample	73.7	77.4	77.5	72.2	72.9	82.8	81.4	81.9	--	90.7	--	79.7	76	72.7	79.3	79.4	83.8	80.4	89.2	81.6	81.5	NA / NA

Notes:

(a) Model Toxics Control Act (MTCA; WAC 173-340) Method A Industrial Soil Cleanup Levels
(b) Samples were analyzed for diesel- and oil-range total petroleum hydrocarbons (TPH) by Washington State Department of Ecology Method NWTPH-Dx (extended)
(c) "Bold" denotes the analyte was detected but below the respective MTCA Cleanup Level
(d) "U" denotes the analyte was not detected at a concentration above the indicated laboratory method reporting limit (MRL)
(e) "Bold denotes the analyte was detected at a concentration at or above the respective MTCA Cleanup Level
(f) Samples were analyzed for semivolatile organic compounds (SVOC) by U.S. Environmental Protection Agency (EPA) Method 8270D
(g) Laboratory could not separate 3-methylphenol and 4-methylphenol, therefore the analytes were reported together as 3&4-methylphenol (m&p-cresol
(h) MTCA Method A / MTCA Method B industrial soil cleanup levels
(i) If non-cancer and cancer values exist for MTCA Method B industrial soil cleanup levels, the lower value of the two is presented
(j) "--" denotes the sample was not analyzed for the indicated analyte

mg/kg = milligrams per kilogram
NA = no cleanup level established
% = percent

TABLE 6

SUMMARY OF INVESTIGATIVE ACTIVITIES
Wishram, Washington

Area/Description(a)	Work Plan Section Reference	Potential Chemicals of Concern(b)	Planned Investigation Activities	Number of New Soil Borings/Wells	Total Number of Samples to be Collected for Analysis	Depth of Sampling Interval(s) (bgs)	Analyses to be Performed(c)	Field Screening to be Performed
Columbia River and Bank Characterizations	3.2.3	Petroleum Hydrocarbons	Monthly bank inspections, nodule and oil-droplet sampling and nodule mapping	NA	1 sample of oil nodule material – 1 sample of oil-droplet material (if observed)	Ground Surface / Surface Water	All samples: NWTPH-Dx, EPH, PAHs, VOCs	ST, VI
Former Power House, Former Heavy-oil Appurtenances – Upland OHM Wells	3.3.1	Petroleum Hydrocarbons	Installation of OHM wells, NAPL thickness/head assessments, NAPL fluid characterizations	4 OHM Wells(d)	0 new [11 previous(d)]	Previous: 19 to 75 feet	Previous soil samples: NWTPH-Dx, SVOCs (see Table 5 for results)	HS, ST, VI
Former Power House – Deep Riverside Wells	3.3.2	Petroleum Hydrocarbons	Installation of deep monitoring wells (possible OHM wells), NAPL thickness/head assessments, NAPL fluid characterizations, dissolved phase monitoring. Pilot borings by direct-push with soil sampling, soil sample analysis if warranted based on field screening.	4 Wells(d)	Soil TBD [10 previous(d)]	Previous: 20 to 70 feet	Previous soil samples: NWTPH-Dx, SVOCs (see Table 5 for results)	HS, ST, VI
OHM NAPL Samples	3.3.3	Petroleum Hydrocarbons	NAPL Fluid Properties analysis	4 Wells(e)	4(e)	25 to 65 feet	NAPL samples will be analyzed for specific gravity, density, capillarity, and viscosity at 50, 70, 100 degrees Fahrenheit. Interfacial tensions between water, air, and NAPL will be measured at 50 degrees Fahrenheit. Analyses will be conducted by PTS Labs.	HS, ST, VI
Additional Vadose Zone Soil Boring	3.3.4	Petroleum Hydrocarbons	Direct-push soil sampling near previous LIF locations TG-CR-04, TG-CR-4.5, and TG-CR-5	1 Boring	1 soil	Approximately 6 to 7 feet bgs	Soil: NWTPH-Dx, VOCs, SVOCs	HS, ST, VI
Upland Locations of Potential Submerged Diesel NAPL Identified in 2013	3.4.1	Petroleum Hydrocarbons	Direct-push soil sampling	2 Borings	2 soil	20 to 25 feet	Soil: NWTPH-Dx and PAHs	HS, ST, VI
Shallow Well Transect Parallel to River Along Potential Diesel Impact Areas	3.4.2	Petroleum Hydrocarbons	Direct-push drilling, installation of shallow monitoring wells, soil sample analysis based on field screening	5 Wells	5 Water from Wells(f) Soil TBD	10 to 20 feet (screened interval)	Water: NWTPH-G, NWTPH-Dx, BTEX, MNA Soil (if any): NWTPH-Dx	HS, ST, VI
Additional Shallow Groundwater Monitoring Wells West of Current Diesel Impact Delineation	3.4.3	Petroleum Hydrocarbons	Direct-push drilling, installation of shallow monitoring wells, soil sample analysis if warranted based on field screening	2 Wells	2 Water from Wells(f) Soil TBD	10 to 20 feet (screened interval)	Water: NWTPH-G, NWTPH-Dx, BTEX, MNA Soil (if any): NWTPH-Dx	HS, ST, VI
Former Transformer Storage Area	3.5	PCBs	Direct-push soil sampling for initial borings, reconnaissance groundwater (RGW) sampling from additional boring if soil PCB concentration exceeds 1 mg/kg in soil	2 initial borings (soil only) 1 additional for RGW if initial PCBs in soil are >1 mg/kg	4 initial soil samples 1 RGW sample from additional boring if initial PCBs in soil are >1 mg/kg	3 to 5 feet 10 to 12 feet	Soil: PCBs RGW, if any: PCBs	HS, ST, VI
Former 30,000-Barrel AST Area	3.5	Petroleum Hydrocarbons	Direct-push soil sampling	3 Borings	6	Sample depths to be based on field screening, otherwise approximately 10 to 15 feet	Soil: NWTPH-Dx, PAHs	HS, ST, VI

