Former Chevron Property
Draft Cleanup Action Plan

December 2011

Parametrix

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Draft Cleanup Action Plan

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The technical material and data contained in this document were prepared under the supervision and direction of the undersigned.

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ACRONYMS AND ABBREVIATIONS

ARAR	applicable relevant and appropriate requirement
bgs	below the existing ground surface
BTEX	benzene, toluene, ethylbenzene, and total xylenes
CAP	Cleanup Action Plan
CFR	Code of Federal Regulations
City	City of Bothell
COPC	contaminant of potential concern
cy	cubic yards
DCA	dichloroethane
DCE	dichloroethene
Ecology	Washington State Department of Ecology
HVOC	halogenated volatile organic compound
IA	interim action
MNA	monitored natural attenuation
MTCA	Model Toxics Control Act
ORC	oxygen release compound
PCE	tetrachloroethylene
RAO	remedial action objective
RI/FS	remedial investigation/feasibility study
Site	Bothell Landing property
SR	State Route
SVOC	semi-volatile organic compound
TCE	trichloroethylene
UST	underground storage tank
VC	vinyl chloride
WAC	Washington Administrative Code

EXECUTIVE SUMMARY

This Draft Cleanup Action Plan (DCAP) presents the proposed approach for a cleanup action to be performed at the Former Chevron Property (site), located at 1310 Highland Avenue in Bremerton, Washington (Figure 1). * This DCAP has been prepared per the requirements of the site's Agreed Order Number DE-07TCPHQ-5024. The proposed cleanup action is a continuation of cleanup work the City of Bremerton (City) has performed at the site starting in 2005. Work performed to date includes a Washington State Department of Ecology Model Toxics Control Act (MTCA)-compliant Remedial Investigation/Feasibility Study (RI/FS) and Interim Action (IA); Parametrix 2011).

The site is the former location of a Chevron bulk fuel tank farm used for commercial sale of petroleum products. An unknown amount of petroleum was released into the site's soil and groundwater during site tank farm operations. Site contamination was discovered by Chevron in 1988 when the tank farm was decommissioned. Chevron conducted cleanup at the site from 1988 through 2003, including the installation and operation of a vapor extraction remediation system. The City of Bremerton purchased the property in 2005 with the intention of completing the cleanup and developing the property as an addition to Evergreen Rotary Park. At the time the City purchased the property, significant contamination remained in the former tank area and operations area where tanker trucks were loaded.

Initial cleanup activities by the City consisted of a review of the site's historical data and development of cleanup approaches and preliminary cost estimates. Following this work, the City began negotiations with Ecology for establishing an Agreed Order (AO) for cleanup. Negotiations included agreement on an IA approach consisting of hot spot removal and in-place treatment of soil using chemical oxidation. Establishment of an AO provided the City with a funding opportunity under Ecology's Remedial Action Grant program. The AO was finalized on November 20, 2007, and the City began the RI/FS process.

RI sampling was conducted to evaluate the extent of contamination at the site. The sampling showed that the extent was similar to that seen historically but that concentrations in soil and groundwater were generally lower. The IA was performed during the summer of 2009 and consisted of the removal of approximately 1,200 cubic yards (cy) of contaminated soil from three hot-spot areas and the in-place treatment of approximately 4,000 cy of contaminated soil by soil mixing using a proprietary chemical oxidant (RegenOX). Results of confirmatory soil samples collected during the IA indicated that approximately 70 percent of the soil contaminant mass was destroyed by the RegenOx application.

Residual contamination in soil and groundwater at the site is currently undergoing natural attenuation. This DCAP outlines the next steps for the site, which will consist of long-term groundwater monitoring and the implementation of institutional controls.

Due to ongoing financial hardship, the City of Bremerton has indicated its ability to fund any follow-on cleanup activities and on-going groundwater monitoring will be severely limited. It is anticipated that this limitation will affect both the scope and implementation schedule of these activities. The City and Ecology will coordinate specifics to ensure the DCAP and implementation schedule acknowledge this issue to ensure the City has the resources to successfully implement all follow-on work.

1. INTRODUCTION

This DCAP has been prepared for at the Former Chevron Property site located at 1310 Highland Avenue in Bremerton, Washington (Figure 1). Preparation of this DCAP is a requirement of the site's Agreed Order (DE-07TCPHQ-5024) established between the Washington State Department of Ecology (Ecology) and the City of Bremerton. To date, the City has performed a Remedial Investigation/ Feasibility Study and Interim Action at the site in order to address soil and groundwater contamination related to historical releases of petroleum products.

1.1 PURPOSE

This DCAP was completed per the Agreed Order and Washington Administrative Code (WAC) 173-340-380, Model Toxics Control Act (Ecology 2007). The purpose of the DCAP is to present a general conceptual-level description of the preferred cleanup actions developed under the RI/FS (Parametrix 2011). MTCA requires a DCAP to include:

- A summary of RI/FS and IA activities performed at the site.
- Applicable state and federal laws for the proposed cleanup action.
- Cleanup standards for each hazardous substance and each medium of concern.
- A brief summary of the other cleanup alternatives evaluated in the RI/FS.
- A description of the proposed cleanup action.
- A description of the required institutional controls, the types and concentration of contaminants left on site, and measures that will be used to prevent contact with these substances.
- A schedule for implementation of the proposed cleanup action.

2. SUMMARY OF SITE CONDITIONS

2.1 SITE DESCRIPTION AND HISTORY

The Former Chevron Property is a 1.4-acre waterfront property located adjacent to Evergreen Rotary Park on the Port Washington Narrows. The historical bulk fuel tank farm operated at the site from prior to 1946 until circa 1988 (Figure 2). Based on aerial photographs, the facility was expanded northward to its present boundaries between 1946 and 1963 (Figure 3) by the placement of fill in the intertidal zone. This filling created a relatively level "lower yard" area where commercial fueling operations were conducted. The site uplands or "upper yard" are the former location of the aboveground bulk fuel tanks (Figure 4). The majority of the site's shoreline is armored with concrete rubble or steel and wooden bulkheads.

Products handled at the tank farm consisted primarily of diesel and gasoline (Hart Crowser 1989a). Fuel was offloaded from barges at a fueling pier in the Port Washington Narrows and pumped through piping to twelve aboveground storage tanks (ASTs) located in the upper yard. Fuel transfer likely occurred through underground piping as evidenced by observations made during the IA, when corroded steel piping was exposed in soil excavations conducted to remove hot spot soils in the lower yard. Leaks from this underground piping are the likely source of the majority of the subsurface contamination at the site. Fuel was loaded from the ASTs to tank trucks at four loading racks located in the lower yard. All aboveground structures were removed by the end of 1988 (GeoEngineers 1998).

2.2 PHYSICAL CHARACTERISTICS OF THE SITE

2.2.1 Geologic and Hydrogeologic Conditions

Soils in the upper yard consist of glacial till underlain by interbedded dense silts and silty sands (outwash). This soil unit was consolidated during the most recent glaciation and, as a result, is typically very dense and relatively impermeable. The lower yard is underlain by silty sand fill, which was used to extend the lower yard into Port Washington Narrows. The fill is underlain by silty sand outwash at a depth of approximately 20 feet below ground surface (bgs). A section view showing site geologic conditions is provided on (Figure 5). The results of slug testing performed by Hart Crowser (1989b) indicate that the hydraulic conductivity of the fill soils is approximately 5x10-5 centimeters per second (cm/s). Groundwater at the site occurs at depths of approximately 4 to 10 feet bgs in the lower yard and 5 to 20 feet bgs in the upper yard.

2.3 SUMMARY OF PREVIOUS SITE INVESTIGATIONS

Environmental work at the site began in 1988 following demolition of the bulk fuel facility (GeoEngineers 1988). A timeline of historic events and work conducted at the site prior to the RI activities is provided in Table 1.

2.3.1 RI Activities Summary

RI activities are described in the RI/FS report (Parametrix 2011) and are summarized in Table 2.

2.3.2 Prior Cleanup Actions

2.3.2.1 Interim Action Activities

The IA was conducted during June through August 2009, during which approximately 4,000 cy of contaminated soil were mixed in situ with RegenOX™ and ORC™. Soil mixing was accomplished using a dual-axis mixing tool affixed to a track backhoe arm. Chemical reagents were injected into the contaminated soil zone between 8 and 14 feet bgs while the soil was simultaneously mixed with the tool. The soil mixing area is shown on (Figure 11 and Figure 12). Confirmation soil samples were collected the same day as mixing and sent to the analytical laboratory for analysis at 7 days following mixing (when approximately 90 percent of the chemical oxidation reaction had taken place). If analytical results were elevated in a sample, the corresponding site area was remixed and a second confirmation sample was collected and analyzed. Confirmation results (shown on Figure 13 and Figure 14) indicate that, average mass reduction rates achieved were 78 percent for gasoline, 88 percent for diesel, and 40 percent for lube oil. Contaminants exceeding their respective cleanup levels in the confirmation soil samples consisted of gasoline, BTEX compounds, and benzo(a)pyrene.

An additional 1,200 cy were excavated from three hot-spot areas and transported off site for disposal at Waste Management's Columbia Ridge Landfill (see Figure 12). Confirmation soil samples were collected from the bottom and sidewalls of the completed excavations and analyzed to confirm that the cleanup was successful. Analytical results confirmed that all contaminated soil with concentrations above cleanup levels had been successfully removed. An exception is Area 3, where no confirmation samples were collected since the area was located within the soil mixing area.

Following the IA, a total of ten monitoring wells (MW-4R, MW-9R, MW-10R, MW-13R, MW16R, MW-18R, MW-19R, MW-21R, MW-22R, and MW-26R; (Figure 8) were installed to replace wells formerly located within the soil mixing and hot-spot excavation areas. Soil samples were collected from selected wells and six push probe boring to assess soil conditions at 6 months following treatment. Soil results are shown on Figure 14. The results of the sample analyses indicated that contaminant concentrations were generally similar to concentrations measured during the IA. Concentrations of gasoline, BTEX compounds, and/or benzo(a)pyrene exceeded cleanup levels in nine of the thirteen samples collected.

2.3.2.2 Supplemental Interim Action

An additional ORC injection event was conducted between May 26 and June 6, 2011 at 108 locations at the site (Figure 15). The supplemental injection was performed in areas where contamination levels remained high in groundwater. Injection was accomplished using a direct push-probe rig and injection pump to inject a slurry consisting of approximately 1/3 ORC and 2/3 water. Injection points were spaced 10 feet on-center in rows spaced 10 feet apart to create a grid pattern near wells with elevated gasoline and benzene concentrations. The top of the vertical treatment zone was selected based on groundwater depths at the time of treatment. Injection was performed starting at 1 foot above the current groundwater table (as measured in the nearby wells) and extended a total depth of 6 feet below this depth. A general dosing rate of 65 pounds of ORC per injection point was used for a total injected weight of 7,050 pounds of ORC. Dosing rates were field adjusted at some locations. The general dosing rate equates to approximately 3 pounds of dry ORC per cubic yard of treated soil. This rate is approximately twice what was used during the original soil mixing application of ORC during the IA.

2.4 SUMMARY OF ENVIRONMENTAL CONDITIONS

2.4.1 Soil

2.4.1.1 Pre IA Conditions

Soil with contamination in excess of cleanup levels was found exclusively in lower yard subsurface soils during the RI sampling. An approximate extent of pre-IA soil contamination is shown on Figure 6. Contaminated soils were observed between the depths of 8 and 14 feet bgs in a "smear zone" corresponding to the annual groundwater table fluctuation. The contamination consisted mainly of gasoline at concentrations as high as 5,100 mg/kg. Benzene was detected in samples containing elevated gasoline at concentrations as high as 21 mg/kg. Diesel was detected above cleanup levels at three locations (PP08, PP14, and PP16) at concentrations as high as 2,316 mg/kg. Motor oil was detected above the cleanup level at a single location (PP14) at a concentration of 3,800 mg/kg. Polycyclic aromatic hydrocarbons (PAHs) exceeded the cleanup level in two samples at concentrations of 0.1 to 0.25 mg/kg total PAHs (by toxicity equivalency method). Note the buried wooden bulkhead shown on Figure 6. Based on the RI data, the bulkhead may have acted as a barrier to contaminant migration in the downgradient direction. This bulkhead was removed during the IA.

No contaminated soils were detected in the upper yard during the RI; however, a limited zone of soil contamination was assumed to exist near Wells MW-16, MW-18, and MW-19 based on the presence of floating product in the wells or elevated groundwater concentrations.

No contaminants were detected in the surface soil samples collected during the RI. Surface soil sampling locations were selected based on the results of field screening conducted on surface soils at 24 locations. No indication of surface contamination was observed during the field screening.

2.4.1.2 Existing (Post IA) Conditions

Following the IA, residual contaminated soils with concentrations exceeding cleanup levels remain in some lower yard areas; however, residual concentrations are significantly reduced from pre-IA levels (Figure 13 and Figure 14). Contaminants that currently exceed cleanup levels in lower yard subsurface soils consist of:

- Gasoline (up to 1,000 mg/kg),
- Benzene (up to 5.4 mg/kg),
- Ethylbenzene (up to 20 mg/kg),
- Total xylenes (up to 94 mg/kg), and
- Polycyclic aromatic hydrocarbons (PAHs; up to 2.7 mg/kg by toxicity equivalency method).

As described previously, all upper yard contaminated soils in excess of cleanup levels were removed during the IA.

2.4.2 Groundwater

The approximate extent of groundwater contamination exceeding cleanup levels during RI sampling is shown on Figure 7. The most recent performance monitoring data is shown on Figure 8.

As shown, the extent of post-IA groundwater contamination has been significantly reduced as compared to the pre-IA contamination extent. Contaminants that currently exceed cleanup levels in groundwater consist of:

- Gasoline (up to 2,100 ug/L),
- Diesel (up to1.3 mg/L), and
- Benzene (up to 310 ug/L).

Gasoline and benzene concentrations versus time are charted on Figures 9 and 10. A sharp decrease in concentrations was observed in the first performance monitoring samples collected following the IA. Follow-on performance monitoring shows a generally decreasing trend in concentrations with two exceptions: MW-09R and MW-21R exhibited increasing concentrations in the second through fourth performance monitoring sampling events. Concentrations then decreased following the supplemental ORC injection. The increasing concentrations are apparently due to residual gasoline contamination present in the soils within the vicinity of the wells. As the oxygen released by the ORC declined with time, the associated aerobic biodegradation also declined. Once aerobic respiration was no longer occurring, concentrations in groundwater increased to equilibrium levels associated with anaerobic conditions.

Evidence that aerobic respiration has occurred in the wells is demonstrated by elevated alkalinity and decreasing dissolved oxygen concentrations following both injection events.

Evidence that anaerobic biodegradation is occurring is provided by elevated dissolved methane concentrations with associated negative oxidation reduction potential values (Table 3).

Testing was conducted for both total and dissolved lead during the sampling events; the only results that exceeded cleanup levels were total lead results from wells MW-09R, MW-20, and MW-21R (Table 3). In general, corresponding dissolved results did not exceed cleanup levels, indicating that the total results were biased high by the presence of suspended sediment. An exception is a single dissolved lead result from well MW-09R in August 2010, which slightly exceeded the cleanup level.

2.5 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) identifies primary contaminant sources, release mechanisms, transport mechanisms, secondary contaminant sources, potential pathways, and exposure routes. Existing chemical data, site characterization data, future land uses, and identification of potential human and ecological receptors were used to develop the model presented in Figure 16. The CSM is discussed further below.

2.5.1 Primary Sources of Contamination and Primary Release Mechanisms

The primary contaminant source is the bulk fuel tanks and piping, including potential releases from tanks, dispensers, piping, and spilled products. Contaminants associated with the bulk fuel tanks consist of petroleum hydrocarbons and lead.

2.5.2 Secondary Sources and Release Mechanisms

When a released contaminant is retained in an environmental medium such as soil, the medium functions as a secondary source for further chemical release. Secondary release mechanisms for contaminants potentially present at the Site include the following:

- Leaching from on-site soil to groundwater.
- Volatilization from soil and groundwater to air.
- Downgradient discharge from groundwater to surface water.

2.5.3 Pathways and Potential Receptors

An exposure pathway is a mechanism by which receptors are assumed to contact contaminants. MTCA defines an exposure pathway in terms of four components (WAC 173-340-200):

- A source and mechanism of chemical release (e.g., a release of contaminants to the subsurface).
- A retention or transport medium (e.g., groundwater).
- A point of potential exposure to a contaminated medium (e.g., commercial worker in an on-site building located above the groundwater plume).
- An exposure route at the exposure point (e.g., inhalation of vapors).

If any of these four components is not present, then a potential exposure pathway is considered incomplete and is not evaluated further in a risk assessment. If all four components are present, a pathway is considered complete.

Potential exposure routes for human and ecological receptors at the site include the following:

- **Dermal/Direct Contact**. Exposure to chemicals in soil may occur through direct contact with soil. Direct contact is a potential exposure route for current and future on-site workers or recreational visitors. Burrowing or ground-dwelling mammals and invertebrates may be exposed directly to soil contaminants.
- **Inhalation**. Particulates from soil can be transported by air and inhaled by potential on-site and off-site receptors. Emissions of volatile chemicals from soil and groundwater may also be transported as vapors by air. Terrestrial biota could also be exposed to chemicals volatilizing to outdoor air, but if this exposure actually occurs, the duration of exposure would be expected to be relatively short. Burrowing animals (e.g., shrew) may be exposed to volatile air contaminants in underground stagnant air while spending time within the burrow.
- **Ingestion**. Ingestion of chemicals in soil is a primary exposure route for human and ecological receptors. Uptake by plants is also a potential exposure route.

Potentially complete exposure pathways include the following:

- Current/Future Outdoor Recreational User:
  - Inhalation of vapors from the subsurface (groundwater and soil) in outdoor air.
- Current/Future Construction/Utility Worker:
  - Incidental soil ingestion and dermal contact.
  - Inhalation of vapors from the subsurface soil in outdoor air.
  - Inhalation of vapors from or dermal contact with groundwater in a trench or excavation.

- Ecological Receptors:
  - Incidental soil ingestion and dermal contact in a burrow.
  - Inhalation of vapors from the subsurface soil in outdoor air or in a burrow.
  - Inhalation of vapors from or dermal contact with groundwater in a burrow.

