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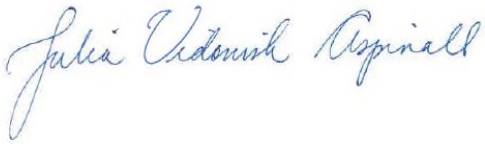
Chevron Environmental Management Company

REMEDIAL INVESTIGATION WORK PLAN

Former Chevron Station No. 97502
640 Metcalf Street
Sedro-Woolley, Washington
FSID: 61112475
CSID: 6368

May 20, 2021



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ACRONYMS AND ABBREVIATIONS

1,2-DCE	1,2-dichloroethylene
AO	Agreed Order
Arcadis	Arcadis U.S., Inc.
ASTM	ASTM International
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CEMC	Chevron Environmental Management Company
City	City of Sedro-Woolley
COC	constituent of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CRA	Conestoga-Rovers & Associates
CSID	Cleanup Site Identification Number
CUL	Cleanup Level
DCAP	Draft Cleanup Action Plan
DIPE	Diisopropyl ether
DRO	Diesel Range Organics
DUP	Duplicate
Ecology	Washington State Department of Ecology
EDB	Ethylene dibromide
EMCON	Sweet-Edwards/EMCON
ETBE	Ethyl tertiary-butyl ether
FSID	Facility Site Identification Number
ft bgs	feet below ground surface
GRO	Gasoline Range Organics
HO	Heavy Oil Range Organics
IDW	investigation-derived waste
inHg	inches of mercury
LNAPL	light non-aqueous phase liquid
mg/L	milligrams per liter
mL	milliliters

mL/min	millimeters per minute
MRL	Method Reporting Limit
MTBE	Methyl tertiary butyl ether
MTCA	Model Toxics Control Act
MW	Monitoring Well
NWTPH-Dx	Northwest Method Total Petroleum Hydrocarbons – Diesel
NWTPH-Gx	Northwest Method Total Petroleum Hydrocarbons – Gasoline
%	percent
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene
PID	photoionization detector
PLP	Potentially Liable Person
property	640 Metcalf Street, Sedro-Woolley, Washington
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
RI	Remedial Investigation
RI WP	Remedial Investigation Work Plan
ROW	Right-of-way
SCPHD	Skagit County Public Health Department
site	property and surrounding ROW areas
TAME	Tert-Amyl methyl ether
TBA	Tertiary butyl alcohol
TCE	Trichloroethylene
TGI	Technical Guidance Instructions
TPH	Total Petroleum Hydrocarbons
USEPA	United States Department of Environmental Protection
UST	underground storage tank
VI	Vapor intrusion
VOCs	Volatile Organic Compounds

1. INTRODUCTION

On behalf of Chevron Environmental Management Company (CEMC), Arcadis U.S., Inc. (Arcadis) prepared this Remedial Investigation Work Plan (RI WP) for former Chevron station No. 97502, located at 640 Metcalf Street in Sedro-Woolley, Washington (property). The "site" is defined in the Agreed Order (AO) No. DE 18034 and RI WP as the property (lots 77454, 77455, and 77456) and surrounding right-of-way (ROW) areas (Ecology 2020a). The RI WP was created in response to the Ecology AO No. 18034, effective September 14, 2020 (Ecology 2020a). Potentially Liable Persons (PLPs) for the site are CEMC and the City of Sedro-Woolley (City). The property is currently owned by the City and is home to Hammer Heritage Square, a public City park. A site location map is presented on Figure 1 and a site map is included as Figure 2. A parcel map and parcel data for the site are presented in Appendix A.

The site is formally known as Chevron 97502, Chevron Station 97502, Chevron Lot Town Square Park, CUSA Facility 60097502, or Chevron U.S.A. Inc. SS 97502 in Ecology's database. Identifiers are:

- Facility Site Identification Number (FSID): 61112475
- Cleanup Site Identification Number (CSID): 6368
- Agreed Order Number: 18034
- Current Address: 640 Metcalf Street, Sedro-Woolley, WA 98284
- Historical Address: 124 West Ferry Street, Sedro-Woolley, WA 98284

Ecology's website for the site is available and documents available electronically can be accessed from this web page: https://apps.ecology.wa.gov/gsp/CleanupSiteDocuments.aspx?csid=6368.

The objectives of this RI WP are to address data gaps regarding the nature and extent of contaminant releases in soil, groundwater, and soil vapor associated with the historic use of the property.

The Remedial Investigation Checklist (Ecology 2020d) was used as a guidance document during the preparation of this RI WP.

1.1 Limitations

This RI WP is based on available reports and current site knowledge.

This RI WP includes data from lots 77454, 77455, and 77456. Groundwater wells and soil borings have also been installed in City right of way (ROW) areas.

2. BACKGROUND

This section describes the site and summarizes historical activities conducted at the site.

2.1 Site Description

The site's general information is listed below, and documentation is included in Appendix A:

- **Site Location:** 640 Metcalf Street and surrounding ROW areas
- **Site County:** Skagit County
- **Site Parcel Number, Address, Area, Current Use:**
  - Parcels P77454, P77455, P77456:
    - 640 Metcalf Street (historically shown as 124 West Ferry Street)
    - 0.21 acre
    - Currently Hammer Heritage Square Park
- **Site Land Use:** The property is zoned as Public, which allows parks, schools, public infrastructure and other developments intended primarily for public use (City of Sedro Woolley 2019).
- **Vicinity Land Use**: Surrounding properties are zoned as Central Business District, which may be used for commercial, multi-family residential, and public uses (City of Sedro Woolley 2019).

2.2 Site History

The site and surrounding neighborhood have been developed for commercial uses since at least the early 1900s. The site is comprised of lots P77454, P77455, and P77456, and the surrounding ROW areas. Historical ownership and land use of these lots are described below, including historical petroleum activities and/or spills.