TABLE 6

SUMMARY OF INVESTIGATIVE ACTIVITIES
Wishram, Washington

Area/Description[(a)]	Work Plan Section Reference	Potential Chemicals of Concern[(b)]	Planned Investigation Activities	Number of New Soil Borings/Wells	Total Number of Samples to be Collected for Analysis	Depth of Sampling Interval(s) (bgs)	Analyses to be Performed[(c)]	Field Screening to be Performed
Former Repair Shops	3.5	Petroleum Hydrocarbons, BTEX, PAHs, VOCs, Metals (RCRA 8)	Direct-push drilling, installation of temporary well, RGW sampling, soil sample analysis based on field screening	3 Borings	3 RGW 3 soil	10 to 12 feet	RGW: NWTPH-G, NWTPH-Dx, BTEX, PAHs, total/dissolved Metals (RCRA 8), VOCs Soil: NWTPH-Dx, BTEX, Metals (RCRA 8), PAHs, VOCs	HS, ST, VI
Former Wash Rack	3.5	Petroleum Hydrocarbons, BTEX, PAHs, VOCs, Metals (RCRA 8)	Direct-push drilling, installation of temporary well, RGW sampling, soil sample analysis based on field screening	1 Boring	1 RGW 1 Soil	10 to 12 feet	RGW: NWTPH-G, NWTPH-Dx, BTEX, PAHs, total/dissolved Metals (RCRA 8), VOCs Soil: NWTPH-Dx, BTEX, Metals (RCRA 8), PAHs, VOCs	HS, ST, VI
Former Oil House (East of Store House)	3.5	Petroleum hydrocarbons, BTEX, PAHs, lead	Direct-push drilling, installation of temporary well, RGW sampling, soil sample analysis based on field screening	2 Borings	2 RGW 2 Soil	10 to 12 feet	RGW: NWTPH-G, NWTPH-Dx, BTEX, PAHs, total/dissolved Metals (RCRA 8), PAHs, VOCs Soil: NWTPH-Dx, BTEX, Metals (RCRA 8), PAHs, VOCs	HS, ST, VI
Former Oil House and 1,000-gallon Gasoline UST	3.5	Petroleum hydrocarbons, BTEX, PAHs, lead	Direct-push drilling, installation of temporary well, RGW sampling, soil sample analysis based on field screening	2 Borings	2 RGW 2 Soil	10 to 12 feet	RGW: NWTPH-G, NWTPH-Dx, BTEX, PAHs, total/dissolved Metals (lead only) Soil: NWTPH-G, NWTPH-Dx, PAHs, and BTEX	HS, ST, VI
Former 5,000-gallon Oil UST	3.5	Petroleum hydrocarbons, PAHs, lead	Direct-push drilling, installation of temporary well, RGW sampling, soil sample analysis based on field screening	1 Boring	1 RGW 1 Soil	10 to 12 feet	RGW: NWTPH-Dx, PAHs, total/dissolved Metals (lead only) and naphthalene Soil: NWTPH-Dx	HS, ST, VI
Former Engine House/Machine Shop	3.5	Petroleum Hydrocarbons, BTEX, PAHs, VOCs, Metals (RCRA 8)	Direct-push drilling, installation of temporary well, RGW sampling, soil sample analysis based on field screening	7 Borings	8 RGW 7 Soil	7 RGW samples from 10 to 12 feet; 1 deep RGW sample from top of bedrock surface, approximately 60 feet	RGW: NWTPH-G, NWTPH-Dx, BTEX, PAHs, total/dissolved Metals (RCRA 8), VOCs Soil: NWTPH-Dx, BTEX, PAHs, Metals (RCRA 8), VOCs	HS, ST, VI
Quarterly Groundwater Monitoring	3.5	Petroleum Hydrocarbons, Metals (lead)	Low flow sampling of new [(g)] and existing wells, long-term potentiometric surface monitoring with pressure transducers	5 Wells	5 Wells per event; 4 quarterly events [(f)]	10 to 20 feet (screened interval)	All water samples: NWTPH-G, NWTPH-Dx, BTEX, and MNA. Total and dissolved lead for one event[(g)] Water samples from 2 wells: total/dissolved arsenic, PAHs for one event[(h)]	
Semi-Annual Groundwater Monitoring	3.5	Petroleum Hydrocarbons, Metals (lead)	Low flow sampling of new[(i)] and existing wells, long-term potentiometric surface monitoring with pressure transducers	19 total (11 new + 8 existing)	19 Wells per event; 4 semi-annual events[(e)]	Shallow wells: 10 to 20 feet (screened interval) Deep wells: 25 to 50 feet (screened interval)	All water samples: NWTPH-G, NWTPH-Dx, BTEX, MNA, Total and dissolved lead for one event[(g)] Deep well water samples: Add PAHs	HS, ST, VI

TABLE 6

SUMMARY OF INVESTIGATIVE ACTIVITIES
Wishram, Washington

Notes:

(a) Refer to Figures 12 and 13 for approximate sampling locations.
(b) Potential issues of concern and chemicals of concern based on previous investigations, site walk, interviews, and historical aerial photographs and maps.
(c) Estimated sample analyses to be included in Phase I of RI. Actual number and type of analyses performed will be dependent on site conditions and field monitoring results (headspace monitoring, hydrocarbon sheen test, odor, visual conditions). Assume approximately one sample submitted for analysis from each sampling location unless otherwise specified. However, other opportunistic samples may be collected based on field conditions encountered or preliminary analytical results.
(d) Soil borings for Upland and Riverside Wells were completed in July 2014. Soil samples have been analyzed and are presented in Table 5.
(e) NAPL fluid samples will be collected from each of the four upland OHM wells and any riverside deep wells containing NAPL (if any).
(f) Baseline sampling will be conducted on each permanent groundwater monitoring well installed that does not contain NAPL (excluding the shallow transect wells). The shallow transect wells will be monitored on a quarterly frequency for 1 year (four events) before being added to the site semi-annual monitoring program. During the first round of groundwater monitoring, four of the new shallow groundwater monitoring wells (WMW-12, WMW-13, WMW-16, and WMW-18) will also be analyzed using EPA Method 8270 for compounds commonly found in creosote mixtures (including naphthalene, o, m and p-cresol and PAHs). All other permanent groundwater monitoring wells installed (that do not contain NAPL) begin with semiannual monitoring frequency.
(g) Total and dissolved lead and NWTPH-G analyses will be discontinued after one monitoring event if not detected at concentrations above the MTCA Method A groundwater cleanup level.
(h) Total and dissolved arsenic and PAHs analyses will be performed for samples from two (2) groundwater monitoring wells (WMW-17 and WMW-18) during the first quarterly groundwater monitoring event. These analyses will be discontinued after one monitoring event if not detected at concentrations above applicable MTCA groundwater cleanup levels.
(i) New wells will include five (5) new shallow transect wells, two (2) new shallow groundwater monitoring wells located west of current diesel impact delineation, and four (4) Riverside wells. Therefore, eleven (11) new wells are expected to be included in semi-annual groundwater monitoring following the RI.

Abbreviations:

bgs – below ground surface
BTEX – benzene, toluene, ethylbenzene, and xylenes
EPH – extractable petroleum hydrocarbons
HS - Head-space VOC screening of soils
LIF – laser induced fluorescence
mg/kg – milligrams per kilogram
NA - Not applicable
NAPL – non-aqueous phase liquid
OHM – oil head monitoring
PAHs - polycyclic aromatic hydrocarbons
PCBs - polychlorinated biphenyls
RI – remedial investigation
ST - hydrocarbon sheen test of soils
TBD – to be determined
TPH - total petroleum hydrocarbons
UST - underground storage tank
VI - visual inspection of soils
VOCs - volatile organic compounds

Analyses:

NWTPH-Dx – Diesel- and heavy oil- range TPH (without silica gel cleanup, except of field-selected duplicate samples)
NWTPH-G – Gasoline-range TPH
SVOCs – semi-volatile organic compounds by U.S. Environmental Protection Agency (EPA) 8270D
Metals – Resource Conservation and Recovery Act (RCRA 8) metals (As, Ba, Cd, Cr, Pb, Hg, Se, Ag) by EPA 6000/7000 series
VOCs – volatile organic compounds by EPA 8260
PCBs – polychlorinated biphenyls by EPA 8081
MNA – Geochemical indicators of natural attenuation (nitrate/nitrite, ammonia, sulfate, sulfide, dissolved iron, manganese, and methane)
PAHs –- polycyclic aromatic hydrocarbons by EPA 8270
EPH – extractable petroleum hydrocarbons by Washington State Department of Ecology (Ecology) methods

TABLE 7

AGREED ORDER SCHEDULE OF DELIVERABLES OR ACTION REQUIRED
Wishram, Washington

Deliverable or Action Required	Completion/Due to Ecology
Continued monitoring of riverbank	To be conducted on a monthly basis from the Effective Date until otherwise directed by Ecology, with increased frequency, reporting, and response as described in Exhibit B, Task 1.
Draft RI Work Plan, including detailed schedule, HASP, and SAP/QAPP	Due within 60 days of Effective date for Order.
Final RI Work Plan	Due within 45 days of receipt of Ecology's written comments on Draft RI Work Plan.
Perform RI field work, including any field work associated with any modifications or addenda to the RI Work Plan	In accordance with detailed schedule in Ecology-approved Final RI Work Plan and any modification or addenda thereto.
Monthly reports on the progress of the RI	Monthly progress reports will be submitted to Ecology via mail or email. Progress reports shall be submitted to Ecology on or by 15th of the month for work performed the previous month. Monthly reporting will discontinue upon submission of the Draft RI/FS.
Draft RI/FS Report	Due within 120 days of receipt of the validated analytical data from the final phase of sampling events specified under the Final RI Work Plan or any modifications or addenda thereto.
Revised RI/FS Report	Due within 45 days of receipt of Ecology's comments on the Draft RI/FS Report.
Draft Cleanup Action Plan	Due within 60 days of Ecology's written approval of Revised RI/FS Report.
Interim Action (if any)	In accordance with detailed schedule in Ecology-approved Interim Action Work Plan.