2.5.4 Fate and Transport

The primary contaminant transport mechanisms are advection and dispersion caused by seepage of groundwater through the contaminated smear zone soils. Residual petroleum constituents may desorb from contaminated soil particles into groundwater and become transported in the downgradient direction where they may resorb to clean soil particles or continue to travel with the groundwater. Dissolved petroleum constituents are typically subject to biodegradation by naturally occurring soil bacteria. Low dissolved oxygen concentrations measured in site wells during the third quarterly sampling event suggest that sufficient oxygen is not available to support aerobic biodegradation (the most efficient biodegradation process).

Vapor migration from soil and/or groundwater is a potential transport mechanism at the site. The occurrence of such migration has not been established. In an outdoor park setting, soil vapors are expected to be rapidly diluted by ambient air currents and are not anticipated to present an exposure risk.

2.5.5 Assessment of Risk

Potential exposure pathways developed under the RI/FS (Parametrix 2011) include the following:

- Current/future outdoor recreational user:
  - Inhalation of vapors from the subsurface (groundwater and soil) in outdoor air
- Current/future construction/utility worker:
  - Incidental soil ingestion and dermal contact
  - Inhalation of vapors from the subsurface soil in outdoor air
  - Inhalation of vapors from or dermal contact with groundwater in a trench or excavation
- Ecological receptors
  - Incidental soil ingestion and dermal contact
  - Inhalation of vapors from the subsurface soil in outdoor air or in a burrow
  - Inhalation of vapors from or dermal contact with groundwater in a burrow.

Exposure to contaminants could occur via the complete exposure pathways described above. Based on the nature of the Site and the extent of contamination, current risks appear limited. The likely greatest potential risk to human receptors is to construction workers during soil-disturbing activities. The second most likely exposure risk is to outdoor recreational users and ecological receptors from inhalation of vapors from the outdoor air as the site's future development will be park space.

3. CLEANUP REQUIREMENTS

3.1 HUMAN HEALTH AND ENVIRONMENTAL CONCERNS

Current risks to human receptors at the site appear limited since residual contaminated soils are located at depths below 8 feet. These soils do not present a direct contact risk under a scenario consisting of recreational use at an outdoor park. Use of the site as an outdoor park also greatly reduces (or eliminates) the potential for exposure to soil vapors as compared to potential indoor exposures under a residential scenario. The apparent greatest potential risk to human receptors is to construction workers who may come into direct contact with contaminated soil during future excavation/trenching activities. Ecological receptors have a similar risk of exposure under this excavation scenario if deeper contaminated soils are deposited on or near the ground surface.

Groundwater is not currently used at the site nor is it likely to be under any potential future site use scenario. This is supported by MTCA 173-340-720(2)(d), which recognizes that, for sites with shallow groundwater in close proximity to marine water, there is an extremely low probability that groundwater will be used for drinking water. The groundwater may be classified as non-potable since the following conditions of 340-720(2)(d) are met:

340-720(2)(a) – The groundwater does not currently serve as a source of drinking water;

340-720(2)(c) – It is unlikely that hazardous substances will be transported from the contaminated groundwater to groundwater that is a current or potential source of drinking water;

340-720(2)(d)(ii) – There are known points of entry of the groundwater into the surface water;

340-720(2)(d)(iii) – The surface water is not classified as a suitable domestic water supply source under WAC 173-201A and;

340-720(2)(d)(iv) – The groundwater is sufficiently hydraulically connected to the surface water that the groundwater is not practicable to use as a drinking water source.

Risk posed by the groundwater to surface water pathway appear to be minimal. This observation is supported by the results of the sediment chemical and biological testing described in Section 2.3. As described, sediments adjacent to the site were tested during two separate sampling events and were shown to pass applicable SMS criteria. In addition, contaminant concentrations in three of six wells located adjacent to the shoreline are either not detectable or are below cleanup levels (Figure 8): wells MW-27, MW-26R, and MW22R. The remaining three wells (MW-21R, MW-13R, and MW-25) contain gasoline and benzene contamination at concentrations slightly to moderately above cleanup levels. Gasoline and benzene are relatively highly soluble and are expected to be diluted many times over as soon as they enter surface water.

Risks at the site can be mitigated by the establishing institutional controls for the property that prevent or control excavation activities within the contaminated soil and that prevent the use of groundwater for any purpose (see Section 4.2).

3.2 INDICATOR HAZARDOUS SUBSTANCES

Contaminants of concern (COCs) at the site remaining in site soils consist of:

- Benzene (up to 5.4 mg/kg),
- Ethylbenzene (up to 20 mg/kg),
- Total xylenes (up to 94 mg/kg), and
- Polycyclic aromatic hydrocarbons (PAHs; up to 2.7 mg/kg by toxicity equivalency method).

Contaminants of concern remaining in site groundwater consist of:

- Gasoline (up to 2,100 ug/L),
- Diesel (up to 1.3 mg/L), and
- Benzene (up to 310 ug/L).

3.3 CLEANUP LEVELS

Applicable cleanup levels for the site were established in the RI/FS and IA work plan (Parametrix 2007) and consist of:

MTCA Method A Soil Cleanup Levels for Unrestricted Land Use (WAC 173-340, Table 740-1).

MTCA Method A Cleanup Levels for Groundwater (WAC 173-340, Table 720-1).

MTCA Method A cleanup levels are listed in Table 4.

3.4 POINTS OF COMPLIANCE

WAC 173-340-200 defines "point of compliance" as the point or points where cleanup levels established shall be attained. Conditional points of compliance are allowed in instances where cleanup levels are not met at the standard point of compliance under the selected cleanup action. Points of compliance for soil and groundwater shall be established as follows:

Soil (Human Health): The point of compliance for protection of human health shall be established in the soils throughout the site. Per WAC 173-340-740(6)(f), Ecology recognizes that for cleanup actions that involve containment of hazardous substances, soil cleanup levels may not be met at the point of compliance. "Containment" in this case is achieved by the presence of a minimum of 8 feet of clean soils overlying the residual contaminated soils in the lower yard. Under future use as a park, these clean soils will be vegetated and/or paved and will act as a physical barrier to prevent direct human contact with contaminated soils. Under MTCA, the cleanup action may be determined to comply with cleanup requirements providing the action is protective of human health (173-340-740(6)(f)(ii)).

Soil (Terrestrial Ecological Receptors): For terrestrial ecological receptors, WAC 173-340-7490(4)(a) states that the biologically active zone may be assumed to extend to a depth of 6 feet. As previously stated, residual contaminated soil in the lower yard is located below the depth of 8 feet; thus the cleanup action is protective of terrestrial ecological receptors. A conditional point of compliance for protection of terrestrial ecological receptors shall be set at 6 feet bgs.

Groundwater: A conditional point of compliance for groundwater shall be set at the property boundary as allowed by WAC 173-340-720(8)(i). Monitoring points to establish whether or not cleanup levels are met shall be the downgradient monitoring wells MW-21R, MW-26R, MW-22R, MW-13R, MW-25, and MW-27.

3.5 APPLICABLE REGULATORY REQUIREMENTS

Cleanup actions under MTCA (WAC 173-340-710) require the identification of all applicable or relevant and appropriate requirements (ARARs). These requirements are defined as:

> "Applicable" requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site.
>
> "Relevant and appropriate" requirements means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site, address problems or situations sufficiently similar to those encountered at the site that their use is well suited to the particular site.

The potential ARARs for the site include three types: Chemical-specific, location-specific, and action-specific. Potential ARARs were identified for each medium of potential concern in Table 5.

4. SELECTED CLEANUP ACTION

IA activities performed at the site to date have resulted in a substantial reduction in contaminant mass. Natural attenuation is occurring at the site and should continue to reduce contaminant concentrations over time. The proposed future cleanup actions for the site include long-term groundwater monitoring to monitor groundwater concentrations and to verify that natural attenuation is continuing to occur. It is anticipated that, once groundwater concentrations reach cleanup levels at the point of compliance, groundwater monitoring will be discontinued. In addition to groundwater monitoring, institutional controls will be implemented to reduce exposure risk for contaminants remaining in site soil and groundwater.

4.1 LONG-TERM GROUNDWATER MONITORING

A detailed groundwater monitoring plan will be developed by the City following approval of this DCAP and finalization of the Cleanup Action Plan (CAP). A summary of the anticipated future groundwater monitoring plan is provided below.

- ***Summary of Proposed Long Term Groundwater Monitoring Plan*** – Groundwater monitoring will be conducted quarterly in all ten lower yard wells (MW-4R, MW-9R, MW-10R, MW-11, MW-13R, MW-21R, MW-22R, MW-25, MW-26R and MW-27) for an initial period of one year. The three upper yard wells (MW-16R, MW-18R, and MW-19R) will not be monitored since COCs were not detected above cleanup levels in these wells during four consecutive rounds of monitoring (Table 3). All samples will be analyzed for gasoline, BTEX, diesel, lube oil, field parameters, and natural attenuation parameters (Table 6). In addition, MW-9R will be analyzed for total and dissolved lead. At the completion of each quarterly sampling event, a technical memorandum will be prepared and submitted presenting the groundwater results. Following the four quarterly monitoring events, a summary report will be prepared and submitted. The summary report will include proposed changes to the monitoring program based on the initial years monitoring results. Proposed changes may include reduction in the total number of wells sampled or a reduction in the number of analytes. It is anticipated that follow on-sampling will consist of 2 years of semi-annual monitoring followed by two years of annual monitoring. However, the frequency, locations, and parameters will be finalized in consultation with Ecology based on the groundwater monitoring data. At the end of the initial 5-year monitoring period, a 5-year summary monitoring report will be prepared, which will include recommendations for any follow on monitoring. A proposed monitoring schedule is provided in Table 7.

4.2 INSTITUTIONAL CONTROLS

WAC 173-340-360(2)(e) requires cleanup actions to use institutional controls to limit or prohibit activities that may interfere with the integrity of a cleanup action or that may result in exposure of hazardous substances at a site. They are required to ensure the continued protection of human health and the environment and the integrity of the cleanup. Institutional controls may include physical measures (such as fences), restrictions on the use of the property, maintenance requirements for engineering controls (e.g., maintenance of caps), education programs, and financial assurances.

The following institutional controls are proposed for the site:

- ***Land Use Restrictions:*** A restrictive covenant (or Ecology-approved equivalent) will be executed by the City and recorded with the register of deeds for Kitsap County. At a minimum, the restrictive covenant will describe procedures to be followed during any future site excavation activities that could result in worker exposure or the transfer of contaminated soils to the ground surface. Such procedures shall include worker health and safety training requirements and contaminated soil management procedures. Use of site groundwater for any purpose will be prohibited. Future sites use shall be restricted to that of an outdoor recreational park. The restrictive covenant will also require that Ecology be notified of the City's intent to convey any interest in the site or to change land use from an outdoor recreational park to some other use. Final requirements for the restrictive covenant (or equivalent) will be negotiated by Ecology and the City.

4.3 SCHEDULE

Implementation of the CAP will begin once this DCAP is finalized. It is anticipated that the first plan elements (development of a Long Term Groundwater Monitoring Plan and Quarter 1 groundwater monitoring) will occur during the second quarter of 2012. A proposed project schedule is provided in Table 7.

4.4 FIVE-YEAR REVIEW

Due to the implementation of land use restrictions as part of the CAP, it is anticipated that the site will be entered in to Ecology's Environmental Covenant registry; this registry consists of cleanup sites with land use restrictions that are subject to review by Ecology every 5 years. The purpose of the review is to verify the effectiveness of ongoing cleanup measures such as natural attenuation and assess the continued effectiveness of any engineering controls and land use restrictions. Sites remain on the registry as long as the land use restrictions are required to protect human health and the environment.

5. ALTERNATIVES CONSIDERED AND BASIS FOR REMEDY SELECTION

5.1 INTERIM ACTION DEVELOPMENT

The IA approach used at the site was negotiated by the City and Ecology during discussions that led up to the establishment of the site's Agreed Order. Prior to these negotiations, four conventional cleanup approaches were developed and evaluated by the City (including cost estimates) for pre-purchase planning purposes (Parametrix 2005). Alternatives evaluated included monitored natural attenuation, capping, installation of a groundwater cutoff wall, and complete removal of contaminated soil by excavation. The preferred approach identified during this analysis consisted of an impermeable cap coupled with a groundwater cutoff wall.

During the AO negotiations, Ecology indicated that acceptable cleanup approaches included only those that would result in significant reduction/destruction of source contamination or its complete removal by excavation. Since none of the original approaches were acceptable, the City developed the IA approach used. This approach was proposed as an alternative to complete soil removal since this was estimated to be a prohibitively expensive option. The IA is intended to constitute a "permanent cleanup" as defined by MTCA in that cleanup standards will be met at the site without further action being required. Since the City and Ecology agreed to a permanent cleanup approach, a detailed evaluation of cleanup alternatives and the disproportionate cost analysis of WAC 173-340-360(3)(e) are not required per WAC 173-340-360 (3)(d).

A summary of estimated costs associated with the initial alternatives evaluated and the IA approach selected is provided as follows:

- Monitored Natural Attenuation – $260,000
- Impermeable Cap – $430,000
- Impermeable Cap and Groundwater Cut Off Wall – $850,000
- Complete Soil Excavation and Removal – $5,700,000
- In-Situ Chemical Oxidation and Hot Spot Soil Removal $980,000 (actual construction cost)

It may be observed from the above that the IA conducted provided a relatively high benefit to cost ratio as compared to the other alternatives.

5.2 MINIMUM REQUIREMENTS FOR CLEANUP ACTIONS

5.2.1 Threshold Requirements

MTCA requires that all cleanup actions meet the following threshold requirements to be considered viable (WAC 173-340-360[2][a]):

- **Protection of Human Health and the Environment:** The IA will meet this requirement through source reduction in soils and meeting the cleanup levels for groundwater at the conditional point of compliance established for the site (see Section 4.2). The protectiveness of the remedy will be maintained through the use of institutional controls.

- **Compliance with Cleanup Standards:** This requirement will be met through the actions described under "Protection of Human Health and the Environment" above.
- **Compliance with ARARs:** In addition to meeting cleanup standards, compliance requires that the cleanup actions also meet location-specific and action-specific state and federal requirements (see Table 5). The IA was designed and implemented to meet the requirements of this threshold criterion.
- **Provision for Compliance Monitoring:** This requirement was met in part by the confirmational soil and groundwater samples collected during and following the IA. Continued groundwater monitoring through a long-term groundwater monitoring program (to be implemented) will complete this requirement.

5.3 OTHER REQUIREMENTS

In addition to the threshold requirements, WAC 173-340-360(2) requires cleanup actions to meet "other requirements" that are part of the minimum requirements for cleanup actions. These other requirements include the following:

- **Use Permanent Solutions to the Maximum Extent Practicable:** The IA meets this requirement by reducing or eliminating the sources of petroleum at the site. As described in the IA Report (Parametrix 2010), a total of 1,644 tons of contaminated soil were excavated and removed from the site. In addition, an approximate total of 3,900 cubic yards of contaminated soil were treated in situ using RegenOx and ORC. Based on post-IA soil testing, the average mass reduction achieved for gasoline, diesel, and lube oil was 78 percent, 88 percent, and 40 percent respectively.
- **Provide for a Reasonable Restoration Timeframe:** Significant reductions in soil and groundwater contaminant concentrations were achieved during the IA. The supplemental ORC injection event is expected to result in continued reductions in both soil and groundwater concentrations. Once the ORC is expended (within approximately one year from the date of injection), natural attenuation of contamination should continue at the site, although at a slower rate. A 5-year restoration time frame is estimated based on anticipated performance of the ORC and follow-on natural attenuation. The cleanup actions performed at the site to date provide for a reasonable restoration time per WAC 173-340-360(4) since they address the factors described in 173-340-360(4)(b) as follows:
  - 173-340-360(4)(b)(i) – Potential risks posed by the site to human health and the environment are minimal.
  - 173-340-360(4)(b)(ii) – The practicality of achieving a shorter restoration timeframe was addressed during the consideration of preliminary alternatives described Section 4.1 above. Achieving a shorter time frame would involve a prohibitively expensive alternative such as complete excavation and removal.
  - 173-340-360(4)(b)(iii/ iv) – Releases from the site are not expected to affect resources that are associated with current and future uses of the site and surrounding areas.
  - 173-340-360(4)(b)(v) – Alternative water supplies at the site are available (City water utility).
  - 173-340-360(4)(b)(vi) – Institutional controls are expected to be highly effective at the site.

- 173-340-360(4)(b)(vii) – Control and monitoring of migration of hazardous substances from the site is easily achievable.
- 173-340-360(4)(b)(viii) – The toxicity of hazardous substances at the site is relatively low.
- 173-340-360(4)(b)(ix) – Natural processes such as natural attenuation have been documented as occurring at the site.

- **Consider Public Concerns:** The RI/FS and IA Work Plan (Parametrix 2007) was made available for public comment prior to final approval by Ecology. No substantive public comments were received.