The earliest known development of the property occurred in 1905 with the construction of the Seidell Building. Before it burned down in 1949, the Seidell Building was used for various commercial businesses, including a bank, lawyer's office, barber shop, tailor, and stores for sporting goods, liquor, and general retail (Ecology 2020a).

The property was redeveloped as a service station around 1950, becoming the Gateway Service Station in 1953. In 1965, Standard Oil Company of California acquired the Gateway Service Station property and remodeled and took over operations at the property (Ecology 2020a).

On July 25, 1989, approximately 100 gallons of unleaded gasoline were spilled when an underground storage tank (UST) overflowed during filling. The spilled gasoline flowed south down the gutter along Metcalf Street to Ferry Street and entered a catch basin at the northwestern corner of Metcalf and Ferry Streets. The gasoline was flushed from the storm water drainage system on July 25 and 26, 1989 (Conestoga-Rovers & Associates [CRA] 2008a). Documentation of this release is provided in Appendix B.

Service station operations ended in early 1992, and all USTs were removed by February 1992. An estimated eight USTs were historically present at the service station – three gasoline (one leaded, one unleaded, and one unleaded supreme), as well as fuel oil, used oil, and kerosene USTs. The service station also contained two pump islands, two hydraulic hoists, and associated underground piping (Ecology 2020a). The City purchased the lots that comprise the property in several transactions between 1997 and 2000 and constructed Hammer Heritage Square in 2005 (Ecology 2020a).

Hammer Heritage Square is paved with concrete pavers and contains a gazebo, planters, and public restrooms. The park is the location of the Sedro-Woolley Farmers Market and other community events. (Ecology 2020a). Ten groundwater monitoring wells are currently on site, as shown on Figure 2.

2.3 Site Regulatory History

Environmental activities at the site began after the 1989 release, which was documented by Skagit County Department of Emergency Management, as described above.

Based on subsurface investigations and UST removals conducted on behalf of CEMC from 1991 through 1993, the City, in cooperation with CEMC, enrolled the site in Ecology's Voluntary Cleanup Program (VCP) in May 2000.

On September 6, 2000, Ecology sent a VCP Opinion letter to the City stating that additional work would be required to address environmental impacts at the site (Ecology 2020a).

Ecology sent a PLP status letter to CEMC on October 1, 2015, and a subsequent letter dated February 22, 2016 identified CEMC as a PLP at the site. An Ecology letter dated April 27, 2016 identified the City as an additional PLP for the site. On September 14, 2020, Ecology issued AO No. DE 18034 which requires the following actions and conditions:

- PLPs will complete an Agency Review Draft RI WP. The RI WP will include all actions needed to characterize impact extent at the site in all environmental media.
- Implement the RI WP and submit an Agency Review RI report.
- Implement potential interim actions if needed to reduce immediate threats to human and environmental health, to prevent issues at the site that may become substantially worse if remedial action is delayed, or if needed to complete the requirements of the AO.
- Prepare a Feasibility Study (FS) report to evaluate remedial alternatives for the site.
- Following Ecology's approval of the RI/FS, the PLPs will submit a preliminary Draft Cleanup Action Plan (DCAP).
- Comply with the State Environmental Policy Act (SEPA) and public participation processes.
- Attend key meetings listed in the AO and provide quarterly progress reports.

An AO Fact Sheet and Public Participation Plan were created by Ecology in June 2020 for public review (Ecology 2020c). Comments were accepted from June 22 to July 21, 2020. A virtual public meeting was hosted by Ecology on June 30, 2020. The presentation is available on Ecology's site information webpage, along with Ecology's response to public comments.

2.4 Environmental Setting

The site environmental setting is described below:

- **Site Elevation:** The site is generally flat, with surrounding areas sloping downhill to the south toward the Skagit River. Area elevations range from approximately 40 to 60 feet above sea level.
- **Climate:** Temperate climate with local annual precipitation averaging 46.5 inches. Local temperatures range from average lows in the mid-30s Fahrenheit in winter months to highs in the 70s Fahrenheit in summer months (U.S. Climate Data 2020).
- **Nearest Waterbodies:** The Skagit River is located 1.25 miles south of the site. Brickyard Creek is 0.5 mile northwest of the site. The closest drinking water wells are located approximately 0.5 mile northeast and 0.85 mile southwest and are not in hydraulic connection with the site (Ecology 2020b).
- **Site Soils:** Geology at the site is classified as the Vashon Till, a Quaternary glacial deposit characterized by gravel, silty sand, and silty clay (CRA 2009; Skagit County Public Health Department [SCPHD] 2018).
- **Site Groundwater:** Groundwater monitoring began at the site in 1992 and continued until September 2014. Monitoring frequency was typically quarterly, though several years only had semi-annual sampling.
    - Monitoring network: Fourteen groundwater monitoring wells have been installed at the site, though only 10 remain today. Groundwater monitoring wells MW-1 through MW-3 were installed in 1991 and decommissioned in 1992. Groundwater monitoring well MW-9 was decommissioned in 2001. The remaining groundwater monitoring wells were regularly sampled until 2014.
    - Observed depth to water: Depth to water at the site averages between 7 and 16 feet below ground surface (ft bgs) (CRA 2009; SCPHD 2018).
    - Groundwater elevation: Groundwater elevation ranges from approximately 43 to 52 ft above mean sea level.
    - Groundwater flow direction: Groundwater flow direction at the site is primarily toward the south, and has varied from south-southeast to south-southwest, with a hydraulic gradient ranging from 10^{-5} to 10^{-3} (CRA 2014, SCPHD 2018). A review of available historical groundwater contour maps indicated no seasonal or temporal trends observed. Available historical groundwater contour maps are included in Appendix D.
- **Site Surface Water:** Brickyard Creek is located approximately 0.5 miles to the northwest. No other surface water is present on or within 0.5 miles of the site, and no risks to surface water have been identified.
- **Site Sediment:** No risks to sediments have been identified.