Note:
This table describing the schedule of deliverables or action required is a summary of the obligations described in greater detail in Exhibit B (Statement of Work).

Ecology = Washington State Department of Ecology
RI = remedial investigation
HASP = Health and Safety Plan
SAP = Sampling and Analysis Plan
QAPP = Quality Assurance Project Plan
FS = feasibility study

Figures

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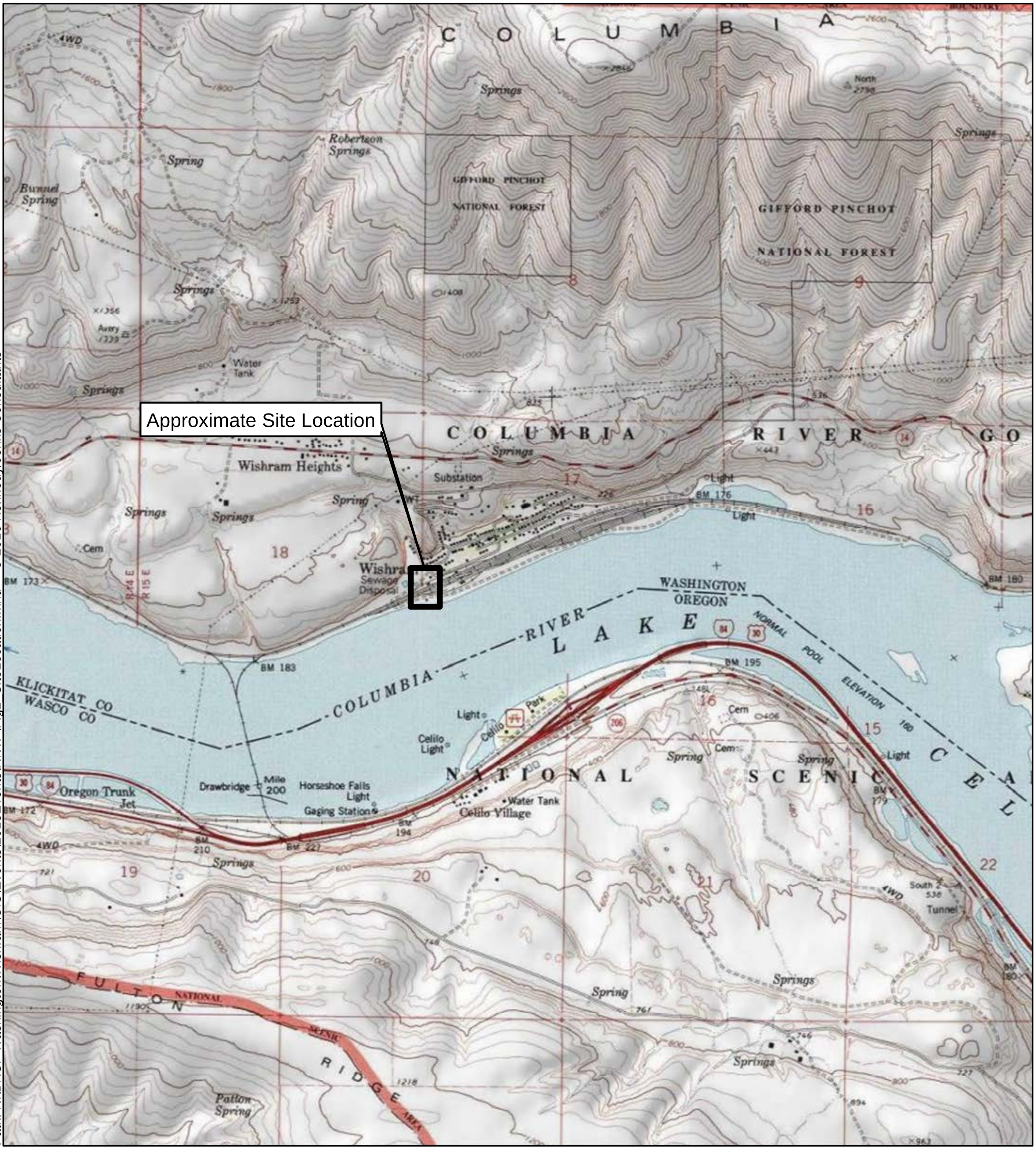

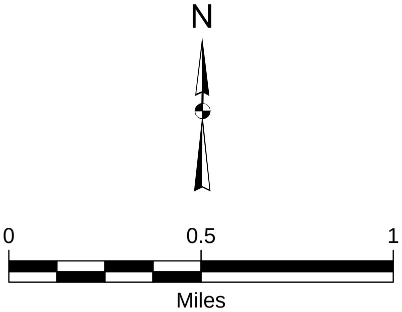

Note:
1. All locations are approximate.

Kennedy/Jenks Consultants

BNSF Wishram Rail Yard
Wishram, Washington

Site Location Map

Figure 1

K/J Project Number 1596120.00

Path: N:\BNSF Washington\Wishram\GIS\Events\2015Events\RIWP\Fig2_CurrentSiteFeatures.mxd © 2016 Kennedy/Jenks Consultants

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

- ⊕ Existing Monitoring Well
- 173.13 Top of Casing Elevation (feet AMSL)
- -·- Approximate BNSF Property Line

Notes:

1. All locations are approximate and have been detemined using past reports and historical maps and images.
2. Well elevations surveyed in 2012.
3. Elevation in feet above mean sea level (AMSL).
4. Approximate BNSF property lines are based on surveys, Klickitat County parcel maps and other available information. Where relevant, actual property lines should be confirmed in the field.

N

0 100 200

Scale: Feet

Kennedy/Jenks Consultants

BNSF Wishram Rail Yard
Wishram, Washington

Current Site Features

Figure 2

K/J Project Number 1596120.00

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Path: N:\BNSF Washington\Wishram\GIS\Events\2015Events\RIWP\Fig3_HistoricalSiteFeaturesRescaledRev.mxd

Legend

Existing Sample Locations

- ⊕ Existing Monitoring Well
- — · — Approximate Former Bunker Fuel Distribution Pipe and Associated Facilities
- — · — Approximate BNSF Property Line
- ▭ Suspected Diesel Fueling Area
- ▭ Suspected Oil Fueling Area
- ▭ Existing Site Feature
- ⬚ Former Site Feature
- ▨ Approximate Previous Excavation Area (2002)
- ▨ Approximate Previous Excavation Area (2005/2010)

Notes:

1. All locations are approximate and have been determined using past reports and historical maps and images.
2. Major features are shown; however, other features may have been present. Refer to historical plat maps for additional detail.
3. Approximate BNSF property lines are based on surveys, Klickitat County parcel maps and other available information. Where relevant, actual property lines should be confirmed in the field.