6. REFERENCES

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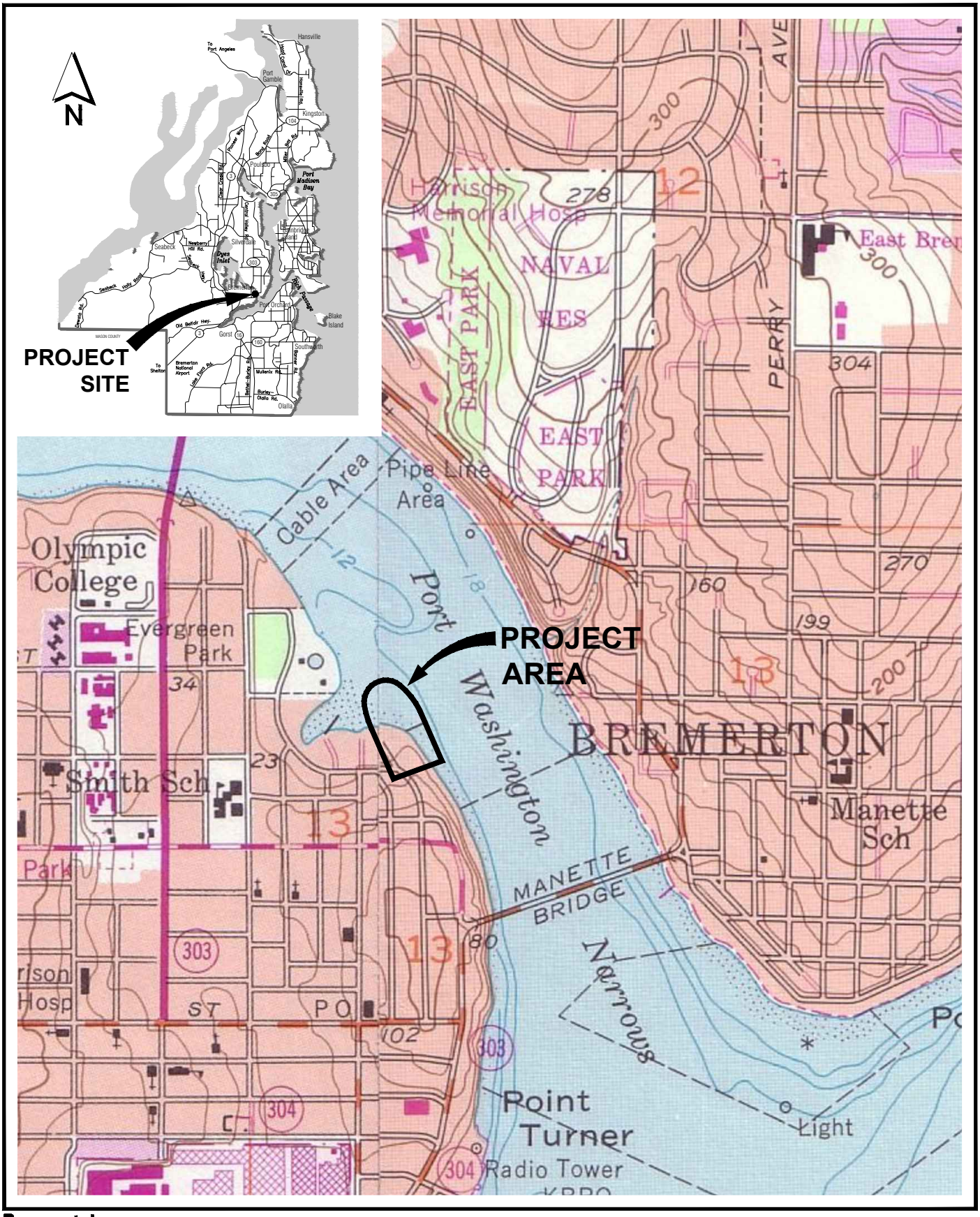
PEG (Pacific Environmental Group, Inc.). 1994. Supplemental environmental site assessment, decommissioned Chevron Bulk Terminal No. 61001351, 1301 Highland Avenue, Bremerton Washington. Prepared for Chevron U.S.A. March.

FIGURES



Parametrix DATE: Oct 03, 2011 FILE: BR1896063P04T1304 098 F01

N

0 1000

SCALE IN FEET

Figure 1
Former Chevron Property DCAP
Project Vicinity

Parametrix DATE: Oct 03, 2011 FILE: BR1896063P04T1304 098 F02

0 N

NO SCALE

Figure 2
Former Chevron Property DCAP
1963 Aerial Photograph

Parametrix DATE: Oct 03, 2011 FILE: BR1896063P04T1304 098 F02

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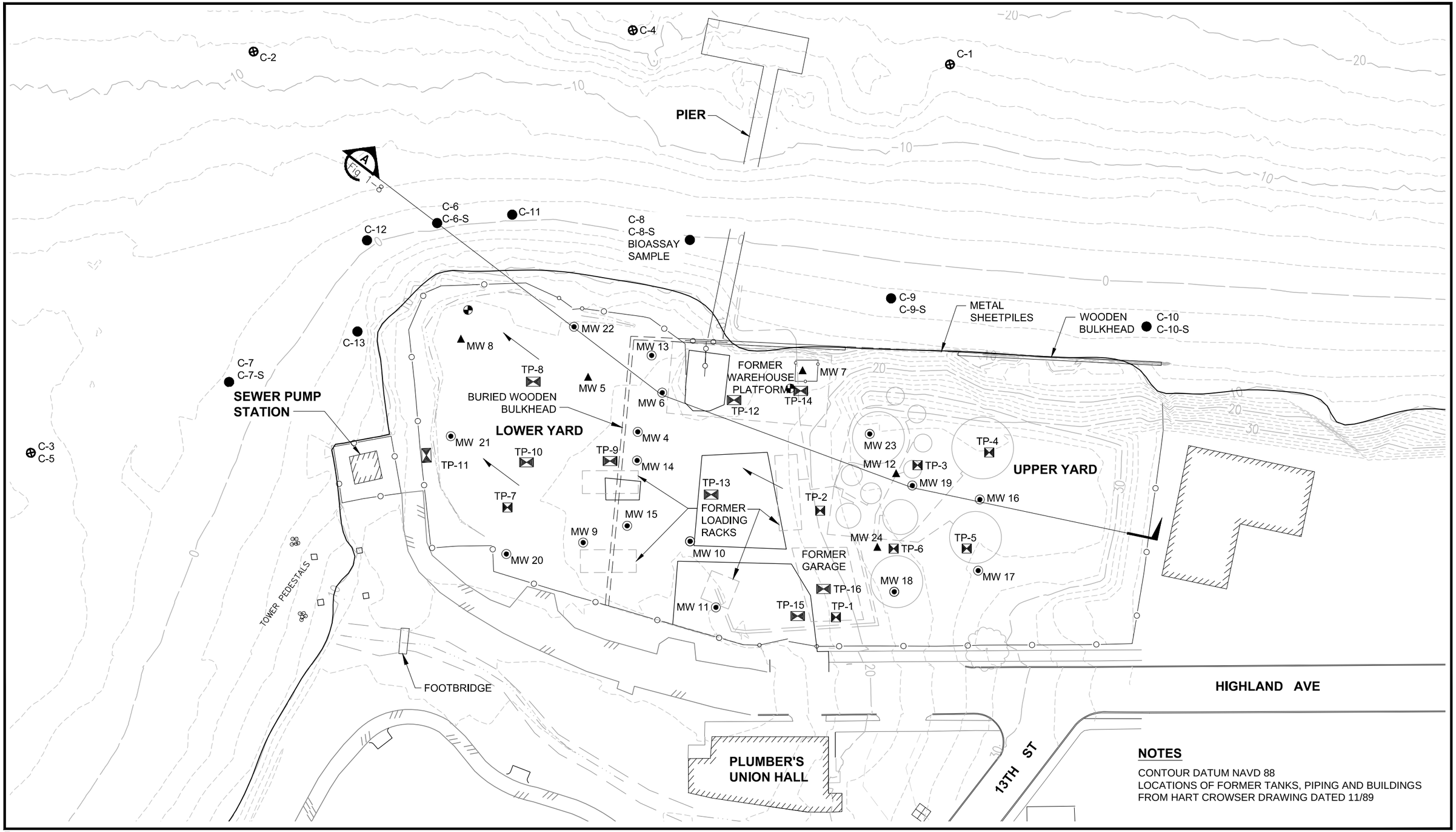
Figure 3
Former Chevron Property DCAP
CIRCA 2005 Aerial Photograph



NOTES

CONTOUR DATUM NAVD 88
LOCATIONS OF FORMER TANKS, PIPING AND BUILDINGS
FROM HART CROWSER DRAWING DATED 11/89

Parametrix DATE: Oct 03, 2011 FILE: BR1896063P04T1304 098 F04

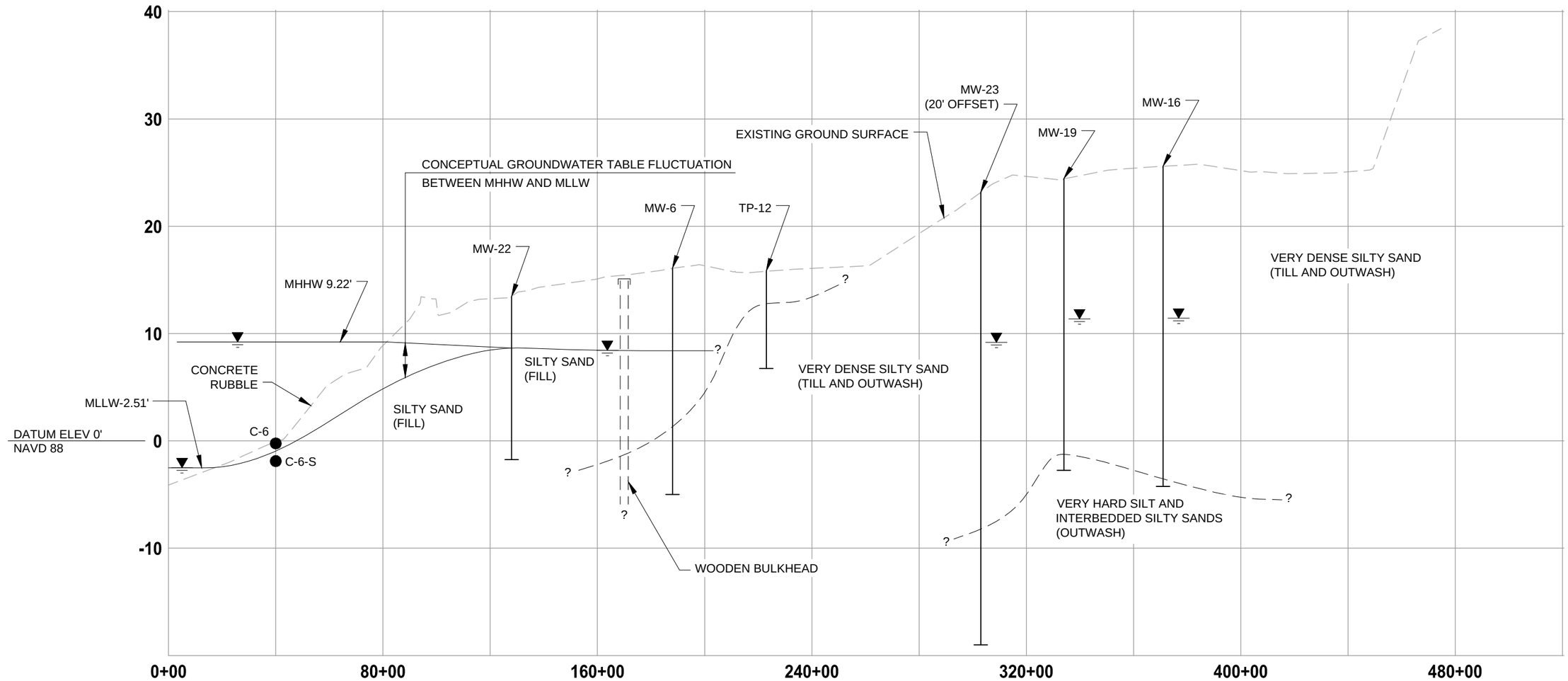
N

0 50
SCALE IN FEET

LEGEND

- INTERTIDAL SEDIMENT SAMPLE
- SUBTIDAL SEDIMENT SAMPLE
- EXISTING MONITORING WELL
- TEST PIT , GEO ENGINEERS 1988
- TEST PIT, HART CROWSER 1989
- DESTROYED MONITORING WELL
- EXISTING CONCRETE PAD
- EXISTING BUILDING
- CHAIN LINK FENCE
- DRAINAGE DITCH
- FORMER PIPING/BUILDING/ LOADING RACK
- C-6 SURFACE SEDIMENT SAMPLE
- C-6-S SEDIMENT SAMPLE COLLECTED AT 2 FT DEPTH
- FORMER ABOVEBROUND STORAGE TANK
- GENERAL GROUNDWATER FLOW DIRECTION

Figure 4
Former Chevron Property DCAP
Historical Site Features



SECTION A

HORIZ: 1"=40'
VERT: 1"=10'

Parametrix DATE: Oct 03, 2011 FILE: BR1896063P04T1304 098 F05

NOTES:

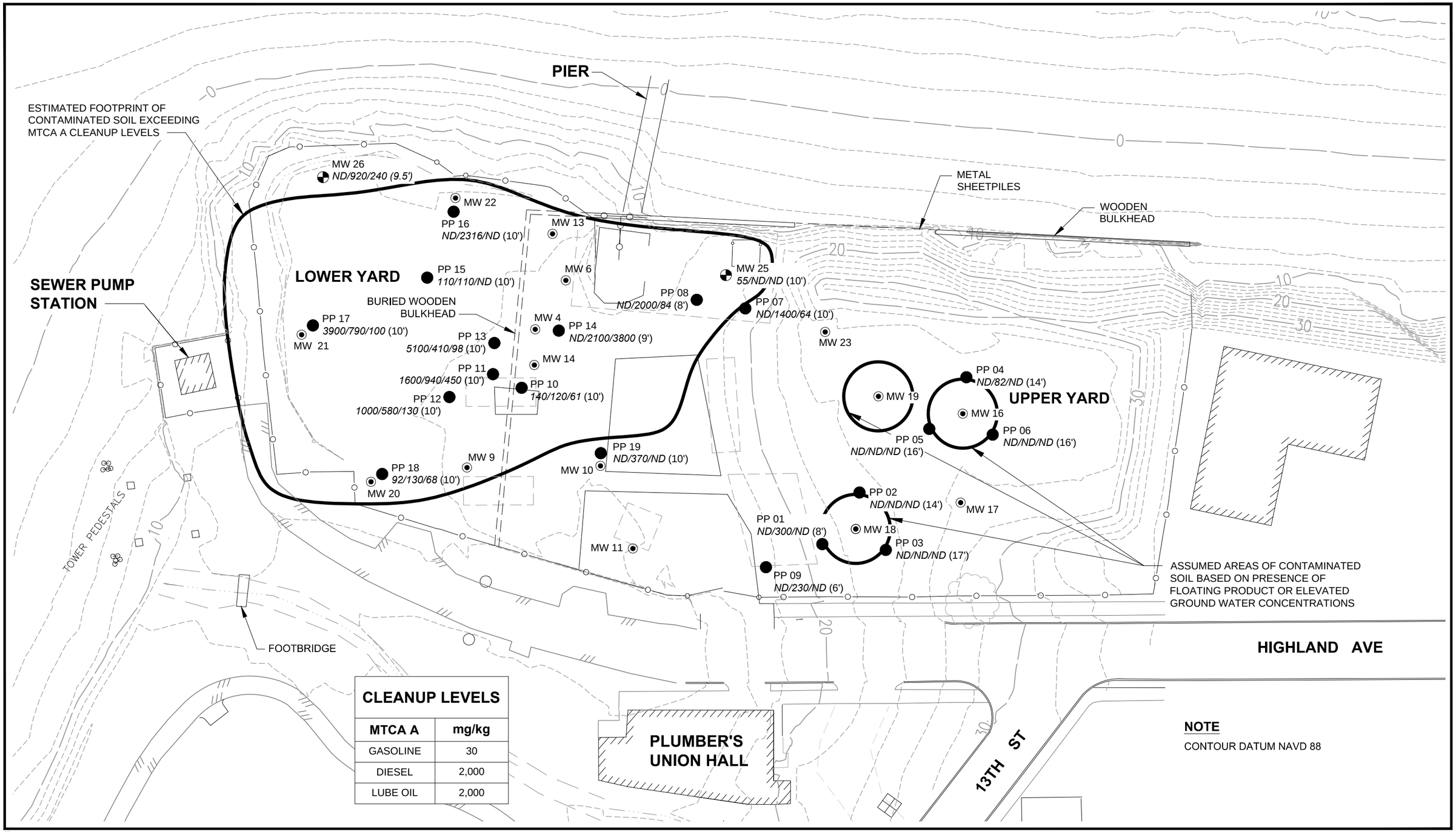
MEAN HIGHER HIGH WATER (MHHW) AND MEAN LOWER LOW WATER (MLLW) ELEVATIONS OBTAINED FROM NOAA RECORDS FOR TIDAL STATION BREMERTON, WA, ID NO. 9445958

LEGEND

▼ GROUNDWATER TABLE ELEVATION MEASURED 10/24/06

● SEDIMENT SAMPLES

Figure 5
Former Chevron Property DCAP
Section A



CLEANUP LEVELS

MTCA A	mg/kg
GASOLINE	30
DIESEL	2,000
LUBE OIL	2,000

NOTE

CONTOUR DATUM NAVD 88

Parametrix DATE: Oct 03, 2011 FILE: BR1896063P04T1304 098 F06

N

0 40

SCALE IN FEET

LEGEND

- EXISTING BUILDING
- CHAIN LINK FENCE
- DRAINAGE DITCH
- *ND* NOT DETECTED
- EXISTING MONITORING WELL
- NEW RI/FS PUSH PROBE
- RI/FS MONITORING WELL
- *ND/920/240* (9.5') RI/FS SOIL RESULTS FOR: *GASOLINE/DIESEL/LUBE OIL* (SAMPLE DEPTH) RESULTS IN mg/kg

Figure 6
Former Chevron Property DCAP
RI/FS Subsurface
Soil Sampling Locations

PIER

ESTIMATED CONTAMINATED GROUNDWATER PLUME EXCEEDING MTCA A CLEANUP LEVELS

METAL SHEETPILES

WOODEN BULKHEAD

MW 22
ND/ND/ND (7.9')

MW 26
1300/1300/ND (9.0')

MW 13

MW 6

MW 25
1600/1200/ND (8.3')

LOWER YARD

SEWER PUMP STATION

BURIED WOODEN BULKHEAD

MW 4
5400/27000/2300 (12')
(SAMPLE HIGHLY TURBID)

MW 21
9200/1700/ND (8.9')

MW 14

MW 23
530/ND/ND (20.5')

MW 19
ND/8100/ND (10.9')

MW 16

UPPER YARD

MW 20
ND/ND/ND (7.5')

MW 9

MW 10
ND/160,000/ND (8.4')

MW 17

MW 18

MW 11
ND/270/ND (6.9')