3. PREVIOUS ENVIRONMENTAL INVESTIGATIONS

Investigations have been conducted at the site since 1989 and included soil, groundwater, soil vapor, and light non-aqueous phase liquid (LNAPL) assessment. Those investigations are summarized in the following sections. Historical boring logs are provided in Appendix C and historical maps and data are provided in Appendix D.

3.1 Soil Investigations

From 1991 to 2008, seven subsurface investigations were conducted to determine the extent of soil impacts in the vicinity of the former USTs and dispenser islands. Sixty-three soil samples were collected and submitted for laboratory analysis. EMCON conducted two subsurface soil investigations and two UST removal assessments from 1991 through 1993. Additional soil sampling was performed in 2002 and 2006 during the installation of groundwater monitoring wells. The most recent soil investigation at the site was conducted by CRA in April 2008, with five soil borings advanced to better identify the potential source of LNAPL at the site.

The 2008 investigation included five soil borings (GB-1 through GB-5) in the vicinity of former USTs and dispenser islands. Soil borings ranged in depth from 12 to 16 ft bgs.

- TPH-GRO was the only analyte detected above MTCA Method A CULs in soil samples. A maximum concentration of TPH-GRO of 110 mg/kg was detected at 5 feet bgs in the vicinity of the former USTs (boring GB-2) (CRA 2008a).
- The maximum TPH-GRO concentration detected near former dispenser islands (GB-4) was 380 mg/kg at 2 feet bgs, indicating that the dispenser islands were also not the likely source of LNAPL (CRA 2008a).

Additional soil data was collected in conjunction with excavations as described in Section 4.

Soil samples at the site have been analyzed for the following constituents: gasoline range organics (GRO), diesel range organics (DRO), heavy oil range organics (HO), benzene, toluene, ethylbenzene, and total xylenes (BTEX), lead, volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), priority pollutant metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver), carcinogenic polycyclic aromatic hydrocarbons (cPAHs), methyl tertiary-butyl ether (MTBE), ethylene dibromide (EDB), 1,2-Dichloroethane (EDC), tetrachloroethylene (PCE), and trichloroethylene (TCE).

Historically, soil concentrations of GRO, DRO, HO, and BTEX have been found in exceedance of MTCA Method A CULs between 2 and 12 ft bgs. All other constituents analyzed were below MTCA Method A CULs. Historical soil analytical data are shown in Table 1. The lateral extent of soil impacts is shown on Figure 3. Boring logs are provided in Appendix C.

3.2 Groundwater Investigations

Groundwater investigation began at the site in February 1991 with the installation of groundwater monitoring wells MW-1 through MW-5 by Sweet-Edwards/EMCON (EMCON). A total of 14 groundwater monitoring wells (MW-1 through MW-14) were installed at the site between 1991 and 2006. Ten

groundwater monitoring wells currently remain and constitute the groundwater monitoring well network. Groundwater monitoring well construction details are shown in Table 2.

Groundwater samples were regularly collected and analyzed for BTEX, GRO, DRO, HO, and lead (total and dissolved). MTBE, EDB, di-isopropyl ether (DIPE), ethyl tertiary-butyl ether (ETBE), tertiary amyl-methyl ether (TAME), tertiary butyl alcohol (TBA), and 1,2-dichloroethene (1,2-DCE) have also been included in several sampling events.

BTEX, GRO, DRO, HO, MTBE, and lead have been detected above MTCA Method A CULs. All other constituents analyzed were below, or do not have, MTCA Method A CULs.

Groundwater monitoring wells have been gauged from 1991 to 2014. LNAPL was first observed in October 1991 in groundwater monitoring well MW-3 at a thickness of 1.08 feet. LNAPL has been observed in groundwater monitoring wells MW-3, MW-7, MW-12, and MW-13. The maximum LNAPL thickness observed at the site was 1.85 feet at MW-13 in June 2007. No LNAPL has been observed at the site since 2009. A sheen was also historically observed in groundwater monitoring wells MW-1, MW-4, and MW-5; however, no LNAPL was measured in those wells.

In 2008 CRA conducted a subsurface investigation to identify the potential source of LNAPL. During the 2008 investigation, LNAPL was observed in groundwater monitoring wells MW-7, MW-12, and MW-13 at thicknesses ranging from 0.03 feet (MW-7) to 0.024 feet (MW-13) (CRA 2008a). The investigation included five soil borings (GB-1 through GB-5) in the vicinity of former USTs and dispenser islands to depths of 12 to 16 ft bgs. Grab groundwater samples were collected from temporary wells installed in each boring. Based on analytical results, a source area for LNAPL was not determined.

- Groundwater in one boring (GB-5) indicated elevated concentrations of TPH-GRO at 1,100 ug/L and TPH-DRO at 990 ug/L. These concentrations, however, were not indicative of LNAPL (CRA 2008).

Groundwater results are shown in Tables 3 through 7. Available boring logs are presented in Appendix C.

3.3 Soil Vapor Investigations

Three nested vapor probes (VP-1 through VP-3) were installed by CRA in October 2007 to assess the potential of vapor intrusion (VI) downgradient from the site. The probes were installed at 4.5 and 7.5 ft bgs at each vapor probe near wells MW-10, MW-11, and MW-14 (Figure 2). Vapor samples were analyzed for BTEX according to United States Environmental Protection Agency (USEPA) Method TO-15 and oxygen, carbon dioxide, and methane by ASTM International (ASTM) Method D-1946. A Johnson & Ettinger Vapor Intrusion Model concluded that the analytes did not pose a VI risk (CRA 2008b). However, comparing results to current MTCA screening levels indicates that detected concentrations of benzene exceeded the MTCA Method B Sub-Slab Soil Gas Screening Level in one sample (VP-1-8). Soil vapor was not analyzed for TPH. The 2007 soil vapor data are shown in Table 8 and on Figure 6.