N

0 125 250

Scale: Feet

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BNSF Wishram Rail Yard
Wishram, Washington

Historical Site Features

Figure 3

K/J Project Number 1596120.00

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Path: N:\BNSF Washington\Wishram\GIS\Events\2015Events\RIWP\Fig4_BedrockContoursRev.mxd © 2016 Kennedy/Jenks Consultants

Legend

- ● LIF Survey Location (2013)
- 24 Estimated Bedrock Depth (ft)
- —20— Estimated Depth to Bedrock Contour (10 ft interval)
- ······· Inferred Depth to Bedrock Contour
- -·-·- Approximate BNSF Property Line

Notes:

1. All locations are approximate and have been detemined using past reports and historical maps and images.
2. Depth to bedrock surface approximated based on LIF survey data.
3. Approximate BNSF property lines are based on surveys, Klickitat County parcel maps and other available information. Where relevant, actual property lines should be confirmed in the field.

N

0 60 120

Scale: Feet

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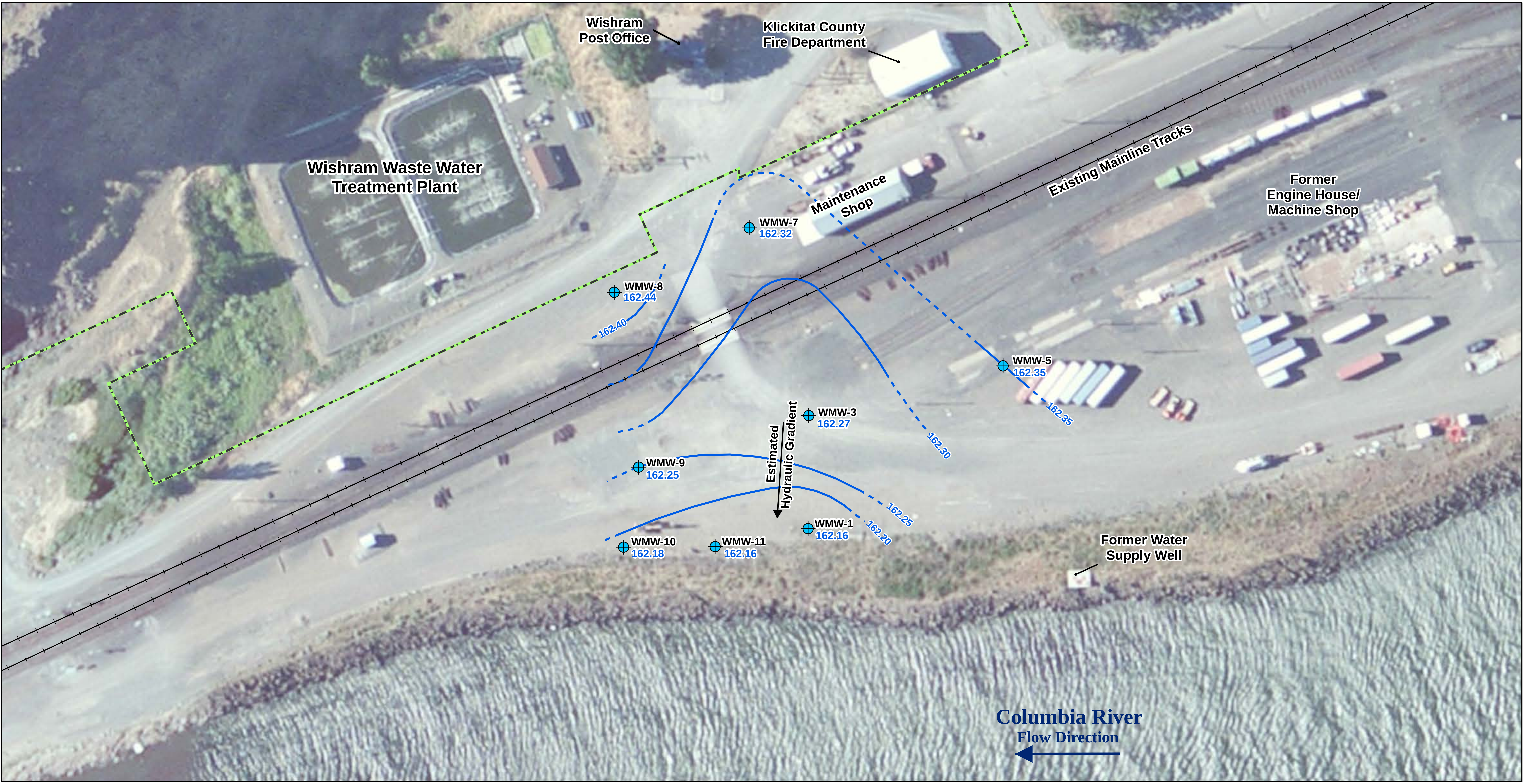
BNSF Wishram Rail Yard
Wishram, Washington

Approximate Depth to Bedrock Contour Map

Figure 4

K/J Project Number 1596120.00



Path: N:\BNSF Washington\Wishram\GIS\Events\2015Events\RIWP\Fig5_Potentiometric_April2014.mxd ©2016 Kennedy/Jenks Consultants

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

⊕ Monitoring Well

— 162.35 Approximate Potentiometric Surface Contour (feet AMSL, Dashed Where Inferred)

-·- Approximate BNSF Property Line

Notes:

1. All locations are approximate and have been detemined using past reports and historical maps and images.
2. Potentiometric surface contour in feet above mean sea level (AMSL).
3. Approximate BNSF property lines are based on surveys, Klickitat County parcel maps and other available information. Where relevant, actual property lines should be confirmed in the field.

N

0 80 160

Scale: Feet

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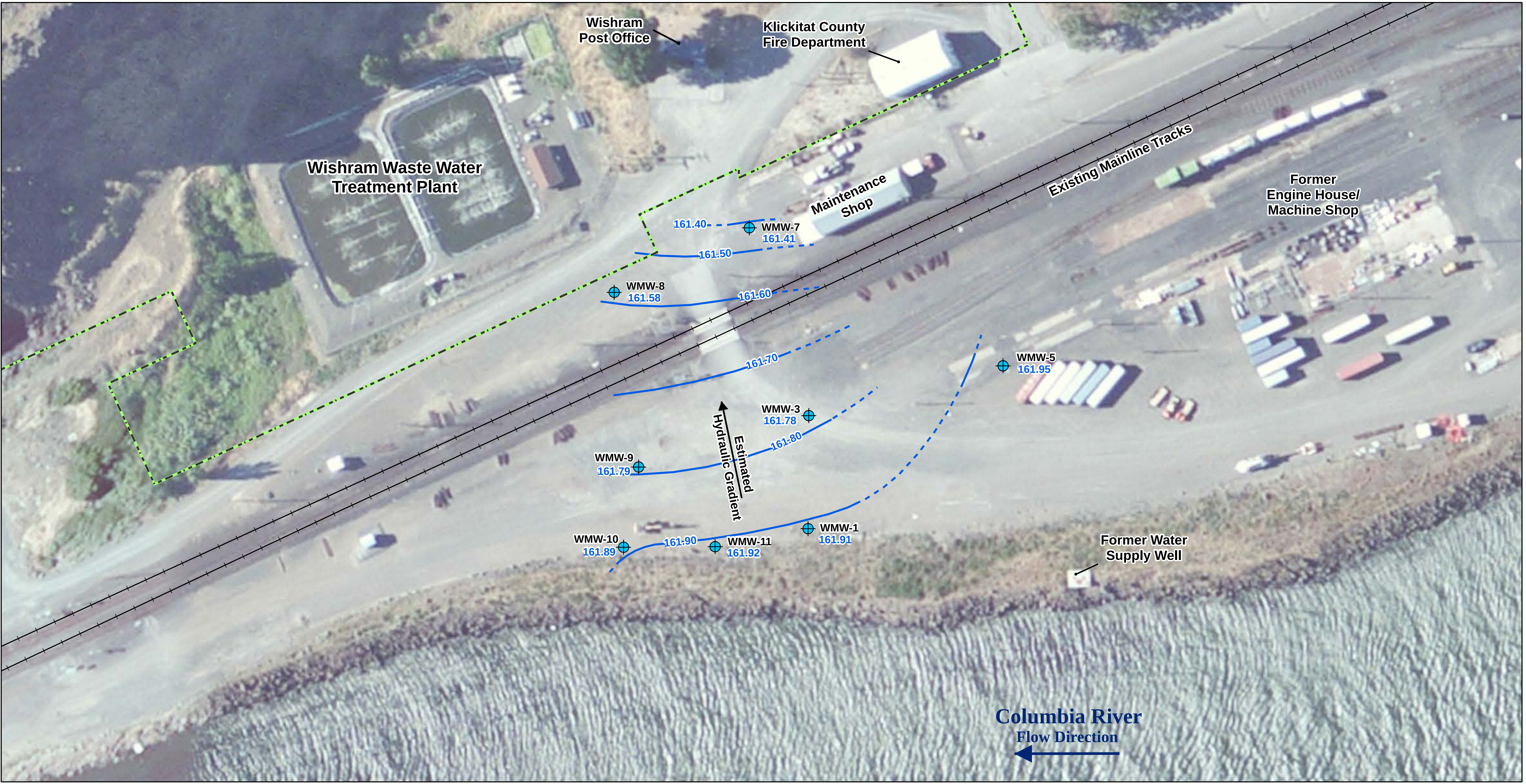
BNSF Wishram Rail Yard
Wishram, Washington