TOWER PEDESTALS

FOOTBRIDGE

HIGHLAND AVE

13TH ST

PLUMBER'S UNION HALL

CLEANUP LEVELS

MTCA A	ug/L
GASOLINE	800
DIESEL	500
LUBE OIL	500

NOTE

CONTOUR DATUM NAVD 88

Parametrix DATE: Oct 03, 2011 FILE: BR1896063P04T1304 098 F07

N

0 40

SCALE IN FEET

LEGEND

EXISTING BUILDING

CHAIN LINK FENCE

DRAINAGE DITCH

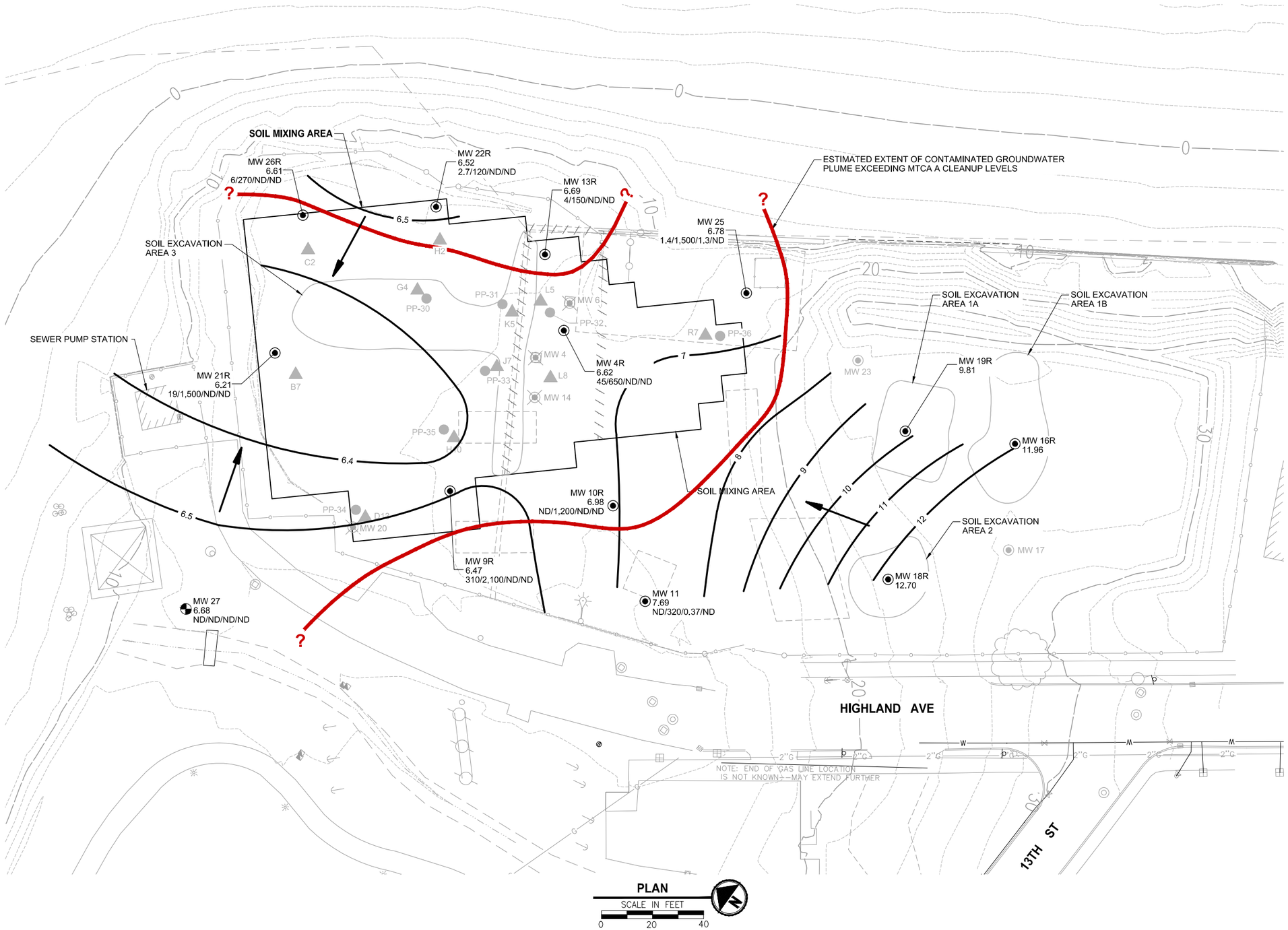
ND NOT DETECTED

EXISTING MONITORING WELL

RI/FS MONITORING WELL

ND/920/240 (10') RI/FS GROUNDWATER RESULTS FOR: *GASOLINE/DIESEL/LUBE OIL* (GROUNDWATER DEPTH BELOW TOP OF WELL CASING) RESULTS IN ug/L

Figure 7
Former Chevron Property DCAP
RI/FS Groundwater
Sampling Locations



LEGEND

- EXISTING CHAIN LINK FENCE
- EXISTING MONITORING WELL
- SOIL MIXING AREA CONFIRMATION SOIL SAMPLE LOCATION (DEPTH)
- PUSH-PROBE LOCATION
- SOIL EXCAVATION AREA
- MW 14 — WELL DESTROYED DURING INTERIM ACTION
- MW 19R — QUARTERLY MONITORING WELL LOCATION
- R — INDICATES REPLACEMENT WELL INSTALLED FOR PERFORMANCE MONITORING
- 10 — GROUNDWATER ELEVATION
- GROUNDWATER FLOW DIRECTION
- 15.11 — GROUNDWATER ELEVATION AT TIME OF SAMPLING
- ESTIMATED CONTAMINATED GROUNDWATER PLUME EXCEEDING MTCA A CLEANUP LEVELS
- 19/1,500/ND/ND — GW RESULTS FOR BENZENE GASOLINE/DIESEL/LUBE OIL RESULTS IN ug/L
- NEW WELL INSTALLED FOR PERFORMANCE MONITORING IN MARCH 2011
- ND — NOT DETECTED

GENERAL NOTES:

1. CONTOUR DATUM NAVD 88

CLEANUP LEVELS	
MTCA A	ug/L
BENZENE	5
GASOLINE	800
DIESEL	500
LUBE OIL	500

REVISIONS

NO.	DESCRIPTION	DATE	BY

ENGINEER STAMP

0 1" 2"
TWO INCHES AT FULL SCALE
IF NOT SCALE ACCORDINGLY

SCALE
HORIZ. 1"=20' VERT. N/A

FIELD BOOK

DRAWING NO. 3

CITY OF BREMERTON
DEPARTMENT OF PUBLIC WORKS & UTILITIES
ENGINEERING DIVISION

DRAWN BY: SBR
DATE 9/10

DESIGN BY: DLD
WASH. P.E. #
DATE 4/10

CHECKED BY:
WASH. P.E. #
DATE

FORMER CHEVRON PROPERTY DCAP
SAMPLING RESULTS
SEPTEMBER 2011

FIG. NO. 8

PN: 255-1896-063

SHEET
OF

BREMERTON BOARDWALK PROJECT

FILE: BR189606JP041304 098 F17a
DATE: Dec 15, 2011 - 10:20am PLOTTED BY: rasmuste
IMAGES: Chevron Property FIG1
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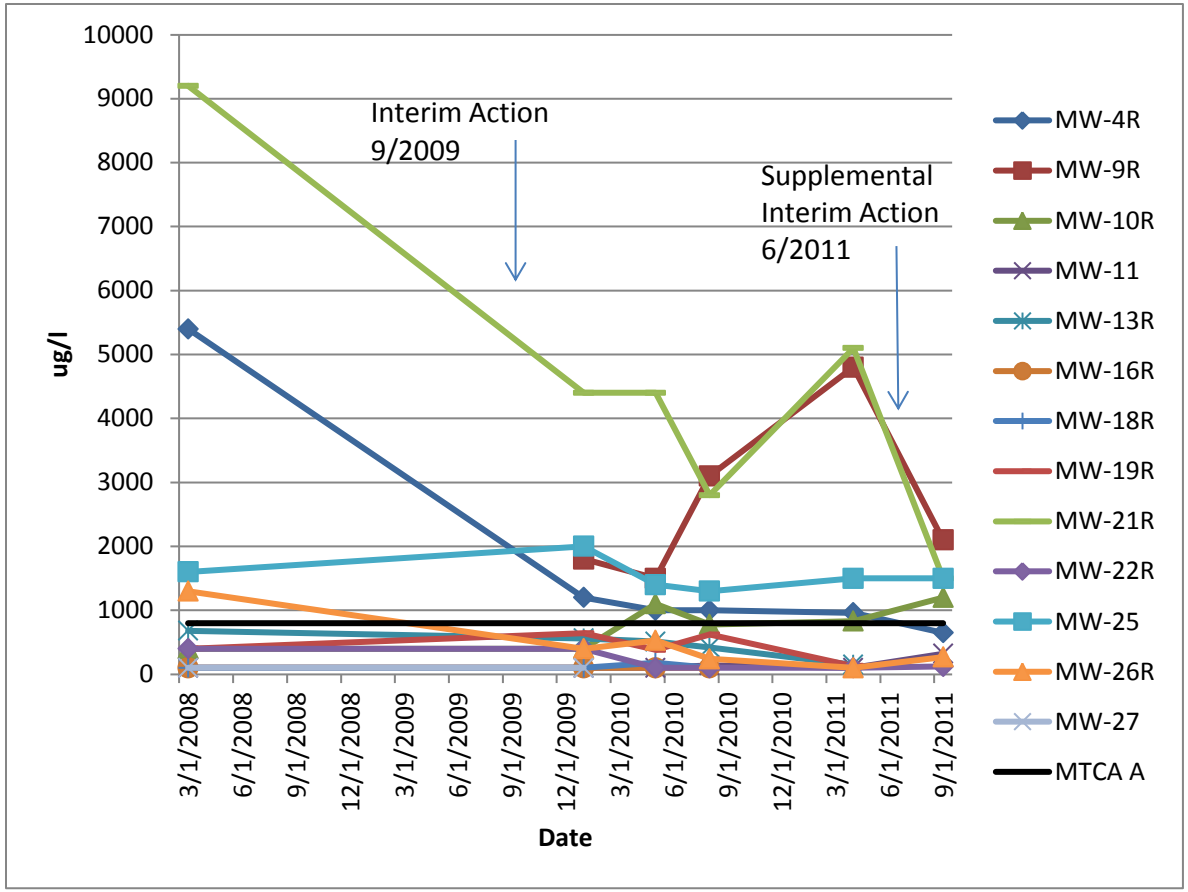

Figure 9. Gasoline Results – RI and Performance Monitoring

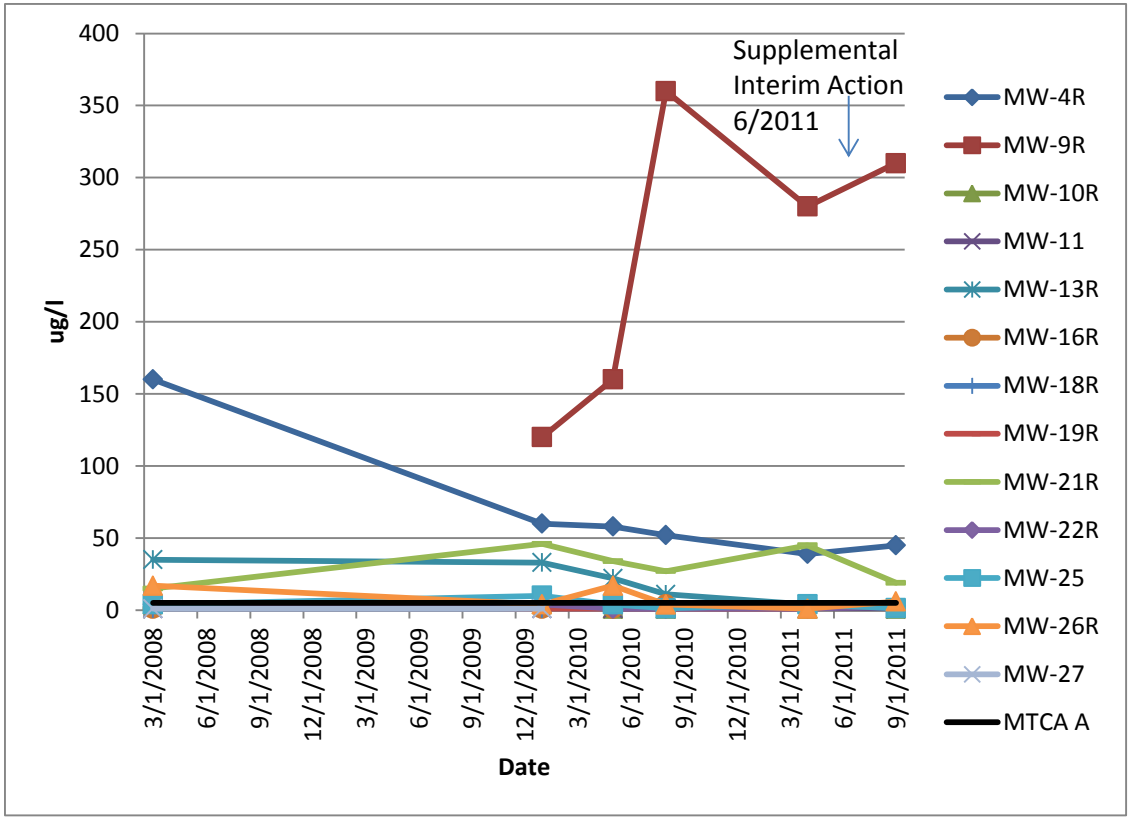

Figure 10. Benzene Results – RI and Performance Monitoring

LEGEND

	EXISTING CHAIN LINK FENCE
	EXISTING MONITORING WELL
	SOIL EXCAVATION AREA
MW 23	WELL DECOMMISSIONED DURING INTERIM ACTION
MW 19R	QUARTERLY MONITORING WELL LOCATION
R	INDICATES REPLACEMENT WELL INSTALLED FOR POST TREATMENT GROUNDWATER MONITORING

GENERAL NOTES:

1. CONTOUR DATUM NAVD 88

SOURCE: PARAMETRIX 2010 DRAFT RI/FS REPORT.
FIG 3-7 3RD QUARTER GROUNDWATER CONTOURS AUG 2010

REVISIONS			
NO.	DESCRIPTION	DATE	BY

ENGINEER STAMP

0 1" 2"
TWO INCHES AT FULL SCALE
IF NOT SCALE ACCORDINGLY

SCALE
HORIZ. 1"=20' VERT. N/A

FIELD BOOK

DRAWING NO. 3

CITY OF BREMERTON
DEPARTMENT OF PUBLIC WORKS & UTILITIES
ENGINEERING DIVISION

DRAWN BY: SBR
DATE 3/11

DESIGN BY: DLD
WASH. P.E. # DATE 3/11

CHECKED BY:
WASH. P.E. # DATE

FORMER CHEVRON PROPERTY DCAP
AIR SAMPLE LOCATIONS

FIG. NO. 11

PN: 255-1896-063

SHEET OF

BREMERTON BOARDWALK PROJECT

FILE: BR189606 3P041304 098 F14
DATE: Oct 03, 2011 – 8:38am PLOTTED BY: peterjul
IMAGES: Chevron Property FIG1 |
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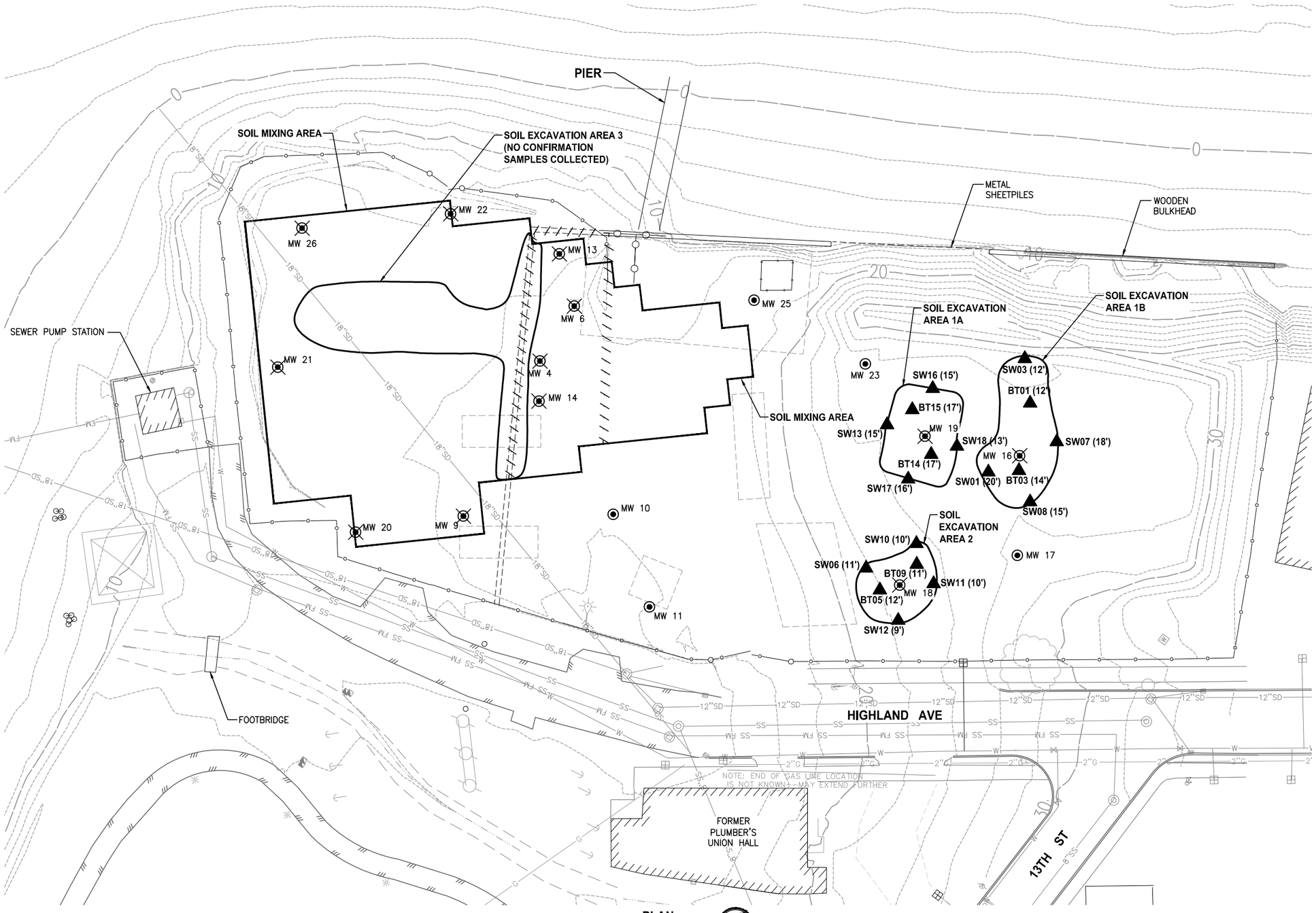