4. SUMMARY OF PREVIOUS REMEDIAL ACTIONS

4.1 UST and Site Structure Removals

In June and July 1991, EMCON removed two USTs (one 550-gallon used oil UST and one 300-gallon kerosene UST) located in the southwestern portion of the property. The USTs were within a concrete vault that was part of a former building. In June 1991, Northwest Enviroservices, Inc. “pumped and removed approximately 20 gallons of accumulated product, water, and saturated soil from the base of the vault” (EMCON 1993).

In February 1992, EMCON removed the remaining six USTs: one 3,000-gallon supreme unleaded gasoline UST, one 6,500-gallon unleaded gasoline UST, one 8,000-gallon leaded gasoline UST, one 550-gallon heating oil UST, one 300-gallon UST with unknown contents, and one 100-gallon UST with unknown contents. The pump islands, hoists, underground fuel infrastructure, and former station building were also demolished and removed during this event. Concentrations of TPH and BTEX constituents were detected above MTCA Method A CULs in soil samples collected from the sidewalls and floors of the excavations. Soil removed was placed back into excavations (EMCON 1993).

4.2 1992 Excavations

In June 1992, four excavations were performed at the vault area, the gasoline USTs and pump island area, and the used oil and kerosene USTs area. Groundwater monitoring wells MW-1, MW-2, and MW-3 were destroyed as part of these excavations. Excavation areas and soil sample locations are shown on Figure 3.

The vault area was excavated to a maximum depth of 19 ft bgs, with an average excavation depth of 10 to 12 ft bgs. Approximately 300 gallons of groundwater that seeped into the excavation area were pumped and removed as well as 50 cubic yards of soil. An additional 50 cubic yards of soil were excavated and removed from the heating oil UST area. Two soil samples (VA-SEF 12 and VA-NW-12) exceeded MTCA Method A CULs.

The excavation surrounding the former used oil and kerosene USTs extended to a maximum depth of 19 ft bgs near groundwater monitoring well MW-3, with an average excavation depth of 10 to 12 ft bgs. Groundwater with sheen seeped into the excavation area at 13 ft bgs, and approximately 500 gallons were pumped and removed. Approximately 350 cubic yards of soil were excavated in this area. Two soil samples (FUOE-WW-8 and FUOE-NWC-7) exceeded MTCA Method A CULs at the west and northwest limits of the excavation, near the footings of the west-adjoining building.

The excavation near the former gasoline USTs and pump islands extended to a maximum depth of 20 ft bgs near the center of the former gasoline USTs area, with an average depth of 12 to 15 ft bgs. Groundwater with a hydrocarbon sheen seeped into the excavation area at 13 ft bgs, and approximately 4,000 gallons were pumped and removed. An estimated 1,800 cubic yards of soil were excavated from this area (EMCON 1992). Three soil samples (FPIA-ESW-8, FPIA-EW-8, and FPIA-SWW-8) from the eastern limit of the pump island excavation area exceeded MTCA Method A Cleanup Levels.

The excavated soil from the heating oil UST, vault, used oil, and kerosene UST areas (450 cubic yards) was disposed of offsite. The excavated soil from the gasoline USTs and pump areas (1,800 cubic yards) was sifted through a mechanical screening Read DR-40 Screen-All device that aerated soil to volatilize hydrocarbons. All soils excavated from the gasoline UST and pump area were stockpiled and screened via photoionization detector (PID) and laboratory analytical samples (analyzed for TPH and BTEX) to ensure treatment below MTCA Method A CULs and then used as backfill (EMCON 1993).

Samples collected from excavation sidewalls and floors were analyzed for GRO, DRO, HO and BTEX. GRO, toluene, and total xylenes were detected above the MTCA Method A CULs. GRO and BTEX concentrations exceeded MTCA Method A CULs in two samples collected from the northwestern/western sidewalls of the used oil UST area excavation, three samples from the eastern/southern sidewall of the pump island area excavation, and two samples collected from the limits of the vault excavation. BTEX concentrations exceeded MTCA Method A CULs in four soil samples from the pump island area and vault excavations. The remaining soil samples collected at the limits of the former gasoline UST complex, pump island area, and vault area excavations did not exceed MTCA Method A CULs (EMCON 1993).

Total lead analysis was conducted on soil samples from the gasoline UST excavation area and excavated soils. Total lead was either not detected above laboratory reporting limits or was detected below MTCA Method A CULs (EMCON 1993).

The soil sample collected from beneath the service bay floor drain (SBFD-4) was submitted for analysis of volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), and priority pollutant metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver). VOCs, PCBs, and metals were not detected above the laboratory reporting limits in soil sample SBFD-4 (EMCON 1993).

4.3 Bimonthly Vacuum Extraction

Bimonthly vacuum truck extraction events were performed on groundwater monitoring wells MW-7 and MW-13 between March 2006 and May 2007. Extractions were discontinued due to insufficient LNAPL reduction and the appearance of LNAPL in MW-13, where it was detected at 1.85 feet in June 2007 (CRA 2009).

4.4 2009 Injections

To decrease the LNAPL observed in groundwater monitoring wells MW-7, MW-12, and MW-13, which contained LNAPL thicknesses of 0.01, 0.7, and 0.01 feet at the time, Gold Crew HAD-O81 non-ionic surfactant at 4 percent (%) concentration was injected into these wells in September 2009. Approximately 85 gallons of surfactant were injected into groundwater monitoring wells MW-12 and MW-13 at a rate of 5.7 gallons per minute; and approximately 75 gallons were injected into groundwater monitoring well MW-7 over two hours. A vacuum truck then extracted 720 gallons of groundwater from the affected groundwater monitoring wells over the next several days (CRA 2009; Ecology 2008).