Potentiometric Surface
April 2014

Figure 5

K/J Project Number 1596120.00



Path: N:\BNSF Washington\Wishram\GIS\Events\2015Events\RIWP\Fig6_Potentiometric_Sept2014.mxd ©2016 Kennedy/Jenks Consultants

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

- ⊕ Monitoring Well
- 161.70 Approximate Potentiometric Surface Contour (feet AMSL, Dashed Where Inferred)
- Approximate BNSF Property Line

Notes:

1. All locations are approximate and have been detemined using past reports and historical maps and images.
2. Potentiometric surface contour in feet above mean sea level (AMSL).
3. Approximate BNSF property lines are based on surveys, Klickitat County parcel maps and other available information. Where relevant, actual property lines should be confirmed in the field.

N

0 80 160

Scale: Feet

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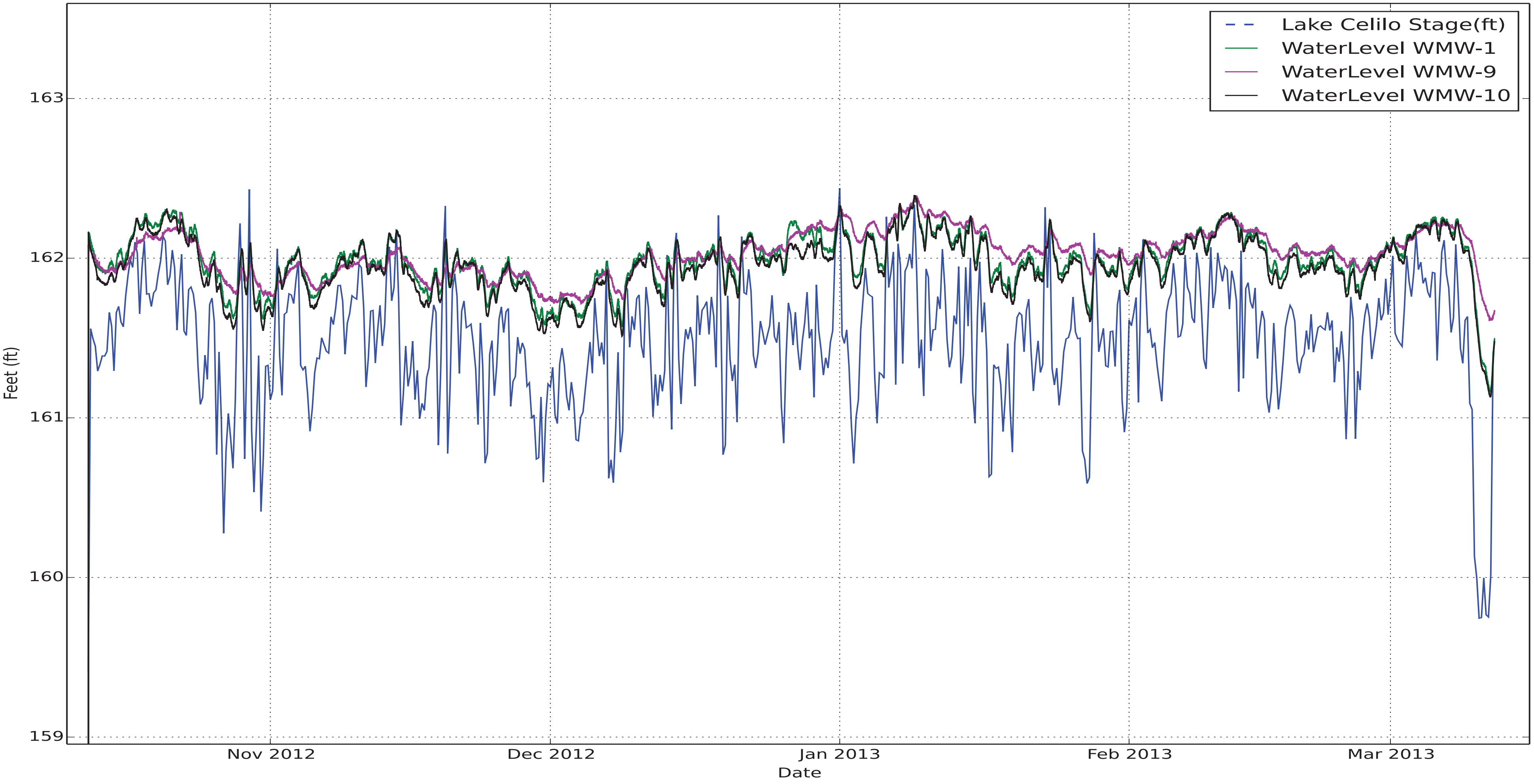
BNSF Wishram Rail Yard
Wishram, Washington