LEGEND

- EXISTING BUILDING
- EXISTING CHAIN LINK FENCE
- MW 10 — EXISTING MONITORING WELL
- REMOVED MONITORING WELL
- BT01 (10') — CONFIRMATION SOIL SAMPLE LOCATION (DEPTH)
- SOIL EXCAVATION AREA

GENERAL NOTES:

1. CONTOUR DATUM NAVD 88

BT BOTTOM SAMPLE

SW SIDEWALL SAMPLE

PLAN

SCALE IN 1"=20'

0 20 40

REVISIONS			
NO.	DESCRIPTION	DATE	BY

ENGINEER STAMP

0 1" 2"

TWO INCHES AT FULL SCALE IF NOT SCALE ACCORDINGLY

SCALE

HORIZ. 1"=20' VERT. N/A

FIELD BOOK

DRAWING NO. 1

CITY OF BREMERTON

DEPARTMENT OF PUBLIC WORKS & UTILITIES

ENGINEERING DIVISION

DRAWN BY: SBR DATE 10/09

DESIGN BY: DD WASH. P.E. # DATE 10/09

CHECKED BY: WASH. P.E. # DATE

FORMER CHEVRON PROPERTY DCAP
INTERIM ACTION
SOIL EXCAVATION AREAS

FIG. NO. 12

PN: 255-1896-063

SHEET 1 OF 1

BREMERTON BOARDWALK PROJECT

FILE: BR189606 3P0411304_098 F08
DATE: Oct 03, 2011 – 8:39am PLOTTED BY: peterjil

IMAGES: Chevron Property FIG1 |
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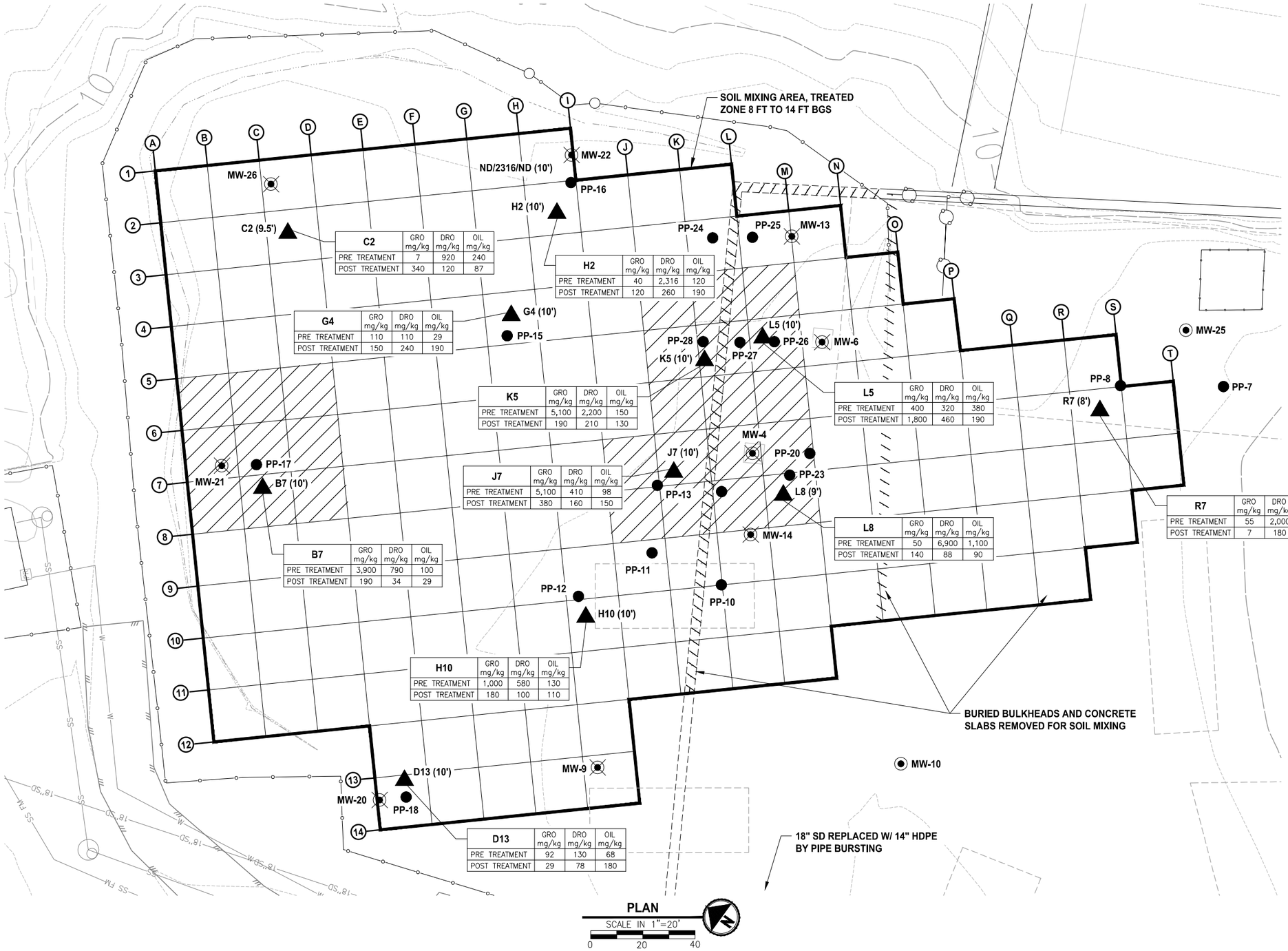

C2	GRO mg/kg	DRO mg/kg	OIL mg/kg
PRE TREATMENT	7	920	240
POST TREATMENT	340	120	87

H2	GRO mg/kg	DRO mg/kg	OIL mg/kg
PRE TREATMENT	40	2,316	120
POST TREATMENT	120	260	190

G4	GRO mg/kg	DRO mg/kg	OIL mg/kg
PRE TREATMENT	110	110	29
POST TREATMENT	150	240	190

K5	GRO mg/kg	DRO mg/kg	OIL mg/kg
PRE TREATMENT	5,100	2,200	150
POST TREATMENT	190	210	130

L5	GRO mg/kg	DRO mg/kg	OIL mg/kg
PRE TREATMENT	400	320	380
POST TREATMENT	1,800	460	190

J7	GRO mg/kg	DRO mg/kg	OIL mg/kg
PRE TREATMENT	5,100	410	98
POST TREATMENT	380	160	150

R7	GRO mg/kg	DRO mg/kg	OIL mg/kg
PRE TREATMENT	55	2,000	98
POST TREATMENT	7	180	150

L8	GRO mg/kg	DRO mg/kg	OIL mg/kg
PRE TREATMENT	50	6,900	1,100
POST TREATMENT	140	88	90

B7	GRO mg/kg	DRO mg/kg	OIL mg/kg
PRE TREATMENT	3,900	790	100
POST TREATMENT	190	34	29

H10	GRO mg/kg	DRO mg/kg	OIL mg/kg
PRE TREATMENT	1,000	580	130
POST TREATMENT	180	100	110

D13	GRO mg/kg	DRO mg/kg	OIL mg/kg
PRE TREATMENT	92	130	68
POST TREATMENT	29	78	180

LEGEND

PP-11	RI/FS PUSH-PROBE LOCATION
MW-10	EXISTING MONITORING WELL
B7(10')	CONFIRMATION SAMPLE LOCATION AND DEPTH
	TREATMENT CELL-BASLINE DOSE (10LB/CY REGENOX)
	AGGRESSIVE DOSE TREATMENT AREA (20LB/CY REGENOX)
	MONITORING WELL REMOVED FOR SOIL MIXING
GRO	GASOLINE RANGE ORGANICS
DRO	DIESEL RANGE ORGANICS
OIL	LUBE OIL RANGE ORGANICS
mg/kg	MILLIGRAMS PER KILOGRAM
400	SAMPLE RESULT IN mg/kg

CLEANUP LEVELS	
MTCA A	mg/kg
GASOLINE	30
DIESEL	2,000
LUBE OIL	2,000

REVISIONS

NO.	DESCRIPTION	DATE	BY

ENGINEER STAMP

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TWO INCHES AT FULL SCALE IF NOT SCALE ACCORDINGLY

SCALE
HORIZ. 1"=10' VERT. N/A

FIELD BOOK

DRAWING NO. 2

CITY OF BREMERTON
DEPARTMENT OF PUBLIC WORKS & UTILITIES
ENGINEERING DIVISION

DRAWN BY: JLP DATE 4/10
DESIGN BY: DLD WASH. P.E. # DATE 4/10
CHECKED BY: WASH. P.E. # DATE

FORMER CHEVRON PROPERTY DCAP
INTERIM ACTION
SOIL MIXING AREA AND
CONFIRMATION SAMPLE RESULTS

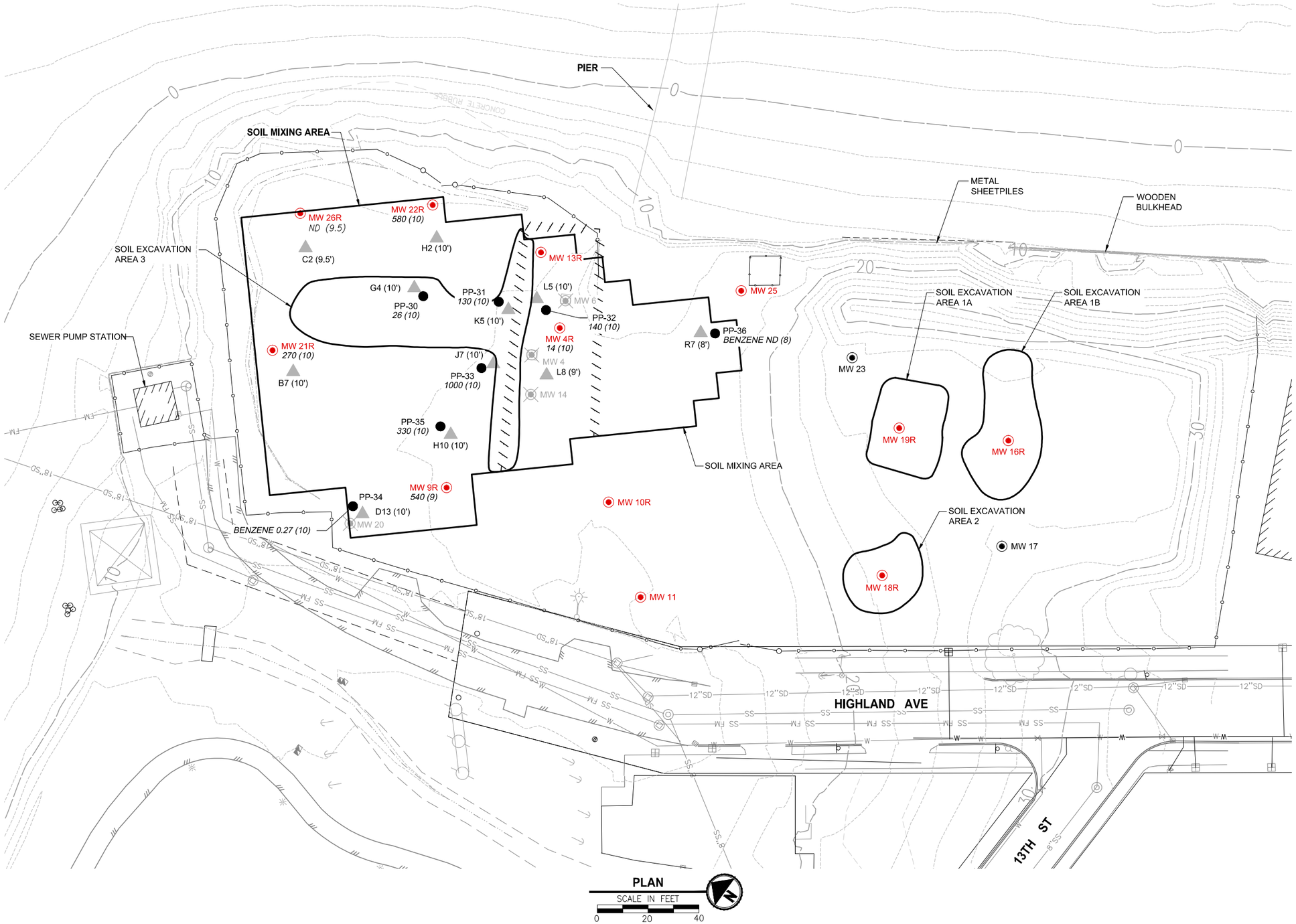
FIG. NO. 13

PN: 255-1896-063

SHEET 1 OF 1

BREMERTON BOARDWALK PROJECT

FILE: BR189606.3P041304.098 F09
DATE: Oct 03, 2011 - 8:45am PLOTTED BY: peterjul
IMAGES: Chevron Property FIG1
XREFS: XB-BREM_WTRFRNT-BA-SV-061201 | XBR189606.3P041301F-BA



LEGEND

	EXISTING CHAIN LINK FENCE
	EXISTING MONITORING WELL
H2 (10')	SOIL MIXING AREA CONFIRMATION SOIL SAMPLE LOCATION (DEPTH)
	PUSH-PROBE LOCATION
	SOIL EXCAVATION AREA
MW 14	WELL DESTROYED DURING INTERIM ACTION
MW 19R	WELL INCLUDED IN CONFIRMATION SAMPLING PROGRAM
R	INDICATES REPLACEMENT WELL INSTALLED FOR POST TREATMENT GROUNDWATER MONITORING
540	GASOLINE OR BENZENE CONCENTRATION IN mg/kg
ND	NOT DETECTED
mg/kg	MILLIGRAMS PER KILOGRAM
(6)	SAMPLE DEPTH IN FEET

GENERAL NOTES:

1. CONTOUR DATUM NAVD 88

CLEANUP LEVELS	
MTCA A	mg/kg
GASOLINE	30
BENZENE	0.03

REVISIONS			
NO.	DESCRIPTION	DATE	BY

ENGINEER STAMP

0 1" 2"
TWO INCHES AT FULL SCALE
IF NOT SCALE ACCORDINGLY

SCALE
HORIZ. 1"=20' VERT. N/A

FIELD BOOK

DRAWING NO. 3

CITY OF BREMERTON
DEPARTMENT OF PUBLIC WORKS & UTILITIES
ENGINEERING DIVISION

DRAWN BY: JLP
DATE 4/10

DESIGN BY: DLD
WASH. P.E. #
DATE 4/10

CHECKED BY:
WASH. P.E. #
DATE

FORMER CHEVRON PROPERTY DCAP
INTERIM ACTION
WELL LOCATION PLAN AND
6-MONTH POST TREATMENT SOIL RESULTS

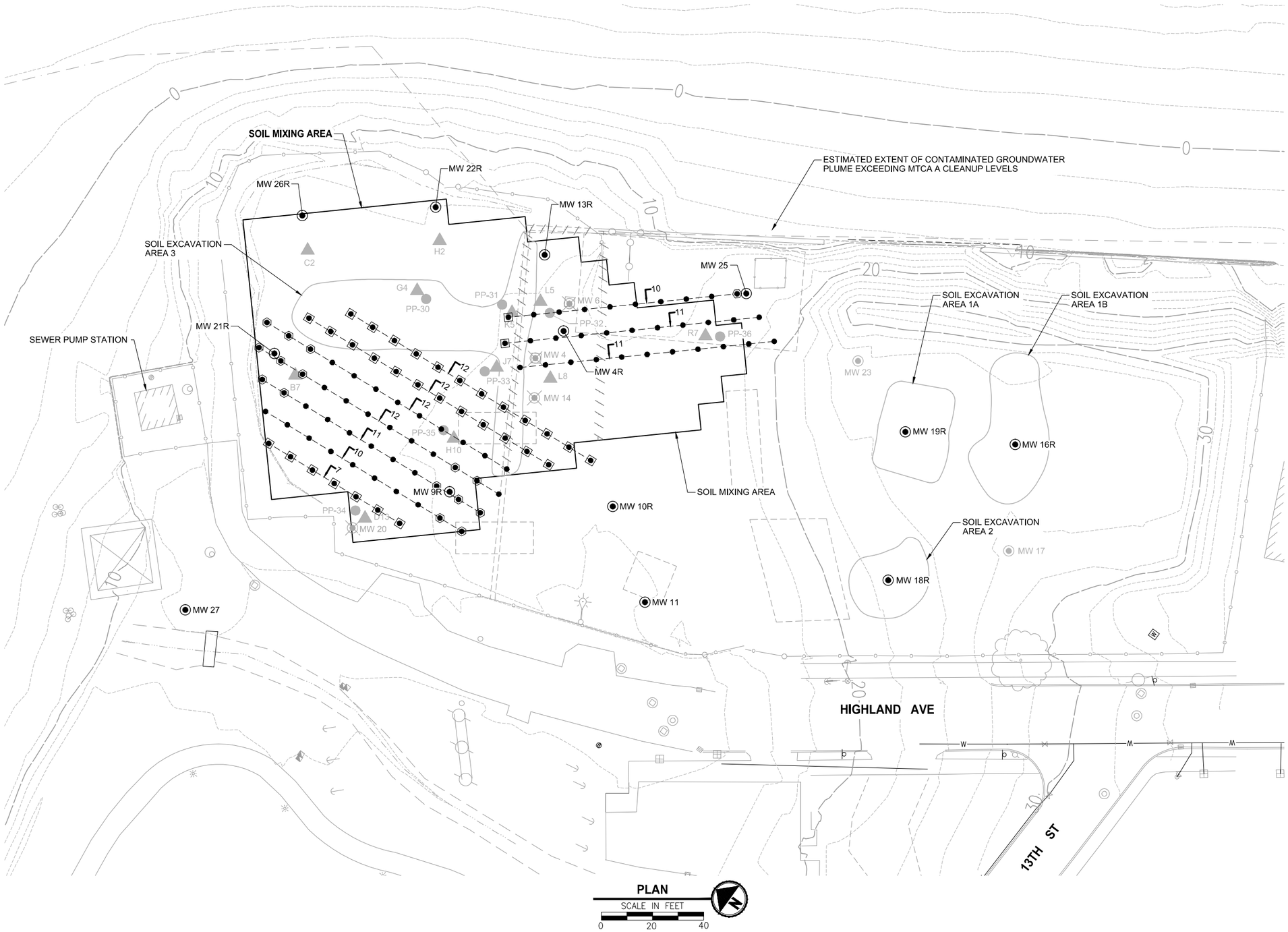
FIG. NO. 14

PN: 255-1896-063

SHEET 1 OF 1

BREMERTON BOARDWALK PROJECT

FILE: BR189606.3P041304 098 F10
DATE: Oct 03, 2011 – 8:46am PLOTTED BY: peterjul
IMAGES:
XREF'S: XB-BREM_WTRFRNT-BA-SV-061201 | XB-BREM_WTRFRNT-BA-SV-061201