Subsequent groundwater monitoring in October 2009 found that the injections and vacuum extractions were effective at removing LNAPL from groundwater monitoring wells MW-7, MW-12, and MW-13. However, no decrease in hydrocarbon concentrations was observed in groundwater monitoring wells

MW-4, MW-8, MW-10, and MW-11. Hydrocarbon concentrations increased at well MW-14 following injections (CRA 2009). No LNAPL has been observed in the treated wells since October 2009.

5. NATURE AND EXTENT OF CONTAMINATION

This section describes the type of contaminants at the site (nature) and the distribution of these contaminants vertically and horizontally across the site (extent). The nature and extent of contamination were identified based on data collected during site investigations described in Section 3 and site remediation described in Section 4.

5.1 Soil Quality

Seven soil sampling events were completed at the site. Initial soil sampling activities in 1991 and 1992 were performed in tandem with UST closure and excavation activities. Soil compliance status with MTCA Method A CUL is presented on Figure 3.

Soil samples were analyzed for the following:

- GRO/DRO/HO: 1991, 1992, 2002, 2006, 2008
- BTEX: 1991, 1992, 2002, 2006, 2008
- Lead: 1992
- PCBs: 1992
- PAHs (includes naphthalene and cPAHs): 2008
- MTBE, EDB, EDC, PCE, and TCE: 2008.

The table below summarizes the maximum soil concentrations historically observed at the site for COCs detected above MTCA Method A CULs. Soils that have been excavated are not included in this table.

	MTCA Method A CULs (mg/kg)	Historical maximum concentration detected (mg/kg)	Date and lot of historical maximum concentration detected
GRO	30/100	9,400	1992; EPIF, 9.5 ft
DRO	2,000	5,080	1991; MW-9, 10 ft
HO	2,000	2,130	1992; FUOE-NWC, 7 ft
Benzene	0.03	17	1991; UOF-1; 7.5 ft
Toluene	7	83	1991; UOF-1; 7.5 ft
Ethylbenzene	6	130	1992; EPIF, 9.5 ft
Total Xylenes	9	680	1992; EPIF, 9.5 ft

Notes: mg/kg = milligrams per kilogram.
DRO=Diesel Range Organic compounds measured using NWTPH-Dx
HO=Organic compounds measured using NWTPH-Dx

Concentrations of lead, PCBs, PAHs, MTBE, EDB, EDC, PCE, and TCE were non-detect or below MTCA Method A CULs

5.1 Groundwater Quality

Groundwater monitoring at the site began in 1992. A total of 14 groundwater monitoring wells were installed at the site (MW-1 to MW-14), four of which have been decommissioned (MW-1 through MW-3, and MW-9). Historical groundwater quality is defined using groundwater data from 1992 to 2014. Current groundwater quality is defined as groundwater data from the most recent groundwater sampling event conducted in August 2020. Historical and current groundwater data are further discussed below and provided in Tables 3 through 7.

5.1.1 Historical Groundwater Quality

Groundwater samples were historically collected from 14 groundwater monitoring wells at the site. Groundwater analytical samples were not collected from groundwater monitoring wells that contained measurable LNAPL, which at times included groundwater monitoring wells MW-3, MW-7, MW-12, and MW-13. Historical groundwater compliance status with MTCA Method A CUL is presented on Figure 4.

Groundwater samples were analyzed routinely for the following constituents of concern (COCs):

- GRO
- DRO (with and without silica gel cleanup)
- HO (with and without silica gel cleanup)
- BTEX

Additional analytes have also been included periodically:

- MTBE
- Total lead
- EDB
- TBA
- DIPE
- ETBE
- TAME
- cPAHs (including benzo(a)pyrene)
- EDC

The table below summarizes the maximum groundwater concentrations of constituents historically observed above MTCA Method A CULs on site. Note that TBA has been detected but there is no MTCA Method A CUL for TBA. All other analytes were non-detect or below MTCA Method A CULs.

	MTCA Method A CULs (µg/L)	Historical maximum concentration detected (µg/L)	Date and well of historical maximum concentration detected
GRO	800/1000	980,000	2009; MW-12
DRO	500	Without silica gel: 530,000 With silica gel: 67,000	2009; MW-7 2011; MW-11
HO	500	Without silica gel: 530,000 With silica gel: 3,400	2009; MW-12 2009; MW-12
Benzene	5	4,600	1992; MW-8
Toluene	1000	7,440	1998; MW-7
Ethylbenzene	700	16,000	1993; MW-8
Total Xylenes	1,000	13,000	1993; MW-7
MTBE	20	70	2002; MW-11
Lead	15	920	2006: MW-7
Benzo(a)pyrene	0.1	0.23	2007: MW-7

Notes: µg/L = micrograms per liter
DRO=Diesel Range Organic compounds measured using NWTPH-Dx
HO=Organic compounds measured using NWTPH-Dx

5.1.2 Current Groundwater Quality

The most recent groundwater sampling event was performed in August 2020. Samples were collected from the 10 remaining groundwater monitoring wells (MW-4 through MW-8 and MW-10 through MW-14). Current groundwater compliance status with MTCA Method A CULs is presented on Figure 5.

Based on historical groundwater data and MTCA testing requirements for petroleum releases, groundwater samples were analyzed in August 2020 for the following potential COCs:

- GRO
- DRO
- HO
- BTEX
- Total lead
- Total naphthalenes
- cPAHs.