Potentiometric Surface
September 2014

Figure 6

K/J Project Number 1596120.00



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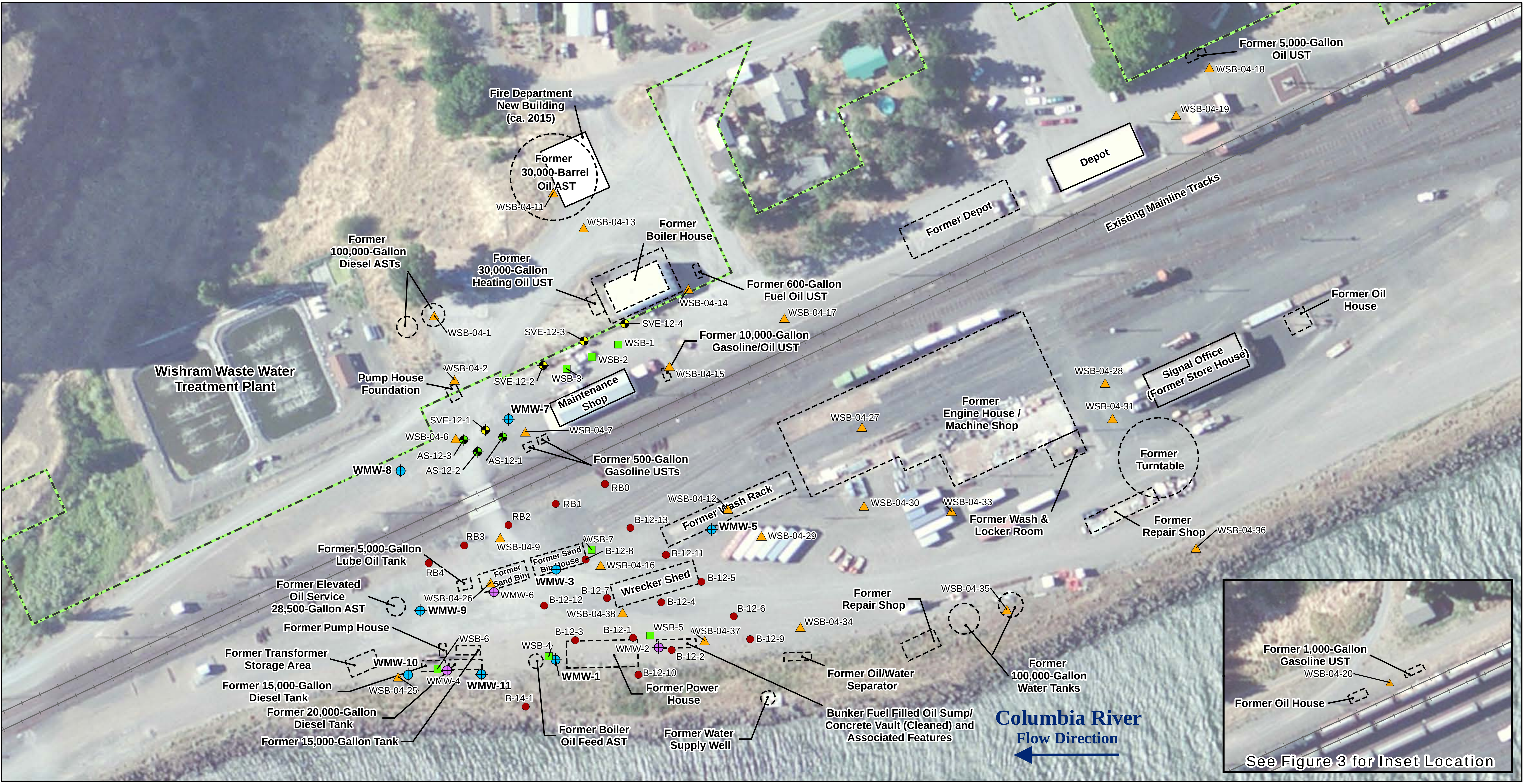
BNSF Wishram Rail Yard
Wishram, Washington

Groundwater Elevation Plot

Figure 7

K/J Project Number 1596120.00



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Path: N:\BNSF Washington\Wishram\GIS\Events\2015Events\RIWP\Fig8_PreviousSampling_SiteFeaturesRev.mxd ©2015 Kennedy/Jenks Consultants

Legend

- ⊕ Existing Monitoring Well
- ⊕ Previous Monitoring Well Location (Abandoned or Destroyed)
- 🟩 Soil Boring (Sept 2003): WSB-#
- ▲ Soil Boring (Feb 2004): WSB-04-#
- ● Soil Boring Location (2012 to 2014)
- ◆ Soil Vapor Extraction (SVE) Well
- ◆ Air Sparge (AS) Well
- ☐ Existing Site Feature
- ⬚ Former Site Feature
- -·- Approximate BNSF Property Line

Notes:

1. All locations are approximate and have been detemined using past reports and historical maps and images.
2. Approximate BNSF property lines are based on surveys, Klickitat County parcel maps and other available information. Where relevant, actual property lines should be confirmed in the field.

N

0 100 200

Scale: Feet

Kennedy/Jenks Consultants

BNSF Wishram Rail Yard
Wishram, Washington

Site Features and Historical Shallow Sampling Locations

Figure 8

K/J Project Number 1596120.00

Path: N:\BNSF Washington\Wishram\GIS\Events\2015Events\RIWP\Fig9_DeepSampleLocationsRevRescaled.mxd

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

- ⊕ Proposed Deep Riverside Monitoring Well (RMD) Location
- ⊕ 2014 Soil Boring/Proposed Oil Head Monitoring (OHM) Location
- ● Soil Boring Location (2012 to 2014)
- ● LIF Survey Location (2013)
- 🟨 Approximate Lateral Extent of Heavy Oil
- -·-· Approximate BNSF Property Line

Notes:

1. All locations are approximate and have been detemined using past reports and historical maps and images.
2. Distribution of heavy oil is inferred from LIF Survey and other information.
3. Approximate BNSF property lines are based on surveys, Klickitat County parcel maps and other available information. Where relevant, actual property lines should be confirmed in the field.