LEGEND

- EXISTING CHAIN LINK FENCE
- EXISTING MONITORING WELL
- SOIL MIXING AREA CONFIRMATION SOIL SAMPLE LOCATION (DEPTH)
- PUSH-PROBE LOCATION
- SOIL EXCAVATION AREA
- MW 14 — WELL DESTROYED DURING INTERIM ACTION
- MW 19R — QUARTERLY MONITORING WELL LOCATION
- R — INDICATES REPLACEMENT WELL INSTALLED FOR POST TREATMENT GROUNDWATER MONITORING
- STANDARD DOSAGE
- DOUBLE DOSAGE
- HALF DOSAGE

GENERAL NOTES:

1. CONTOUR DATUM NAVD 88
2. APPLIED STANDARD DOSAGE RATE WAS 65 LBS ORC PER INJECTION POINT.

REVISIONS			
NO.	DESCRIPTION	DATE	BY

ENGINEER STAMP

0 1" 2"
TWO INCHES AT FULL SCALE IF NOT SCALE ACCORDINGLY

SCALE
HORIZ. 1"=20' VERT. N/A

FIELD BOOK

DRAWING NO. 3

CITY OF BREMERTON
DEPARTMENT OF PUBLIC WORKS & UTILITIES
ENGINEERING DIVISION

DRAWN BY: SBR
DATE 9/10
DESIGN BY: DLD
WASH. P.E. #
DATE 4/10
CHECKED BY:
WASH. P.E. #
DATE

FORMER CHEVRON PROPERTY DCAP
ORC INJECTION AS-BUILT
APRIL 2011

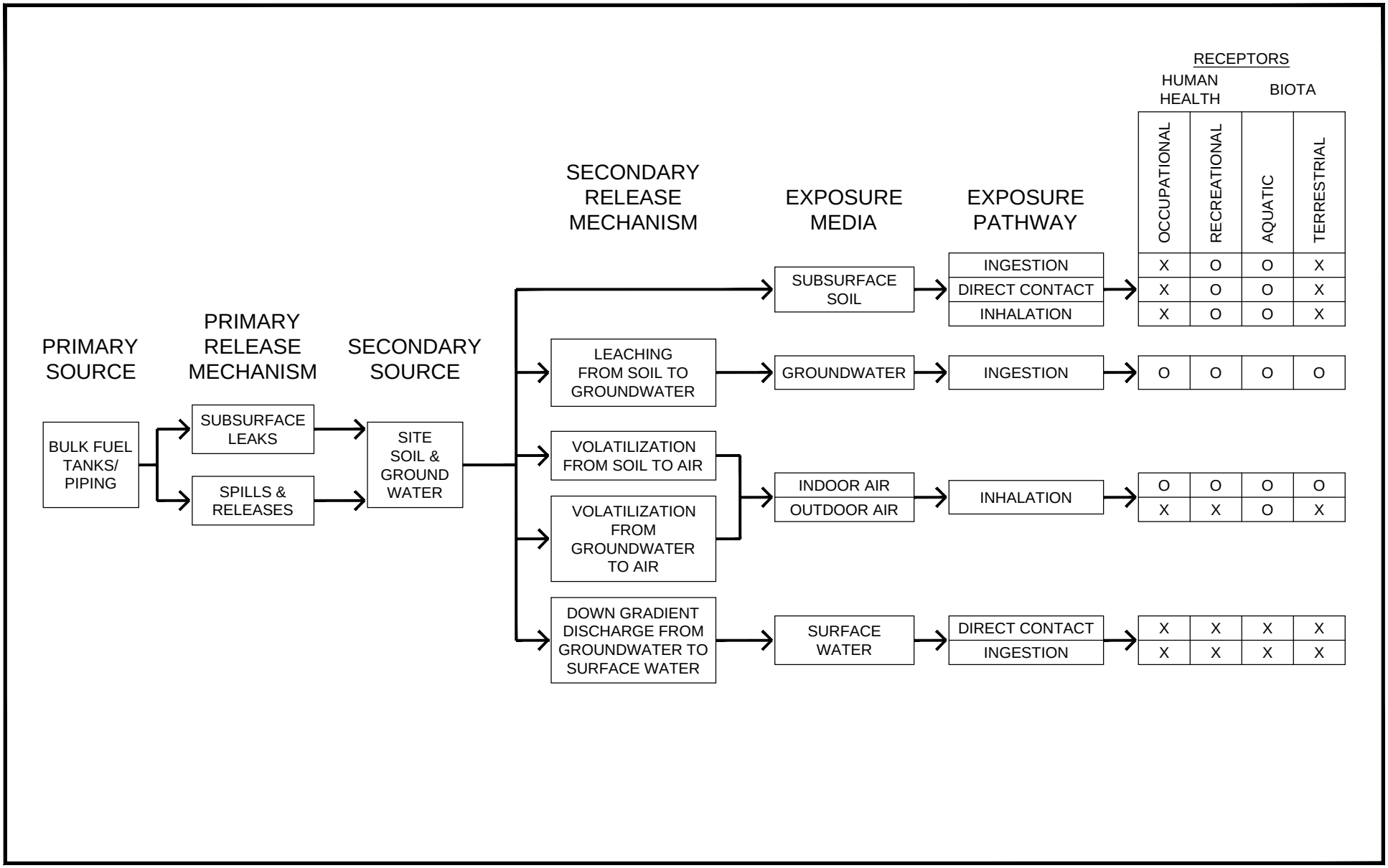
FIG. NO. 15

PN: 255-1896-063

SHEET OF

BREMERTON BOARDWALK PROJECT

FILE: BR189606 3P041304 098 F15
DATE: Oct 03, 2011 – 8:50am PLOTTED BY: peterjul
IMAGES: Chevron Property FIG1 |
XREF'S: XB-BREM_WTRFRNT-BA-SV-061201 | XBR189606 3P041130 1F-BA



Parametrix DATE: Oct 03, 2011 FILE: BR1896063P04T1304 098 F16

LEGEND

X COMPLETE

O INCOMPLETE

Figure 16
Former Chevron Property DCAP
Conceptual Site Model

TABLES

Table 1. Chronology of Site History and Previous Site Investigations

Date	Event	Highlight
Prior to 1946 to 1988	Bulk fuel distribution operations.	Land and water operations.
1988	Fuel distribution facility demolition.	Environmental investigations began.
1988	Installation and sampling of nine wells (MW-4 through MW-12) and in total 16 test pits (GeoEngineers 1988; Hart Crowser 1989).	Highest soil impacts were seen in soils in the lower yard with gasoline concentrations as high as 25,000 milligrams per kilogram (mg/kg) and diesel concentrations as high as 17,000 mg/kg. Groundwater contamination detected in the majority of the wells with total petroleum hydrocarbons (TPH) concentrations as high as 1,742 milligrams per liter (mg/L). In addition, floating free product was measured in some of the wells at thickness of up to 4 feet.
1990	Installation of a soil vapor extraction (SVE) system by Chevron consisting of 11 shallow extraction wells and installation of three more monitoring wells (MW-13 through MW-15).	SVE system installation was to address floating product and soil contamination.
1993	Installation and sampling (soil and groundwater) of nine additional monitoring wells (MW-16 through MW-24).	Installation to expand the monitoring network (PEG 1994). Gasoline and diesel concentrations exceeding Washington State Department of Ecology MTCA Method A criteria were detected in only four of the nine wells (MW-19 through MW-22). Benzene exceeded criteria in two of these wells. Lower yard wells showed highest impacts with gasoline concentrations exceeding MTCA A criteria in four wells. Five upper yard wells exceeded MTCA A criteria for benzene, toluene, ethylbenzene, and xylene (BTEX), and one exceeded gasoline criteria.
1994	SVE system shut down due to diminishing returns.	It was estimated that a total of approximately 195,000 pounds of hydrocarbons were removed during system operation (Emcon 1995).
1994 to 1997	Quarterly groundwater monitoring.	All site wells were included in the monitoring program during at least one sampling event.
1998 to 2003	Semi-annual groundwater monitoring.	General decline in groundwater concentrations and floating product thickness observed.
2005	City of Bremerton purchased Former Chevron Property.	Negotiations with Ecology regarding Agreed Order begin.

(Table Continues)

Table 1. Chronology of Site History and Previous Site Investigations (Continued)

Date	Event	Highlight
2006	City of Bremerton Sediment Characterization Study (Parametrix 2006).	Sediment samples were collected from a total of 19 stations within intertidal and subtidal areas for an assessment of site sediments. One station failed Sediment Management Standards (SMS) for chemistry. The follow on biological test passed. Refer to Appendix B for a summary of sampling activities and results.
2006	Parametrix performed well survey.	Sixteen existing wells were located and measured for depth to groundwater. Two wells (MW-16 and MW-18) contained 3/8-inch floating product.
2007	Ecology performed independent sediment sampling event (Hart Crowser 2007).	An additional thirteen sediments samples were collected from the site vicinity. Samples results passed both chemical and biological SMS criteria. Refer to Appendix B for a summary of sampling activities and results.
2007	City of Bremerton signed AO with Ecology.	AO stipulated the City perform an RI/FS and IA for cleanup of the property.
2007	Ecology approved RI/FS and Interim Action Work Plan (Parametrix 2007).	Interim Action negotiated with Ecology consisting of hot spot soil removal and in-situ chemical oxidation of contaminated soils.

Table 2. Remedial Investigation Activities Summary

Date	Event Description
March 2008	RI activities conducted consist of soil and groundwater sampling from four surface stations, 19 push probes, and two newly-installed monitoring wells. Groundwater samples were also collected from 10 existing monitoring wells. Refer to Figure 6 and Figure 7 for push probe and well locations.
April 2008	Test pits excavated to confirm depth and location of buried bulkhead. Pilot Scale Test Plan submitted summarizing RI results and presenting a proposed plan to test injection of RegenOx into the contaminated soils within the lower yard.
May 2008	Pilot scale RegenOx injection test performed in nine locations on 10-foot centers.
June 2008	Confirmation samples for pilot test collected; results indicated injection was generally effective.
February 2009	Bench scale test performed to assess performance of in-situ soil mixing as an alternative to injection. Test results were used to select a RegenOx dosing rate of 10 pounds reagent per cubic yard (cy) of soil, which was expected to reduce soil contaminant concentrations by 70 to 75 percent. An aggressive dosing rate of 20 pounds per cy was also developed for discrete high concentration areas.
March 2009	Interim Action Plan submitted summarizing pilot and bench scale tests and proposing an IA consisting of hot-spot soil removal and in situ chemical oxidation followed by enhanced bioattenuation. Bioattenuation to be supported by application of an oxygen releasing compound in the soil mixing zone. The selected oxygen releasing compound was ORC by Regenesis at a dosing rate of 1.5 pounds per cy. IA Plan approved by Ecology and construction plans and specifications were prepared.
January 2010 through September 2011	Groundwater samples were collected from site monitoring wells at 6, 9, and 12 months following the IA to assess the effectiveness of soil treatment and ORC application. Two additional rounds of performance sampling were conducted in March 2011 and September 2011. Figure 8 show analytical results for the September 2011 sampling event. Analytical results show significant post-IA contaminant concentration reductions. Gasoline and benzene concentration trends with time are presented on Figure 9 and Figure 10. A summary of the groundwater results is provided in Table 3.
August 2011	A total of seven ambient air tests (A01 through A07) were performed using a piston hand pump (Sensidyne Gas Detector) and colorimetric tubes for benzene with a detection limit of 0.1 parts per million by volume (ppmv). In addition, ambient air at each sample location area was screened for the presence of total VOCs using a photoionization detector (PID). Air sample locations are shown on Figure 11. The ambient air tests did not detect benzene or VOCs at any of the seven locations tested. Note that location A07 was intended as a background location.

Table 3 Groundwater Results Summary, RI 1st through 4th Monitoring Events and Performance Monitoring (February, May, and August 2010, and April and September 2011)

		Monitoring Well No.	MW-04R									MW-09R							MW-10R						MW-11							
PARAMETERS	**Units**	**Sample Date**	**3/19/08[1]**	**1/21/10**	**6/1/10**	**6/1/10***	**8/11/10**	**8/11/10***	**4/5/11**	**4/5/11***	**9/29/11**	**1/20/10**	**5/25/10**	**5/25/10***	**8/11/10**	**4/7/11**	**4/7/11 Z**	**9/28/11**	**3/17/08[1]**	**1/20/10**	**5/25/10**	**8/10/10**	**4/5/11**	**9/30/11**	**3/13/08**	**1/20/10**	**5/25/10**	**8/10/10**	**8/10/10***	**4/5/11**	**4/5/11***	**9/30/11**
		MTCA A																														
VOLATILE ORGANICS (BTEX)																																
Benzene	ug/L	5	160	60 J	58	--	52	--	39	--	45	120 J	160	170	360	280	170	310	4.0 U	4.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Toluene	ug/L	1,000	10 U	2.0 J	1.0 U	--	1.0 U	--	4.0 U	--	1.0 U	4 U	3.2	3.6	11	11	7.6	13	4.0 U	4.0 U	1.0 U	1.0 U	1.0 U	1.2	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	ug/L	700	45	31 J	45	--	40	--	17	--	20	89 J	89	97	230	220	120	150	4.0 U	4.0 U	1.0 U	1.0 U	1.0 U	1.2	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
m,p-Xylene	ug/L	1,000	86	15 J	7.6	--	4.7	--	9.4	--	2.1	170 J	120	140	400	300	180	190	6.8	4.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
o-Xylene	ug/L	1,000	12	1.8 J	1.0 U	--	1.0 U	--	4.0	--	1.0 U	4 U	3.5	3.9	8.1	11	6.7	10	4.0 U	4.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
TOTAL PETROLEUM HYDROCARBONS																																
Gasoline	ug/L	800	5,400	1,200 J	1,100	--	1,000	--	960	--	650	1,800 J	1,500	1,700	3,100	4,800	3,100	2,100	400 U	400 U	1,100	780	830	1200	100 U	100 U	100 U	140	130	100 U	100 U	320
Diesel	mg/L	0.5	27	0.64 M	0.34 U	--	0.62 M	--	0.46	--	0.34 U	0.31 U	0.29 U	0.69	0.45 M	0.82	--	0.33 U	160	0.27 U	0.61 U	0.42 U	0.45 U	0.81 U	0.27	0.17 U	0.26 U	0.25 U	0.25 U	0.26 U	0.26 U	0.37
Lube Oil	mg/L	0.5	2.3	0.45 U	0.42 U	--	0.41 U	--	0.42 U	--	0.42 U	0.49 U	0.47 U	0.66	0.42 U	0.43 U	--	0.42 U	8.8 U	0.44 U	0.42 U	0.45 U	0.43 U	0.43 U	0.40 U	0.27 U	0.42 U	0.41 U	0.41 U	0.42 U	0.42 U	0.42 U
METALS																																
Total Lead	ug/L	15	--	8.2	--	--	--	--	--	--	--	80	36 J	74 J	21 J	170	--	--	--	3.8	--	--	--	--	--	4.7	--	--	--	--	--	--
Dissolved Lead	ug/L	15	--	1.0 U	--	--	--	--	--	--	--	13	12	14	17	3.0	--	--	--	2.2	--	--	--	--	--	1.4	--	--	--	--	--	--
Dissolved Iron	ug/L		--	4,200	--	--	--	--	--	--	--	34,000	--	--	--	--	--	--	--	6,400	--	--	--	--	--	270	--	--	--	--	--	--
Total Ferrous Iron	mg/L		--	--	7.36	--	9.75	--	5.4	--	--	--	46.2	42.1	29.2	49.4	--	--	--	--	25.2	34.4	12.4	--	--	--	19.0	30.4	30.0	2.66	2.74	--
Dissolved Manganese	ug/L		--	3,000	4,600	--	4,400	--	3,400	--	--	5,000	3,600	3,900	4,200	4,500	--	--	--	1,100	1,400	2,000	1,500	--	--	300	1,400	2,600	2,600	400	400	--
PAHs								--																								
Naphthalene	ug/L		--	1.4	--	--	--	--	1.0 U	1.0 U	--	6.4	--	--	--	--	--	--	--	0.14	--	--	--	--	--	0.13 U	--	--	--	--	--	--
2-Methylnaphthalene	ug/L		--	0.20	--	--	--	--	1.0 U	1.0 U	--	2.8	--	--	--	--	--	--	--	0.12 U	--	--	--	--	--	0.13 U	--	--	--	--	--	--
1-Methylnappthalene	ug/L		--	3.2	--	--	--	--	4.7	4.9	--	2.2	--	--	--	--	--	--	--	21	--	--	--	--	--	0.13 U	--	--	--	--	--	--
Acenaphthylene	ug/L		--	0.23	--	--	--	--	1.0 U	1.0 U	--	0.11 U	--	--	--	--	--	--	--	0.12 U	--	--	--	--	--	0.13 U	--	--	--	--	--	--
Acenaphthene	ug/L		--	1.9	--	--	--	--	3.3	3.4	--	0.18	--	--	--	--	--	--	--	0.23	--	--	--	--	--	0.13 U	--	--	--	--	--	--
Flourene	ug/L		--	1.8	--	--	--	--	2.3	2.3	--	0.14	--	--	--	--	--	--	--	0.32	--	--	--	--	--	0.13 U	--	--	--	--	--	--
Phenanthrene	ug/L		--	0.15	--	--	--	--	1.0 U	1.0 U	--	0.17	--	--	--	--	--	--	--	0.12 U	--	--	--	--	--	0.13 U	--	--	--	--	--	--
Anthracene	ug/L		--	0.44	--	--	--	--	1.0 U	1.0 U	--	0.11 U	--	--	--	--	--	--	--	0.12 U	--	--	--	--	--	0.13 U	--	--	--	--	--	--
Fluoranthene	ug/L		--	0.39	--	--	--	--	1.0 U	1.0 U	--	0.11 U	--	--	--	--	--	--	--	0.12 U	--	--	--	--	--	0.13 U	--	--	--	--	--	--
Pyrene	ug/L		--	0.26	--	--	--	--	1.0 U	1.0 U	--	0.11 U	--	--	--	--	--	--	--	0.12 U	--	--	--	--	--	0.13 U	--	--	--	--	--	--
Benzo(a)anthracene	ug/L		--	0.047	0.032	0.03	0.050 U	0.042	0.10 U	0.10 U	--	0.011 U	--	--	--	--	--	--	--	0.014	--	--	--	--	--	0.013 U	--	--	--	--	--	--
Chrysene	ug/L		--	0.033	0.010 U	0.010 U	0.050 U	0.023	0.10 U	0.10 U	--	0.011 U	--	--	--	--	--	--	--	0.012 U	--	--	--	--	--	0.013 U	--	--	--	--	--	--
Benzo(b)fluoranthene	ug/L		--	0.013	0.010 U	0.010 U	0.010 U	0.010 U	0.10 U	0.10 U	--	0.011 U	--	--	--	--	--	--	--	0.012 U	--	--	--	--	--	0.013 U	--	--	--	--	--	--
Benzo(k)fluoranthene	ug/L		--	0.028	0.010 U	0.010 U	0.010 U	0.010 U	0.10 U	0.10 U	--	0.011 U	--	--	--	--	--	--	--	0.012 U	--	--	--	--	--	0.013 U	--	--	--	--	--	--
Benzo(a)pyrene	ug/L	0.1	--	0.020	0.010 U	0.010 U	0.010 U	0.010 U	0.10 U	0.10 U	--	0.011 U	--	--	--	--	--	--	--	0.012 U	--	--	--	--	--	0.013 U	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	ug/L		--	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.10 U	0.10 U	--	0.011 U	--	--	--	--	--	--	--	0.012 U	--	--	--	--	--	0.013 U	--	--	--	--	--	--
Dibenz(a,h)anthracene	ug/L		--	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.10 U	0.10 U	--	0.011 U	--	--	--	--	--	--	--	0.012 U	--	--	--	--	--	0.013 U	--	--	--	--	--	--
Benzo[g,h,i]perylene	ug/L		--	0.010 U	--	--	--	--	0.10 U	0.10 U	--	0.011 U	--	--	--	--	--	--	--	0.012 U	--	--	--	--	--	0.013 U	--	--	--	--	--	--
GENERAL CHEMISTRY																																
Alkalinity	mg/L		--	190	1,900	--	2,100	--	2,300	--	--	700	720	730	800	730	--	--	220	190	200	210	230	--	170	52	210	120	110	70	66	--
Nitrate (as Nitrogen)	mg/L		--	0.050 U	0.050 U	--	0.050 U	--	0.050 U	--	--	0.050 U	0.050 U	0.050 U	0.14	0.050 U	--	--	0.050 U	0.77	0.094	0.050 U	0.050 U	--	0.050 U	0.050 U	0.070	0.086	0.1	0.050 U	0.050 U	--
Sulfate	mg/L		--	250	150	--	120	--	110	--	--	30	7.5	7.4	5.0 U	5.0 U	--	--	5.0 U	10	10 U	5.0 U	5.0 U	--	5.0 U	8.8	10 U	25 U	25 U	5.0 U	5.0 U	--
Chloride	mg/L		--	290	250	--	250	--	230	--	--	77	120	120	78	91	--	--	2.5	10	10	14	6.8	--	5.2	3.1	7.9	8.8	9.4	6.0	5.5	--
Dissolved Methane	ug/L		--	710	590	--	670	--	740	--	--	2,100	8,600	7,800	6,600	9,900	--	--	--	170	510	260	590	--	--	15	1,200	870	730	310	340	--
BOD5	mg/L		--	8.97	8.1	--	8.6	--	--	--	--	5.46	3.0	4.3	12.3	--	--	--	--	3.06	2.0	12 U	--	--	--	3.36	3.1	12 U	12 U	--	--	--
FIELD PARAMETERS																																
Turbidity	NTU		--	333	5.3	5.3	106	106	9.0	9.0	116.0	146	57.9	57.9	>1000	>1000	>1000	106.0	208	54.7	3.0	235	2.7	6.5	12.6	165	1.5	32.9	32.9	3.4	3.4	21.1
pH	--		--	6.63	6.90	6.90	7.01	7.01	7.09	7.09	7.11	6.36	6.77	6.77	6.94	6.78	6.78	7.05	6.38	6.00	6.32	6.05	6.50	6.52	6.20	5.27	6.20	6.27	6.27	6.17	6.17	6.41
Specific Conductance	mS/cm		--	3.50	3.42	3.42	32.6	32.6	35.1	35.1	5.48	1.52	1.42	1.42	2.65	1.81	1.81	1.91	53.4	35.9	51.2	90	90	81.2	63.5	10.3	32.0	90	90	64.3	64.3	89.0
Dissolved Oxygen	mg/L		--	4.91	4.55	4.55	0.0	0.0	4.02	4.02	0.06	9.65	0.96	0.96	0.0	0.40	0.40	6.68	0.0	5.38	6.31	2.38	2.20	6.16	0.0	5.87	0.90	0.0	0.0	2.67	2.67	0.00
ORP	mV		--	-136	-115	-115	-161	-161	-149	-149	-163	-124	-136.8	-136.8	-169	-134	-134	-152	-35	-64	-19.0	-79	-110	-96	62	169	-49.3	-110	-110	-31	-31	-106