Samples from five groundwater monitoring wells (MW-7, MW-8, MW-11, MW-13, and MW-14) contained concentrations of GRO and/or DRO above MTCA Method A CULs. COCs were either not detected, or were detected at concentrations below MTCA Method A CULs in samples from the other five groundwater monitoring wells (MW-4, MW-5, MW-6, MW-10, and MW-12)

The table below summarizes the maximum groundwater concentrations in 2020.

	Constituents detected above MRLs	Maximum concentration detected (August 2020)	Well ID of maximum concentration detected (August 2020)	Constituents detected above MTCA Method A CUL
GRO	Yes	6,210	MW-8	Yes
DRO	Yes	731	MW-13	Yes
HO	No	143 J	MW-7	No
Benzene	Yes	3.76	MW-11	No
Toluene	Yes	4.55	MW-14	No
Ethylbenzene	Yes	143	MW-14	No
Total Xylenes	Yes	488	MW-7	No
Total Lead	Yes	9.29	MW-5	No
Total Naphthalenes	Yes	100.5	MW-11	No
Total cPAHs	No	Non-detect	All wells	No

5.2 Light Non-aqueous Phase Liquid

LNAPL was historically observed at a thickness of 0.01 foot or greater in four groundwater monitoring wells. The maximum historical LNAPL thickness was 1.85 feet in 2007. LNAPL has not been observed since 2009.

A summary of historical LNAPL detections is included in the table below.

Well	Date of first occurrence of LNAPL	Historical maximum thickness (feet)	Date of most recent measurable thickness	Most recent measurable thickness (feet)
MW-3	10/21/1991	1.08	10/21/1991	1.08
MW-7	2/24/1993	0.15	11/20/2008	0.01
MW-12	6/16/2008	0.7	9/22/2009	0.7
MW-13	6/4/2007	1.85	10/15/2009	0.01

5.3 Soil Vapor Conditions

Comparing 2007 soil vapor investigation results (samples analyzed for BTEX only) to current MTCA screening levels indicates that concentrations of benzene exceeded the MTCA Method B Sub-Slab Soil Gas Screening Level in one sample (VP-1-8). Benzene concentrations of a shallower sample in VP-1 (VP-1-5) did not exceed the MTCA Method B Sub-Slab Soil Gas Screening level.

The table below summarizes the maximum soil vapor concentrations in 2007.

	Constituents detected above MRLs	Maximum concentration detected (ug/m3)	Vapor point ID of maximum concentration detected	Constituents detected above MTCA Method B Sub-Slab Soil Gas Screening Level
Benzene	Yes	17.0	VP-1	Yes
Toluene	Yes	38.0	VP-3	No
Ethylbenzene	Yes	41.0	VP-1	No
Total Xylenes	Yes	172.0	VP-1	No

Soil vapor probe locations and 2007 soil vapor data is presented on Figure 6 and in Table 8.

5.4 Data Gaps

Figures 3, 4, and 5 present the historical and current lateral and vertical extent of known impacts.

Soil impacts are shown on Figure 3. Analysis of 63 soil samples collected onsite indicated that soil impacts are primarily in the vicinity of former USTs. Soil impacts have not been fully delineated to the north and west of the vicinity of the former gasoline USTs, to the south of the vault area or to the east of the property.

As shown on Figure 5, groundwater is delineated to the north and east. Current groundwater analytical results from groundwater monitoring wells MW-4, MW-5, MW-6, MW-10 and MW-12 are below MTCA Method A CULs; however, additional groundwater delineation is warranted to the south, southeast, and southwest. MTCA Method A CUL historical exceedances were in groundwater monitoring wells located on the northern portion of the property (MW-1, MW-3, and MW-9), as shown on Figure 4. Groundwater monitoring wells on the northwestern portion of the property and central portion of the property have been destroyed; therefore, additional groundwater monitoring wells are warranted in this area to further evaluate groundwater impacts at the site.

Additional soil vapor sampling is needed to evaluate current soil vapor quality against MTCA screening levels, including TPH concentrations.

6. PRELIMINARY CONCEPTUAL SITE MODEL

The conceptual site model uses data collected during previous investigations and remediation activities to understand constituent occurrence, movement, and potential exposures at the site.

6.1 Source Characterization

As described in Sections 3 and 4, multiple investigations and remediation activities have been conducted at the site. Known sources of contamination are the gasoline release in 1989 and former USTs and dispenser islands. No other known source has been identified onsite. A 2008 subsurface investigation was conducted to determine whether an additional source existed on site; however, no indication of an additional source was discovered. Additional investigation is required to fully delineate the nature and

extent of the impacts associated with the former site activities. Characterization and delineation impacts will be discussed in the RI.

Based on known sources of contamination and on MTCA Table 830-1. Required Testing for Petroleum Releases (WAC 173-340-900), MTCA requires testing for the following chemicals: GRO, DRO, HO, BTEX, EDB. EDC. MTBE, lead, and cPAHs, , as well as PCBs and VOCs at the used oil UST location.

Results of analytical testing conducted during previous environmental investigations at the site have indicated that EDB, EDC, cPAHs (except for benzo(a)pyrene at MW-7 in 2007), PCBs, , DIPE, ETBE, TAME, TBA, TCE, and PCE are below MTCA Method A CULs.

Based on those results, GRO, DRO, HO, BTEX, MTBE, and lead are required for further analyses at the site. Additionally, based on the benzo(a) pyrene exceedance in MW-7, groundwater in MW-7 will also be analyzed for cPAHs.

6.2 Fate and Transport

6.2.1 General Fate and Transport Mechanism

As a generality (non-site-specific), petroleum hydrocarbons can exist in four phases in soils (unsaturated vadose zone and/or smear zone):

- *Residual phase*. Petroleum hydrocarbons are sorbed to soil or trapped within soil pore space.
- *Dissolved or aqueous phase*. Petroleum hydrocarbons are dissolved in water within soil pore space.
- *Vapor phase*. Petroleum hydrocarbons are volatilized into soil pore space.
- *Free phase*. Recoverable LNAPL.