N

0 60 120

Scale: Feet

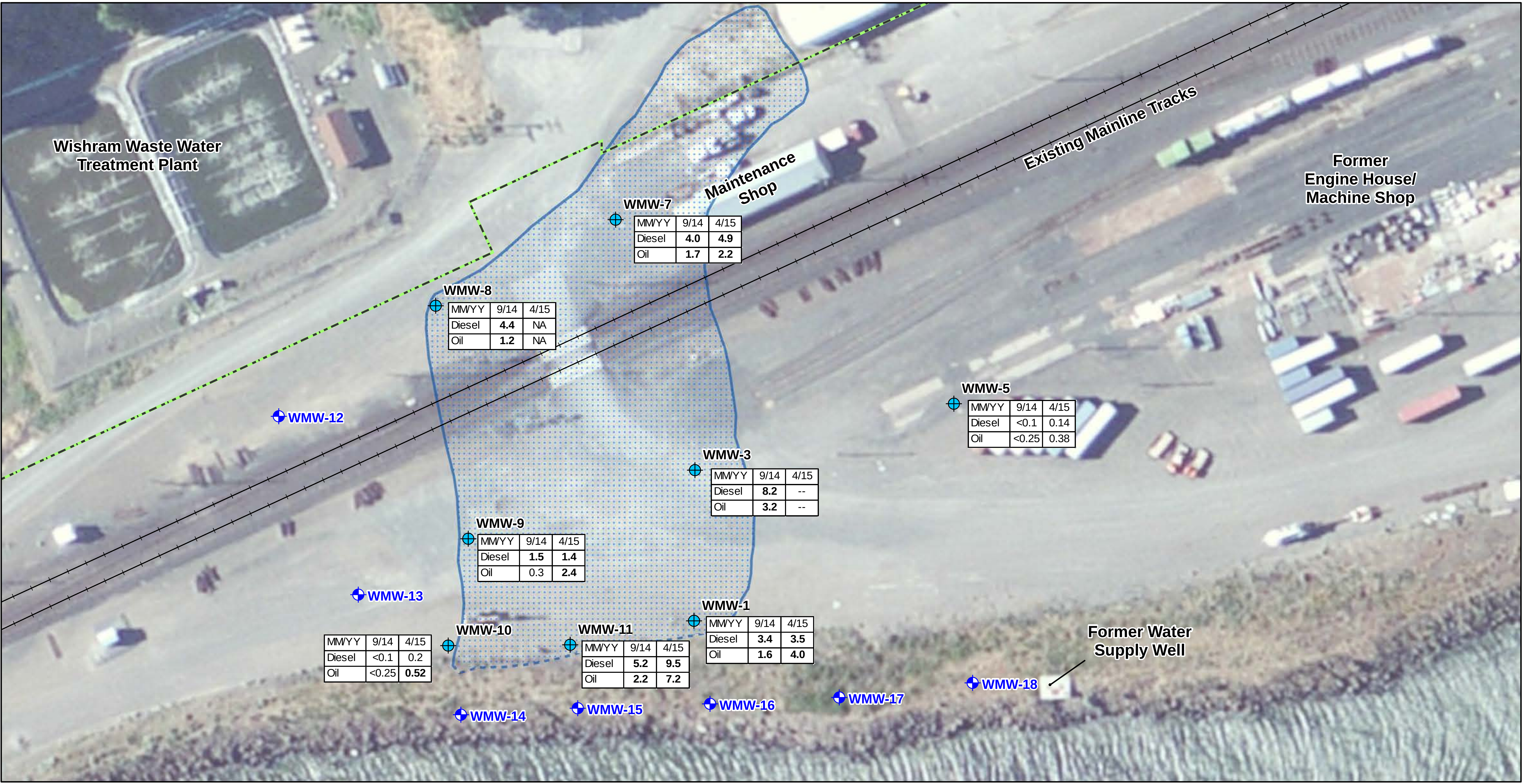
Kennedy/Jenks Consultants

BNSF Wishram Rail Yard
Wishram, Washington

Deep Investigation Sampling Locations and Heavy Oil Distribution Summary

Figure 9

K/J Project Number 1596120.00



WMW-7

MM/YY	9/14	4/15
Diesel	**4.0**	**4.9**
Oil	**1.7**	**2.2**

WMW-8

MM/YY	9/14	4/15
Diesel	**4.4**	NA
Oil	**1.2**	NA

WMW-5

MM/YY	9/14	4/15
Diesel	<0.1	0.14
Oil	<0.25	0.38

WMW-3

MM/YY	9/14	4/15
Diesel	**8.2**	--
Oil	**3.2**	--

WMW-9

MM/YY	9/14	4/15
Diesel	**1.5**	**1.4**
Oil	0.3	**2.4**

WMW-1

MM/YY	9/14	4/15
Diesel	**3.4**	**3.5**
Oil	**1.6**	**4.0**

WMW-10

MM/YY	9/14	4/15
Diesel	<0.1	0.2
Oil	<0.25	**0.52**

WMW-11

MM/YY	9/14	4/15
Diesel	**5.2**	**9.5**
Oil	**2.2**	**7.2**

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Path: N:\BNSF Washington\Wishram\GIS\Events\2015Events\RIWP\Fig10_GWResults2014-2015Rescaled.mxd

Legend

⊕	Proposed Shallow Monitoring Well Location
⊕	Existing Monitoring Well
-·-·	Approximate BNSF Property Line
▦	Approximate Lateral Extent of Light Hydrocarbon

MM/YY	9/14	4/15
Diesel	**1.5**	**1.4**
Oil	0.3	**2.4**

Diesel- and oil-range hydrocarbons in groundwater
Concentrations are in milligrams per liter (mg/L).
Bold indicates concentrations greater than the MTCA Method A groundwater cleanup level (0.5 mg/L).
NA indicates the well was not sampled during the monitoring event due to presence of LNAPL.

Notes:

1. All locations are approximate and have been detemined using past reports and historical maps and images.
2. Monitoring well WMW-3 was not sampled during the 4/15 sampling event (buried under gravel).
3. Approximate BNSF property lines are based on surveys, Klickitat County parcel maps and other available information. Where relevant, actual property lines should be confirmed in the field.

N

0 60 120

Scale: Feet

Kennedy/Jenks Consultants

BNSF Wishram Rail Yard
Wishram, Washington

Shallow Groundwater Monitoring and Light Hydrocarbon Distribution Summary

Figure 10

K/J Project Number 1596120.00

Path: N:\BNSF Washington\Wishram\GIS\Events\2015Events\RIWP\Fig11A_2015CrossSectionLineRev.mxd

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

- 🟩 Soil Boring (Sept 2003): WSB-#
- ▲ Soil Boring (Feb 2004): WSB-04-#
- ● Soil Boring Location (2012 to 2014)
- ⊕ Existing Monitoring Well
- ⊕ Previous Monitoring Well Location (Abandoned or Destroyed)
- ⊕ Air Sparge (AS) Well
- ⊕ Soil Vapor Extraction (SVE) Well
- ▭ Existing Site Feature
- ⬚ Former Site Feature
- -··- Approximate BNSF Property Line

Notes:

1. All locations are approximate and have been detemined using past reports and historical maps and images.
2. Refer to Figure 3 for Historical Site Features and Figure 11B for Preliminary Conceptual Site Model.
3. Approximate BNSF property lines are based on surveys, Klickitat County parcel maps and other available information. Where relevant, actual property lines should be confirmed in the field.

N

0 60 120

Scale: Feet

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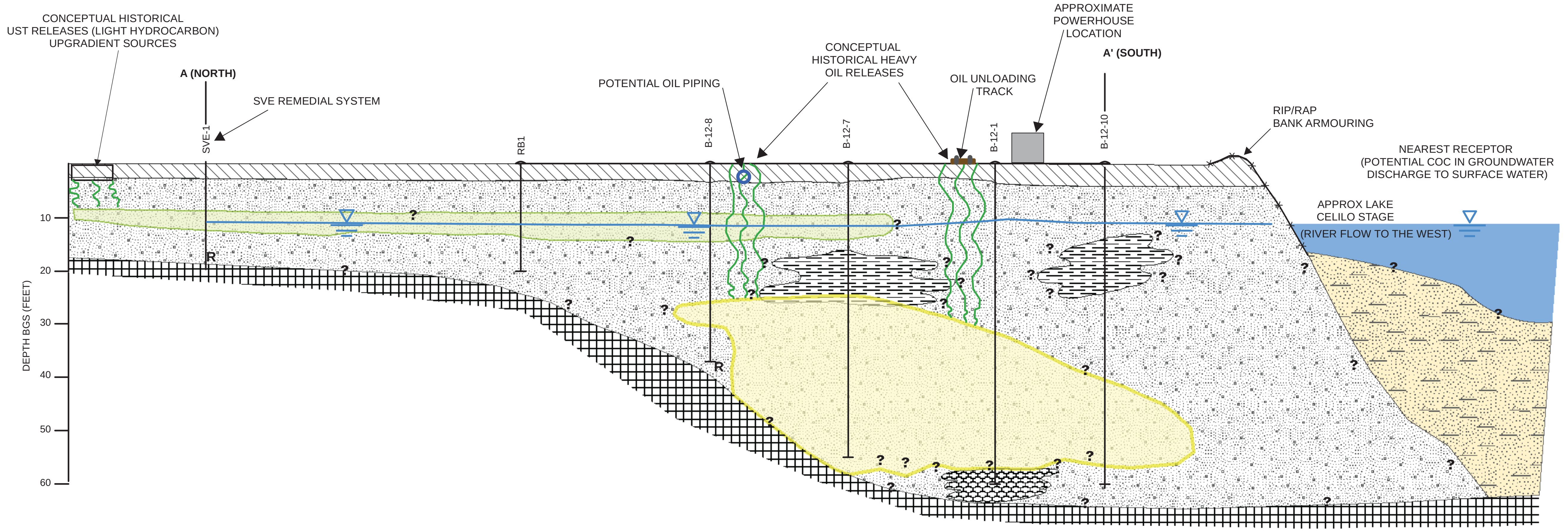
BNSF Wishram Rail Yard
Wishram, Washington

Approximate Soil Boring and
Cross Section Location
(Preliminary Conceptual Site Model)

Figure 11A

K/J Project Number 1596120.00



Path: N:\Projects\2013\1396120.00 Wishram Investigation\GIS\Events\2015Events\Fig11B_CSM_2015.mxd ©2015 Kennedy/Jenks Consultants

Legend

- ▦ Interpreted Bedrock Surface
- ☰ Silt with Sand
- ▩ Well Graded Gravel
- ░ Poorly Graded Sand with Some Silt Locally
- ⸾ Conceptual Release and Vertical Migration Pathway
- ▨ Sand, Silt, Gravel Fill Materials
- 🟧 River Sediment
- 🟨 Heavy Hydrocarbon Containing Soils/Groundwater
- 🟩 Light Hydrocarbon (Smear Zone)
- — Approximate Water Table

Notes:

1. All locations and depths are approximate.
2. BGS = below ground surface.
3. R = drilling refusal on bedrock.
4. Potential release locations are conceptual and not indicative of actual locations.