Notes:

1 Sample collected from original well decommissioned during 2009 Interim Action.

* Duplicate collected.

CAL = Value out of calibration range.

J = Analyte was detected. Reported concentration should be considered an estimate.

M = Hydrocarbons in the gasoline range are impacting the diesel range result.

mg/L= Milligrams per liter.

mS/cm= Millisiemens per centimeter.

mV = Millivolts.

NC = Parameter not collected due to malfunctioning equipment.

NTU = Nephalometric turbidity units.

O = Hydrocarbons indicative of heavier fuels are present in the sample and are impacting the gasoline result.

ORP = Oxidation reduction potential.

R = Replacement well.

µg/L = Micrograms per liter.

U = Analyte not detected above practical quantitation limit given.

U1 = The practical quantitation limit is elevated due to interferences present in the sample.

Z = Sample collected was unpreserved and allowed to settle prior to analysis. Results provided to assess affects of suspended sediment in the samples.

Exceeds MTCA A cleanup level.

Table 3 Groundwater Results Summary, RI 1st through 4th Monitoring Events and Performance Monitoring (February, May, and August 2010, and April and September 2011)

		Monitoring Well No.	MW-13R						MW-16R					MW-18R				MW-19R						MW-20	MW-21R							
PARAMETERS	**Units**	**Sample Date**	**2/15/10**	**5/26/10**	**8/11/10**	**4/6/11**	**4/6/11 Z**	**9/29/11**	**2/16/10**	**5/27/10**	**8/10/10**	**4/6/11**	**4/6/11 Z**	**2/16/10**	**5/25/10**	**8/10/10**	**4/6/11**	**3/12/08[1]**	**2/16/10**	**5/26/10**	**8/12/10**	**4/7/11**	**4/7/11 Z**	**3/13/08**	**3/18/08[1]**	**2/15/10**	**6/1/10**	**8/11/10**	**8/11/10***	**4/6/11**	**4/6/11***	**9/28/11**
		MTCA A																														
VOLATILE ORGANICS (BTEX)																																
Benzene	ug/L	5	35 J	33	22	11	17	4	1.0 U	1.0 U	1.0 U	1.0 U	4.0 U	1.0 U	1.0 U	1.0 U	1.0 U	4.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	15	46 J	34	27	--	45	--	19
Toluene	ug/L	1,000	4.0 U	1.3	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	4.0 U	1.0 U	1.0 U	3.7	1.0 U	4.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	91	5.0 J	2.9	1.7	--	6.7	--	1.0 U
Ethylbenzene	ug/L	700	13 J	15	10	2.6	3.3	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	4.0 U	1.0 U	1.0 U	1.0 U	1.0 U	4.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	620	230 J	240	120	--	340	--	34
m,p-Xylene	ug/L	1,000	4.0 U	1.4	1.7	1.0 U	1.3	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	4.0 U	1.0 U	1.0 U	1.0 U	1.0 U	4.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.5	1.0 U	910	190 J	210	100	--	290	--	21
o-Xylene	ug/L	1,000	4.0 U	1.0 U	1.0 U	1.0 U	1.1	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	4.0 U	1.0 U	1.0 U	1.0 U	1.0 U	4.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	110	8.9 J	2.3	1.9	--	4.0 U	--	1.0 U
TOTAL PETROLEUM HYDROCARBONS																																
Gasoline	ug/L	800	680 J	560	510	420	470	150	100 U	100 U	100 U	100 U	400 U	100 U	100 U	180 O	100 U	400 U	640 J	380	620 O	130	280	100 U	9,200	4,400 J	4,400	2,800	--	5,100	--	1500
Diesel	mg/L	0.5	0.49 U1	0.43	0.39 U	0.41	--	0.26 U	0.28 U	0.27 U	0.37	0.28 U	--	0.27 U	0.26 U	0.27 U	0.27 U	8.1	0.29 U	0.26 U	0.42 M	0.26 U	--	0.27 U	1.7	0.89 U1	0.79 U	0.87 M	--	0.68 U	--	0.42 U
Lube Oil	mg/L	0.5	0.70 J	0.45 U	0.43 U	0.42 U	--	0.42 U	0.44 U	0.43 U	0.39 U	0.44 U	--	0.43 U	0.42 U	0.43 U	0.43 U	0.42 U	0.46 U	0.42 U	0.42 U	0.42 U	--	0.44 U	0.40 U	0.46 U	0.42 U	0.41 U	--	0.42 U	--	0.42 U
METALS																																
Total Lead	ug/L	15	5.2	--	--	--	--	--	1.4	--	--	--	--	1.6	--	--	--	4.5	5.7	--	--	--	--	15	10	15	2.8 J	10 J	5.5 J	1.1	1.1 U	--
Dissolved Lead	ug/L	15	1.1	--	--	--	--	--	1.0 U	--	--	--	--	1.0 U	--	--	--	1.0 U	1.0 U	--	--	--	--	1.0 U	8.9	2.3	1.4	1.4	1.0	1.0 U	1.0 U	--
Dissolved Iron	ug/L		3,600	--	--	--	--	--	56 U	--	--	--	--	830	--	--	--	--	5,100	--	--	--	--	--	--	18,000	--	--	--	--	--	--
Total Ferrous Iron	mg/L		--	15.2	9.31	7.94	--	--	--	1.66	0.336	0.094	--	--	12.1	17.8	1.48	--	--	15.4	17.4	0.839	--	--	--	--	16.2	17.9	--	10.1	--	--
Dissolved Manganese	ug/L		1,500	1,300	2,000	1,800	--	--	10 U	3,800	11,000	10 U	--	1,200	2,800	9,500	1,900	--	2,200	2,400	3,500	1,600	--	--	--	4,100	4,500	3,500	--	4,200	--	--
PAHs																																
Naphthalene	ug/L		15	--	--	0.35	--	--	0.11 U	--	--	--	--	1.0	--	--	--	0.88	0.43	--	--	--	--	0.12 U	18	18	--	--	--	--	--	--
2-Methylnaphthalene	ug/L		1.1	--	--	0.10 U	--	--	0.11 U	--	--	--	--	0.10 U	--	--	--	0.11 U	0.17	--	--	--	--	0.12 U	32	7.3	--	--	--	--	--	--
1-Methylnappthalene	ug/L		4.7	--	--	0.38	--	--	0.11 U	--	--	--	--	0.10 U	--	--	--	15	4.3	--	--	--	--	0.12 U	20	18	--	--	--	--	--	--
Acenaphthylene	ug/L		1.1	--	--	0.40	--	--	0.11 U	--	--	--	--	0.10 U	--	--	--	0.42	0.12	--	--	--	--	0.12 U	0.099	1.1 U	--	--	--	--	--	--
Acenaphthene	ug/L		48	--	--	22	--	--	0.11 U	--	--	--	--	0.10 U	--	--	--	0.96	0.58	--	--	--	--	0.38	1.1	1.3	--	--	--	--	--	--
Flourene	ug/L		21	--	--	7.6	--	--	0.11 U	--	--	--	--	0.10 U	--	--	--	5.2	1.5	--	--	--	--	0.12 U	0.96	0.61	--	--	--	--	--	--
Phenanthrene	ug/L		3.2	--	--	0.70	--	--	0.11 U	--	--	--	--	0.10 U	--	--	--	2.9	0.31	--	--	--	--	0.12 U	0.65	0.44	--	--	--	--	--	--
Anthracene	ug/L		1.9	--	--	1.2	--	--	0.11 U	--	--	--	--	0.10 U	--	--	--	0.15	0.10 U	--	--	--	--	0.12 U	0.095 U	0.26	--	--	--	--	--	--
Fluoranthene	ug/L		1.5	--	--	1.2	--	--	0.11 U	--	--	--	--	0.10 U	--	--	--	0.11 U	0.10 U	--	--	--	--	0.12 U	0.11	0.12	--	--	--	--	--	--
Pyrene	ug/L		0.91	--	--	0.58	--	--	0.11 U	--	--	--	--	0.10 U	--	--	--	0.11 U	0.10 U	--	--	--	--	0.12 U	0.095 U	0.11 U	--	--	--	--	--	--
Benzo(a)anthracene	ug/L		0.15	0.057	0.061	0.058	--	--	0.011 U	--	--	--	--	0.010 U	--	--	--	0.011 U	0.010 U	--	--	--	--	0.015	0.012	0.011 U	--	--	--	--	--	--
Chrysene	ug/L		0.15	0.040	0.050 U	0.044	--	--	0.011 U	--	--	--	--	0.010 U	--	--	--	0.021	0.010 U	--	--	--	--	0.013	0.011	0.011 U	--	--	--	--	--	--
Benzo(b)fluoranthene	ug/L		0.093	0.010 U	0.010 U	0.018	--	--	0.011 U	--	--	--	--	0.010 U	--	--	--	0.011 U	0.010 U	--	--	--	--	0.012 U	0.010	0.011 U	--	--	--	--	--	--
Benzo(k)fluoranthene	ug/L		0.083	0.010 U	0.010 U	0.014	--	--	0.011 U	--	--	--	--	0.010 U	--	--	--	0.011 U	0.010 U	--	--	--	--	0.012 U	0.011	0.011 U	--	--	--	--	--	--
Benzo(a)pyrene	ug/L	0.1	0.092	0.010 U	0.010 U	0.017	--	--	0.011 U	--	--	--	--	0.010 U	--	--	--	0.011 U	0.010 U	--	--	--	--	0.012 U	0.012	0.011 U	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	ug/L		0.041	0.010 U	0.010 U	0.010 U	--	--	0.011 U	--	--	--	--	0.010 U	--	--	--	0.011 U	0.010 U	--	--	--	--	0.012 U	0.0099	0.011 U	--	--	--	--	--	--
Dibenz(a,h)anthracene	ug/L		0.013	0.010 U	0.010 U	0.010 U	--	--	0.011 U	--	--	--	--	0.010 U	--	--	--	0.011 U	0.010 U	--	--	--	--	0.012 U	0.0095 U	0.011 U	--	--	--	--	--	--
Benzo[g,h,i]perylene	ug/L		0.053	--	--	0.010 U	--	--	0.011 U	--	--	--	--	0.010 U	--	--	--	0.11 U	0.010 U	--	--	--	--	0.12 U	0.013	0.011 U	--	--	--	--	--	--
GENERAL CHEMISTRY																																
Alkalinity	mg/L		1,300	1,400	1,600	1,500	--	--	20 U	450	710	20 U	--	200	420	870	250	160	170	200	190	120	--	180	150	140	1,400	1,500	--	2,000	--	--
Nitrate (as Nitrogen)	mg/L		0.050 U	0.050 U	0.050 U	0.050 U	--	--	0.087	0.25 U	0.050 U	0.050 U	--	0.16	0.050 U	0.050 U	0.35	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	--	0.050 U	0.050 U	0.050 U	0.050 U	0.057	--	0.27	--	--
Sulfate	mg/L		460	460	560	280	--	--	5.9	5.0 U	5.0 U	5.0 U	--	26	7.8	5.0 U	7.4	5.0 U	10 U	5.0 U	5.0 U	5.0 U	--	5.0 U	5.0 U	230	170	120	--	110	--	--
Chloride	mg/L		710	670	750	420	--	--	4.2	8.3	8.4	8.7	--	3.7	4.3	14	2.4	3.4	4.7	2.5	3.1	2.0 U	--	11	28	140	120	110	--	100	--	--
Dissolved Methane	ug/L		280	580	680	290	--	--	0.83	3,100	590	4.1	--	420	2,100	5,400	4300	--	32	44	350	61	--	--	--	5,700	4,200	4,800	--	3,200	--	--
BOD5	mg/L		4.47	2.2	5.1	--	--	--	2.00 U	1.0 U	12 U	--	--	2.52	8.1	12 U	--	--	4.20	1.1	2.9	--	--	--	--	17	8.4	16.2	--	--	--	--
FIELD PARAMETERS																																
Turbidity	NTU		366	275.3	106	>1000	>1000	170.0	86.3	2565	>1000	704	704	58.1	16.7	221	28.6	NC	340	319	32.7	>1000		NC	168	303	8.9	384	384	52.2	52.2	646.0
pH	--		6.96	6.81	6.89	6.99	6.99	7.42	6.16	6.53	6.87	6.37	6.37	6.03	6.49	6.61	6.51	6.00	6.40	6.68	6.34	6.41		6.56	6.39	6.56	6.83	7.00	7.00	7.06	7.06	7.06
Specific Conductance	mS/cm		57.3	4.53	55.2	438	438	5.99	4.9	64.9	1.38	18.6	18.6	51.6	58.0	2.20	90	34.5	48.2	38.0	CAL	82.1		79.1	44.4	33.3	2.50	4.47	4.47	430	430	3.33
Dissolved Oxygen	mg/L		7.56	3.07	0.0	4.82	4.82	7.70	10.09	2.32	6.27	14.10	14.10	2.79	1.29	0.0	3.39	0.0	3.00	5.05	0.01	4.10	--	0.0	0.0	0.00	4.92	0.0	0.0	1.80	1.80	0.00
ORP	mV		-13	-96.3	-146	-103	-103	-133	290	-20.3	-38	147	147	143	-2.1	-156	-27	-35	1	-49.8	-84	4	--	-44	15	-107	-140.0	-162	-162	-160	-160	-195

Notes:

1 Sample collected from original well decommissioned during 2009 Interim Action.

* Duplicate collected.