Following a release, petroleum hydrocarbons are driven by gravity toward the water table and, depending on the quantity released, soil type, and depth to groundwater, may reach the groundwater table. As the hydrocarbons migrate toward the water table, residual LNAPL may be left behind in each of the phases (residual, dissolved, and free).

When residual-, dissolved-, or free-phase LNAPL comes into contact with groundwater, dissolution of the hydrocarbons to the groundwater can occur. If a release of petroleum hydrocarbons is large enough, LNAPL may overcome the capillary forces at the capillary fringe within smear zone soil and pool on top of the groundwater. When rainwater infiltrates subsurface soil in the area of a release, the water will flow downward through the soil and may preferentially follow high-conductivity soil lenses horizontally before reaching groundwater.

6.2.2 Site Fate and Transport Mechanism

Petroleum hydrocarbons encountered at the site are described below:

- *Residual phase*. Previous soil investigations indicated that residual soil impacts at the site are primarily in the vicinity of former used oil and gasoline USTs and dispenser islands. Soil impacts were encountered at a range from 2 to 12 ft bgs.

- *Dissolved phase*. The last four consecutive quarters of groundwater monitoring were completed in 2013 and 2014 and analytical results are shown in Table 5. Groundwater analytical results from August 2020 indicate that concentrations of all COCs in samples collected from groundwater monitoring wells MW-10 and MW-12 were below applicable MTCA Method A CULs. Groundwater samples collected from groundwater monitoring wells MW-7, MW-8, MW-11, MW-13, and MW-14 showed concentrations of GRO and DRO, above MTCA Method A CULs. Additional delineation is warranted to the southwest of the site, the southeast, and to the south across Ferry Street. Historical MTCA Method A CUL exceedances were in groundwater monitoring wells located on the northern portion of the property (MW-1, MW-3, and MW-9).
- *Vapor phase*. The vapor investigation at VP-1, VP-2, and VP-3 in 2007 concluded that there was no risk of VI to receptors; however, concentrations of benzene exceeded current MTCA Screening Levels for one sample (VP-1-8), and the 2007 samples were not analyzed for TPH. Therefore, additional vapor sampling and analysis is warranted.
- *Free phase*. LNAPL was observed in MW-3 in 1991, and in MW-7, MW-12, and MW-13 in 2009. No LNAPL has been observed on or off-Property since 2009. Therefore, there is no risk of free phase migration at the site.

6.3 Exposure Pathways and Potential Receptors

6.3.1 Potential Receptors

The primary human receptors at the site are workers, customers of surrounding businesses, including the businesses located south across Ferry Street, and potential future construction workers.

Current ecological receptors are limited due to the presence of primarily paved areas and landscaping at the site. Additionally, due to the location of the site and its land use designation, future native and invasive vegetation are not expected to grow at the site.

There is less than 1.5 acres of contiguous undeveloped land on or within 500 feet of any area of the site; therefore, no further terrestrial ecological evaluation is required under WAC 173-240-749(1)(c). The Terrestrial Ecological Evaluation Form is included in Appendix C.

6.3.2 Potential Exposure Pathways

Potential exposure pathways for the site are:

- *Soil*. Potential exposure to soil via incidental ingestion, dermal contact, and inhalation of windblown dust and leaching to groundwater.
- *Groundwater*. Potential exposure to groundwater via incidental ingestion and dermal contact.
- *Soil vapor*. Potential exposure to soil vapor via inhalation (volatilization of petroleum impacts contained in groundwater and/or soil).

Potential exposure pathways are evaluated below.

6.3.2.1 Potential Soil Exposure Pathways

Potential soil exposure pathways for the site include:

Soil samples collected during a 2008 soil investigation indicated GRO concentrations above the MTCA Method A CUL at depths of 2 to 12 ft bgs.

- *Exposure to soil via incidental ingestion, dermal contact, and inhalation of windblown dust*. The site is primarily paved, therefore potential exposure via incidental ingestion, dermal contact, or inhalation of windblown dust is not a complete pathway for visitors of Hammer Heritage Square. Potential exposure via incidental ingestion, dermal contact, or inhalation of windblown dust for construction workers is a complete pathway as soil concentrations above MTCA Method A CULs are observed as shallow as 2 ft bgs.
- *Soil leaching to groundwater*. COC concentrations in groundwater have been shown to be above Method A groundwater CULs. Therefore, the soil leaching to groundwater pathway is potentially complete.

6.3.2.2 Potential Groundwater Exposure Pathway

Groundwater analytical data from groundwater sampling events in 2013, 2014, and 2020 showed concentrations of GRO and DRO above MTCA Method A CULs. Current human receptors (park visitors) are not exposed to groundwater. Groundwater beneath the site is not used as drinking water. Drinking water in the area comes from Judy Reservoir, located above the town of Clear Lake, Washington. Due to the depth of groundwater (ranging from 8 to 12 ft bgs) and its current use, no ingestion or dermal contact are likely.

6.3.2.3 Soil Vapor Potential Pathway

The vapor investigation at VP-1, VP-2, and VP-3 (located across Ferry Street to the south of the property) in 2007 concluded that there was no risk of VI to receptors. Comparing the 2007 data to current MTCA screening levels, concentrations of benzene exceeded the MTCA Method B Sub-Slab Soil Gas Screening Level in one sample (VP-1-8). Benzene concentrations of a shallower sample in VP-1 (VP-1-5) did not exceed the MTCA Method B Sub-Slab Soil Gas Screening level. In addition, vapor samples were not analyzed for TPH in 2007. Therefore, additional VI analysis is needed to evaluate current conditions. Because the site is mostly paved and open-air, current human receptors (park visitors) are not likely to be exposed to vapor phase petroleum hydrocarbons. Current human receptors (workers and patrons of businesses located across Ferry Street to the south) may be exposed to vapor phase petroleum hydrocarbons. Future construction workers may be exposed to the vapor phase petroleum hydrocarbons through inhalation when working at depths of 2 feet bgs or greater.