NOT TO SCALE

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BNSF Wishram Rail Yard
Wishram, Washington

Preliminary Conceptual Site Model

Figure 11B

K/J Project Number 1596120.00

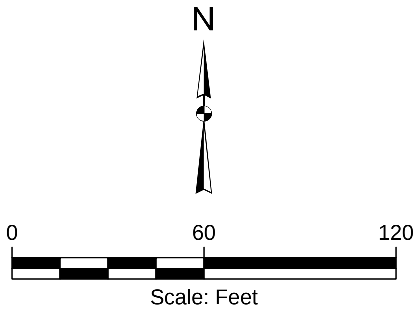
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

- ⊕ Proposed Deep Riverside Monitoring Well (RMD) Location
- ⊕ 2014 Soil Boring/Proposed Oil Head Monitoring (OHM) Location
- ⊕ Proposed Shallow Monitoring Well Location
- ⊕ Existing Monitoring Well
- ● Soil Boring Location (2012 to 2014)
- ■ LIF Survey with Inferred Oil on Bedrock
- ● LIF Survey Location (2013)
- 30 Approximate Oil Thickness in Feet
- ▨ Approximate Lateral Extent of Heavy Oil
- ▨ Approximate Lateral Extent of Oil on Bedrock
- -·-· Approximate BNSF Property Line

Notes:

1. All locations are approximate and have been detemined using past reports and historical maps and images.
2. Distribution of heavy oil is inferred from LIF Survey and other information.
3. Approximate BNSF property lines are based on surveys, Klickitat County parcel maps and other available information. Where relevant, actual property lines should be confirmed in the field.



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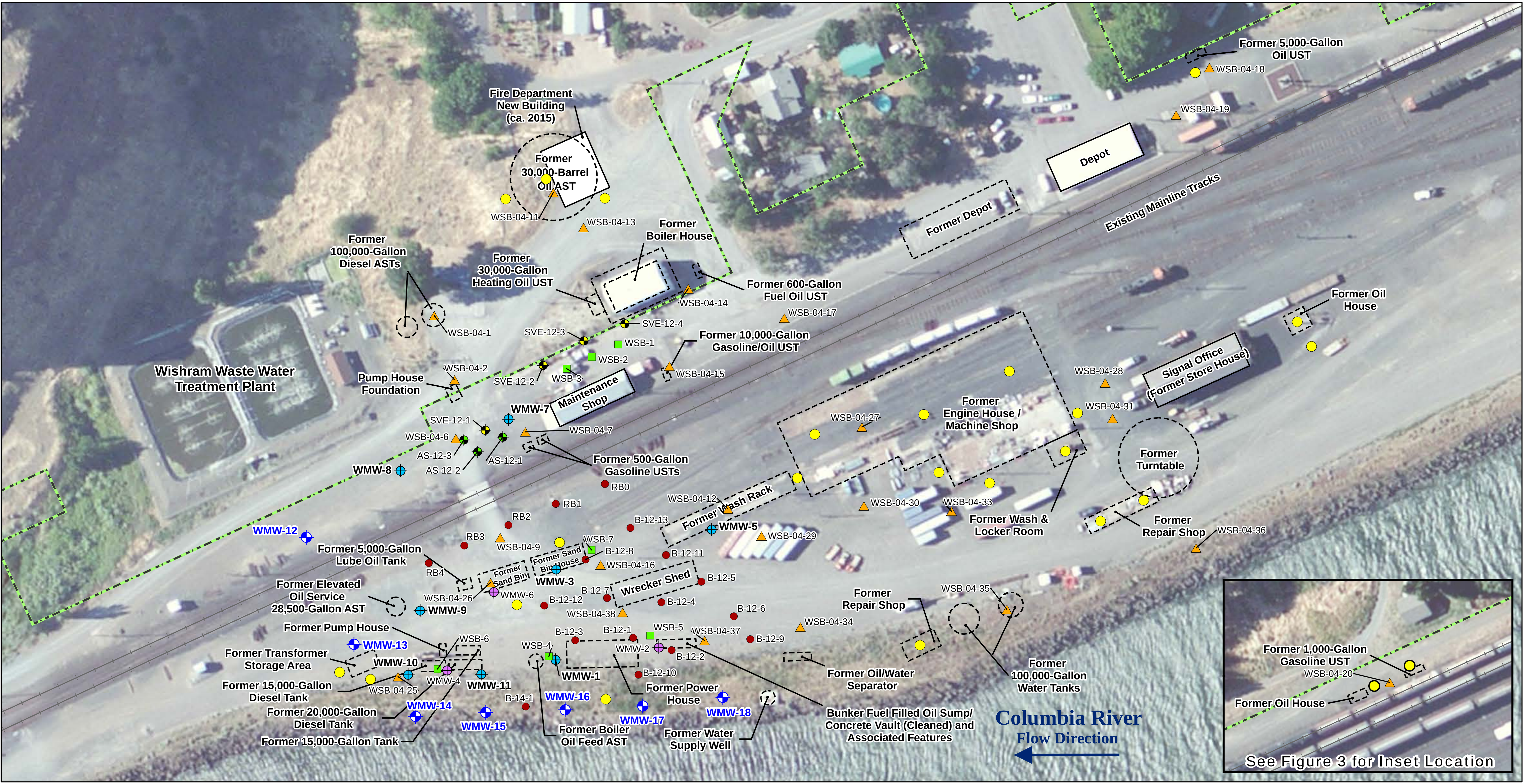
BNSF Wishram Rail Yard
Wishram, Washington

OHM Soil Borings and Proposed OHM Well Locations

Figure 12

K/J Project Number 1596120.00



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Path: N:\BNSF Washington\Wishram\GIS\Events\2015Events\RIWP\Fig13_ProposedBoringsRevWP.mxd © 2016 Kennedy/Jenks Consultants

Legend

- ● Proposed Boring
- 🟩 Soil Boring (Sept 2003): WSB-#
- ▲ Soil Boring (Feb 2004): WSB-04-#
- ● Soil Boring Location (2012 to 2014)
- ⊕ Proposed Shallow Monitoring Well
- ⊕ Existing Monitoring Well
- ⊕ Previous Monitoring Well Location (Abandoned or Destroyed)
- ⊕ Soil Vapor Extraction (SVE) Well
- ⊕ Air Sparge (AS) Well
- ▭ Existing Site Feature
- ⬚ Former Site Feature
- -·- Approximate BNSF Property Line

Notes:

1. All locations are approximate and have been detemined using past reports and historical maps and images.
2. Proposed borings near 30,000-barrel oil AST are subject to property access.
3. Approximate BNSF property lines are based on surveys, Klickitat County parcel maps and other available information. Where relevant, actual property lines should be confirmed in the field.

N

0 100 200

Scale: Feet

Kennedy/Jenks Consultants

BNSF Wishram Rail Yard
Wishram, Washington

Proposed Boring and Shallow Well Locations

Figure 13

K/J Project Number 1596120.00