CAL = Value out of calibration range.

J = Analyte was detected. Reported concentration should be considered an estimate.

M = Hydrocarbons in the gasoline range are impacting the diesel range result.

mg/L= Milligrams per liter.

mS/cm= Millisiemens per centimeter.

mV = Millivolts.

NC = Parameter not collected due to malfunctioning equipment.

NTU = Nephalometric turbidity units.

O = Hydrocarbons indicative of heavier fuels are present in the sample and are impacting the gasoline result.

ORP = Oxidation reduction potential.

R = Replacement well.

µg/L = Micrograms per liter.

U = Analyte not detected above practical quantitation limit given.

U1 = The practical quantitation limit is elevated due to interferences present in the sample.

Z = Sample collected was unpreserved and allowed to settle prior to analysis. Results provided to assess affects of suspended sediment in the samples.

Exceeds MTCA A cleanup level.

Table 3 Groundwater Results Summary, RI 1st through 4th Monitoring Events and Performance Monitoring (February, May, and August 2010, and April and September 2011)

		Monitoring Well No.	MW-22R						MW-23	MW-25							MW-26R						MW-27	
PARAMETERS	**Units**	**Sample Date**	**3/17/08[1]**	**1/20/10**	**5/26/10**	**8/12/10**	**4/6/11**	**9/29/11**	**3/12/08**	**3/18/08**	**3/18/08**	**1/21/10**	**5/27/10**	**8/12/10**	**4/6/11**	**9/29/11**	**3/18/08[1]**	**1/20/10**	**5/26/10**	**8/11/10**	**4/6/11**	**9/28/11**	**4/7/11**	**9/30/11**
		MTCA A																						
VOLATILE ORGANICS (BTEX)																								
Benzene	ug/L	5	4.0 U	4.0 U	1.0 U	1.0 U	1.0 U	2.7	1.1	4.0 U	4.0	10 J	4.0 U	1.3	4.0 U	1.4	17	4.0 U	17	3.9	1.0 U	6.0	1.0 U	1.0 U
Toluene	ug/L	1,000	4.0 U	4.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	4.0 U	4.0	7.2 J	4.0 U	2.1	4.0 U	2.5	4.0 U	4.0 U	4.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	ug/L	700	4.0 U	4.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	56	56	74 J	4.0 U	6.1	5.3	11	4.0 U	4.0 U	4.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
m,p-Xylene	ug/L	1,000	4.0 U	4.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	4.2	4.1	140 J	4.0 U	5.0 U	8.4	1.2	4.0 U	4.0 U	4.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
o-Xylene	ug/L	1,000	4.0 U	4.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	4.0 U	4.0	200 U1	4.0 U	1.0 U	4.0 U	1.0 U	4.0 U	4.0 U	4.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
TOTAL PETROLEUM HYDROCARBONS																								
Gasoline	ug/L	800	400 U	400 U	100 U	100 U	100 U	120	530	1,600	1,700	2,000 U	1,400	1,300 O	1,500	1500	1,300	400 U	530	240	100 U	270	100 U	100 U
Diesel	mg/L	0.5	0.26 U	0.26 U	0.27 U	0.25 U	0.27 U	0.26 U	0.26 U	1.2	1	0.49	0.92	2 M	7.0	1.3	1.3	0.27 U	0.26 U	0.31 U	0.27 U	0.26 U	0.26 U	0.26 U
Lube Oil	mg/L	0.5	0.41 U	0.41 U	0.43 U	0.41 U	0.43 U	0.41 U	0.42 U	0.48 U	0.46 U	0.42 U	0.42 U	0.41 U	0.42 U	0.41 U	0.40 U	0.43 U	0.41 U	0.40 U	0.43 U	0.41 U	0.41 U	0.42 U
METALS																								
Total Lead	ug/L	15	1.1 U	1.3	--	--	--	--	--	1.2	1.3	1.1 U	--	--	--	--	3.3	1.1 U	--	--	--	--	--	--
Dissolved Lead	ug/L	15	1.0 U	1.0 U	--	--	--	--	--	1.0 U	1.0 U	1.0 U	--	--	--	--	1.0 U	1.0 U	--	--	--	--	--	--
Dissolved Iron	ug/L		--	220	--	--	--	--	--	--	--	2,000	--	--	--	--	--	56 U	--	--	--	--	--	--
Total Ferrous Iron	mg/L		--	--	0.295	1.29	0.043	--	--	--	--	--	0.352	3.78	1.39	--	--	--	0.758	0.8	0.059	--	27.6	--
Dissolved Manganese	ug/L		--	1,400	890	3,200	840	--	--	--	--	120	220	130	170	--	--	11 U	66	560	10 U	--	3,900	--
PAHs																								
Naphthalene	ug/L		0.098 U	0.10 U	--	--	--	--	--	1.2	1.4	0.27	--	--	--	--	0.80	0.10 U	--	--	--	--	--	--
2-Methylnaphthalene	ug/L		0.098 U	0.10 U	--	--	--	--	--	0.11 U	0.11 U	0.10 U	--	--	--	--	0.10 U	0.10 U	--	--	--	--	--	--
1-Methylnappthalene	ug/L		0.098 U	0.10 U	--	--	--	--	--	22	25	0.67	--	--	--	--	69	0.10 U	--	--	--	--	--	--
Acenaphthylene	ug/L		0.098 U	0.10 U	--	--	--	--	--	0.17	0.17	0.10 U	--	--	--	--	0.45	0.15 U	--	--	--	--	--	--
Acenaphthene	ug/L		0.52	0.10 U	--	--	--	--	--	0.98	0.96	0.15	--	--	--	--	23	0.17 U	--	--	--	--	--	--
Flourene	ug/L		0.098 U	0.10 U	--	--	--	--	--	1.6	1.7	0.18	--	--	--	--	4.8	0.10 U	--	--	--	--	--	--
Phenanthrene	ug/L		0.098 U	0.10 U	--	--	--	--	--	0.11 U	0.11 U	0.10 U	--	--	--	--	10	0.10 U	--	--	--	--	--	--
Anthracene	ug/L		0.098 U	0.10 U	--	--	--	--	--	0.11 U	0.11 U	0.10 U	--	--	--	--	2.4	0.17 U	--	--	--	--	--	--
Fluoranthene	ug/L		0.098 U	0.10 U	--	--	--	--	--	0.11 U	0.11 U	0.10 U	--	--	--	--	0.88	0.10 U	--	--	--	--	--	--
Pyrene	ug/L		0.098 U	0.10 U	--	--	--	--	--	0.11 U	0.11 U	0.10 U	--	--	--	--	1.2	0.10 U	--	--	--	--	--	--
Benzo(a)anthracene	ug/L		0.0098 U	0.010 U	--	--	--	--	--	0.011 U	0.011 U	0.010 U	--	--	--	--	0.10	0.016 U	--	--	--	--	--	--
Chrysene	ug/L		0.0098 U	0.010 U	--	--	--	--	--	0.011 U	0.011 U	0.010 U	--	--	--	--	0.098	0.010 U	--	--	--	--	--	--
Benzo(b)fluoranthene	ug/L		0.0098 U	0.010 U	--	--	--	--	--	0.011 U	0.011 U	0.010 U	--	--	--	--	0.022	0.010 U	--	--	--	--	--	--
Benzo(k)fluoranthene	ug/L		0.0098 U	0.010 U	--	--	--	--	--	0.011 U	0.011 U	0.010 U	--	--	--	--	0.027	0.010 U	--	--	--	--	--	--
Benzo(a)pyrene	ug/L	0.1	0.0098 U	0.010 U	--	--	--	--	--	0.011 U	0.011 U	0.010 U	--	--	--	--	0.051	0.010 U	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	ug/L		0.0098 U	0.010 U	--	--	--	--	--	0.011 U	0.011 U	0.010 U	--	--	--	--	0.017	0.010 U	--	--	--	--	--	--
Dibenz(a,h)anthracene	ug/L		0.0098 U	0.010 U	--	--	--	--	--	0.011 U	0.011 U	0.010 U	--	--	--	--	0.010 U	0.010 U	--	--	--	--	--	--
Benzo[g,h,i]perylene	ug/L		0.0098 U	0.010 U	--	--	--	--	--	0.011 U	0.11 U	0.010 U	--	--	--	--	0.020	0.010 U	--	--	--	--	--	--
GENERAL CHEMISTRY																								
Alkalinity	mg/L		340	160	320	240	310	--	230	420	410	140	190	260	200	--	190	180	270	210	300	--	310	--
Nitrate (as Nitrogen)	mg/L		0.050 U	0.50	0.050 U	0.17	0.41	--	0.051	0.052	0.050 U	3.4	0.73	0.050 U	1.4	--	0.050 U	1.0	0.16	0.050 U	0.050 U	--	0.050 U	--
Sulfate	mg/L		22	1,200	75	200	39	--	5.0 U	36	36	13	8.0	26	5.0 U	--	1,400	1,200	1,400	2,200	1,300	--	25 U	--
Chloride	mg/L		370	9,100	390	1,600	97	--	3.0	980	910	38	31	610	24	--	9,400	9,100	10,000	20,000	8,400	--	9.8	--
Dissolved Methane	ug/L		--	6.3	21	10	6.8	--	--	--	--	220	190	330	190	--	--	3.0	68	5.0	29	--	8,600	--
BOD5	mg/L		--	2.00 U	1.0 U	1.2 U	--	--	--	--	--	2.00 U	1.9	4.3	--	--	--	2.00 U	1.7	1.5	--	--	--	--
FIELD PARAMETERS																								
Turbidity	NTU		212	56.3	4.1	132	0.8	112.0	29	120	120	164	4.8	32.6	65.5	60.0	85.7	70.2	3.8	38.0	0.1	82.3	49.2	>1000
pH	--		6.62	6.32	6.82	6.69	7.03	7.65	6.49	6.31	6.31	5.81	6.28	6.96	6.20	6.21	6.24	6.19	6.31	6.53	6.88	6.52	6.58	6.53
Specific Conductance	mS/cm		19.6	17.9	1.37	CAL	128	6.04	52.4	19.8	19.8	31.8	28.9	5.13	90	51.6	3.25	16.6	22.42	CAL	CAL	CAL	92	1.18
Dissolved Oxygen	mg/L		0.0	7.55	4.90	0.01	1.75	8.48	0.0	0.0	0.0	4.96	1.10	0.0	0.57	0.00	0.0	6.75	5.52	0.01	0.36	0.00	0.27	0.00
ORP	mV		148	54	62.0	-36	32	-139	19	-56	-56	-14	85.6	-120	-30	-99	48	58	-64.5	-98	-84	-275	-88	-111

Notes:

1 Sample collected from original well decommissioned during 2009 Interim Action.

* Duplicate collected.

CAL = Value out of calibration range.

J = Analyte was detected. Reported concentration should be considered an estimate.

M = Hydrocarbons in the gasoline range are impacting the diesel range result.

mg/L= Milligrams per liter.

mS/cm= Millisiemens per centimeter.

mV = Millivolts.

NC = Parameter not collected due to malfunctioning equipment.

NTU = Nephalometric turbidity units.

O = Hydrocarbons indicative of heavier fuels are present in the sample and are impacting the gasoline result.

ORP = Oxidation reduction potential.

R = Replacement well.

µg/L = Micrograms per liter.

U = Analyte not detected above practical quantitation limit given.

U1 = The practical quantitation limit is elevated due to interferences present in the sample.

Z = Sample collected was unpreserved and allowed to settle prior to analysis. Results provided to assess affects of suspended sediment in the samples.

Exceeds MTCA A cleanup level.

Table 4. Cleanup Levels

	Medium	
	Soil	**Groundwater**
Hazardous Substance	**MTCA A (mg/kg)**	**MTCA A (ug/L)**
Benzene	0.030	5
Diesel	2,000	500
Motor Oil	2,000	500
Gasoline	30/100[1]	800/1,000[2]
Lead	250	15
Benzo(a) pyrene	0.1	.01

[1] 100 if no benzene and gas <1% TEX; 30 for other mixtures.

[2] 1 if no benzene; 0.8 if benzene.

ug/L- Micrograms per liter.

Table 5. Potential Applicable or Relevant and Appropriate Requirements (ARARs)

ARAR	Description	Applicability
Soil		
Model Toxics Control Act (WAC 173-340-740, -747)	MTCA regulates the investigation and cleanup of releases to the environment that may pose a threat to human health or the environment. Establishes cleanup levels for soil, including derivation of soil concentrations protective of groundwater.	MTCA cleanup levels are applicable to site soil.
Groundwater		
Safe Drinking Water Act, Primary Drinking Water Regulations (40 Code of Federal Regulations [CFR] 141.50 and 141.61[a])	These regulations protect the quality of public drinking water supplies through regulation of chemical parameters and constituent concentrations as maximum concentration limits (MCLs).	MCLs are potentially relevant and appropriate where groundwater is a potential source of drinking water.
Model Toxics Control Act (WAC 173-340-720)	MTCA regulates the investigation and cleanup of releases to the environment that may pose a threat to human health or the environment. Establishes cleanup levels for groundwater.	MTCA cleanup levels are applicable to site groundwater.
Surface Water		
Clean Water Act, Section 304, National Recommended Water Quality Criteria, EPA Office of Science and Technology (4304T, 2004).	Establishes ambient water quality criteria for surface water.	Surface water quality criteria are potentially applicable to site surface water.
Clean Water Act's National Toxics Rule (NTR) (40 CFR 131.36)	Establishes ambient water quality criteria for surface water.	Surface water quality criteria are potentially applicable to site surface water.
Washington State Water Quality Standards for Surface Waters (WAC 173-201A)	Establishes ambient water quality criteria for surface water.	Surface water quality criteria are potentially applicable to site surface water.
Model Toxics Control Act (WAC 173-340-730)	MTCA regulates the investigation and cleanup of releases to the environment that may pose a threat to human health or the environment. Establishes cleanup levels for surface water.	MTCA cleanup levels may be applicable to the site.
Air		
National Emission Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR Part 261)	Establishes specific emissions levels allowed for toxic air pollutants.	Applicable to treatment alternatives that may emit toxic pollutants to the air.
Model Toxics Control Act (WAC 173-340-750)	MTCA regulates the investigation and cleanup of releases to the environment that may pose a threat to human health or the environment. Establishes cleanup levels for air.	MTCA cleanup levels may be applicable to the site.
Miscellaneous		
State Environmental Policy Act (SEPA) Chapter 43.21C RCW.	The SEPA requires all governmental agencies to consider the environmental effects of a proposal (such as a remedial action) before making decisions. An environmental impact statement (EIS) must be prepared for all proposals with probable significant adverse effects on the quality of the environment.	At minimum, a SEPA checklist is required for site act activities requiring a grading permit.
Native American Graves Protection and Repatriation Act (43 CFR Part 10)	Native American Graves Protection and Repatriation Act regulations protect Native American burials from desecration through the removal and trafficking of human remains and "cultural items," including funerary and sacred objects.	This Act is potentially applicable to remedial actions at the site because it is possible that the disturbance of Native American materials could occur as a result of excavation activities.
Washington Hazardous Waste Management Act (WAC 173-303)	Establishes standards for the generation, transport, treatment, storage, or disposal of designated dangerous waste in the state.	This regulation is potentially applicable to alternatives that would involve handling of contaminated media at the site. The area of contamination policy allows contaminated media to be consolidated within the same area of a site without triggering Resource Conservation and Recovery Act or Washington dangerous waste regulations.
Department of Transportation Hazardous Wastes Rules (49 CFR 105–180)	Establishes specific U.S. Department of Transportation rules and technical guidelines for the off-site transport of hazardous materials.	Applicable to remedial activities that involve the off-site transportation of hazardous waste.
Washington Solid Waste Handling Standards (WAC 173-350)	Establishes standards for handling and disposal of solid non-hazardous waste in Washington.	These regulations are potentially applicable to solid nonhazardous wastes and are potentially relevant and appropriate to on-site remedial actions governing contaminated media management.
Washington Water Well Construction Act Regulations (WAC 173-160)	Provides requirements for water well construction.	These regulations are potentially applicable to the installation, operation, or closure of monitoring and treatment wells at the Site.

Table 6. Proposed Initial Groundwater Sampling Program

	Gasoline/BTEX	Diesel/Lube Oil	Field Parameters[1]	Conventionals[2]	Dissolved Methane	Total Lead	Dissolved Lead3	Total Ferrous Iron	Dissolved Manganese[3]
MW-4R	X	X	X	X	X	-	-	X	X
MW-9R	X	X	-	X	X	X	X	X	X
MW-10R	X	X	-	X	X	-	-	X	X
MW-11	X	X	-	X	X	-	-	X	X
MW-13R	X	X	X	X	X	-	-	X	X
MW-16R	-	-	-	-	-	-	-	-	-
MW-18R	-	-	-	-	-	-	-	-	-
MW-19R	-	-	-	-	-	-	-	-	-
MW-21R	X	X	-	X	X	-	-	X	X
MW-22R	X	X	-	X	X	-	-	X	X
MW-25	X	X	-	X	X	-	-	X	X
MW-26R	X	X	-	X	X	-	-	X	X
MW-27	X	X	-	X	X	-	-	X	X

[1] Turbidity, dissolved oxygen, ORP, pH, and specific conductance.
[2] nitrate, sulfate, alkalinity, chloride.
[3] field filtered.

Table 7. Proposed Schedule

Work Element	Completed By
DCAP public comment period	May 2012
DCAP finalized as CAP	July 2012
2nd Agreed Order finalized	September 2012
Long Term Monitoring Plan	October 2012
1st quarter groundwater sampling event	November 2012
2nd quarter groundwater sampling event	February 2013
3rd quarter groundwater sampling event	May 2013
4th quarter groundwater sampling event	August 2013
Summary Monitoring Report	September 2013
1st semi-annual groundwater sampling event	February 2014
2nd semi-annual groundwater sampling event	August 2014
3rd semi-annual groundwater sampling event	February 2015
4th semi-annual groundwater sampling event	August 2015
1st annual groundwater sampling event	August 2016
2nd annual groundwater sampling event	August 2017
5-Year Summary Monitoring Report	September 2017
First 5-Year Review	October 2017

Note: Groundwater monitoring memoranda will be submitted within six weeks following completion of each groundwater monitoring event.