7 SAMPLING AND ANALYSIS PLAN

The RI will include sampling and analysis of soil, groundwater, and soil vapor, as described below.

7.1 Pre-field Activities

Before mobilizing to the site, Arcadis will perform the following activities:

- Update the site-specific health and safety plan and prepare job safety analyses and traffic control plans, as appropriate;
- Secure ROW permits from the City, as appropriate;
- Notify Ecology at least 14 days prior to commencing field work;
- Mark the proposed sample locations and contact the state one-call public locate service a minimum of 48 hours prior to initiating the field activities; and
- Contract a private utility locator to additionally identify potential conflicting utilities or other underground structures in addition to potential preferential pathways.

7.2 Utility Locate

At least 48 hours prior to conducting subsurface activities, the Washington811 will be notified to mark known public utilities within the work areas. A utility locate survey was conducted in August 2020, and survey results, along with utility site plans provided by the City of Sedro Woolley, were used to map utilities shown on Figure 7. In addition, a private utility locating company will conduct a utility scan within 24 hours of the start of the investigation, including the use of ground-penetrating radar, to confirm that the proposed boring locations are clear of underground utilities or other features.

7.3 Soil Investigation

Ten borings will be advanced at the site, and seven will be subsequently completed as groundwater monitoring wells, as described in section 7.4. Borings will be pre-cleared by air knife, vacuum truck, and/or hand auger to a minimum depth of 5 ft bgs. After pre-clearance, boreholes will be advanced using direct-push technology or hollow stem auger drilling methods to a target depth of approximately 20 ft bgs. Soil borings may be advanced beyond the target depth if visible staining and/or elevated VOC screening measurements are observed. One boring will be installed south of MW-8, one boring will be installed on the northwest adjoining property, northwest of the former used oil UST, and one boring will be installed east of the property in the vicinity of the former pump island (Figure 7). Locations of remaining borings (to be completed as monitoring wells) are described in Section 7.4.

During pre-clearance, soil samples will be collected by hand auger at approximately 2.5 ft bgs for lithologic logging in accordance with the Arcadis TGI for Soil Description (Appendix E) and screened for VOCs using a PID. During drilling, Arcadis will conduct lithologic logging in accordance with the Arcadis TGI for Soil Description (Appendix E) and soil samples will be collected for laboratory analysis at minimum 5-foot intervals and the total depth of boring. Additional soil samples may be collected for laboratory analysis based on field observations.

Soil will be screened for VOCs using a calibrated PID. Field screening samples will be collected at 2.5-foot intervals using a hand auger during pre-clearing activities. Field samples will be placed into sealed zipper-locked bags for visual inspection and VOC screening.

Soil samples for laboratory analysis will be collected at the groundwater interface and at depths in the vadose or saturated zone, wherever PID readings are highest. In the absence of elevated PID readings, analytical samples may be collected for laboratory analysis to characterize soil based on field observations. A minimum of two soil samples collected from each boring, will be submitted for laboratory analysis.

7.3.1 Laboratory Analysis

Soil samples will be placed in an ice-chilled cooler, and sent to an Ecology-accredited laboratory under chain-of-custody protocol. Soil samples will be analyzed for the following:

- GRO analyzed by Northwest Method Total Petroleum Hydrocarbons – Gasoline (NWTPH-Gx)
- DRO and HO analyzed by Northwest Method Total Petroleum Hydrocarbons – Gasoline (NWTPH-Dx)
- BTEX by USEPA Method 8260
- Lead by USEPA Method 6010
- MTBE by USEPA Method 8260

In addition, soil samples that exceed MTCA Method A CULs for DRO will be analyzed for cPAHs by USEPA Method 8270.

7.4 Groundwater Investigation

Arcadis proposes to install a total of seven groundwater monitoring wells depending on site access and constraints. One groundwater monitoring wells will be installed on the northern portion of the site. Two groundwater monitoring wells will be installed on the central portion of the site. One groundwater monitoring well will be installed in the sidewalk to the southwest of the site. One groundwater monitoring well will be installed in the sidewalk southeast of the site. One groundwater monitoring well will be installed in the alley, across Ferry Street, southwest of the site. One groundwater monitoring well will be installed in the alley south of the restaurant/retail building located across Ferry Street. Proposed groundwater monitoring well locations are shown on Figure 7.

Groundwater monitoring wells will be installed in accordance with the Washington Administrative Code by a licensed Washington driller. Groundwater monitoring wells will be installed to a target depth of 20 ft bgs.

Each well will be constructed of 2-inch-diameter Schedule 40 polyvinyl chloride (PVC) with 0.010-inch slotted screen from approximately 5 to 20 ft bgs. Blank PVC casing will be installed from the top of the screen to near surface grade. Sand filter pack will be placed in the annular space of the borehole from the bottom of the boring to approximately 1 foot above the top of the well screen, followed by a transition seal consisting of hydrated bentonite chips to approximately 2 ft bgs. The remaining open borehole annulus will be sealed with neat cement to near ground surface.

The wellheads will be completed at the ground surface with a locking well cap and traffic-rated bolt-down well vault. Following the installation of monitoring wells, well location, ground surface, and top-of-casing elevations will be surveyed by a professional Washington-licensed land surveyor. Monitoring wells will be

developed to ensure removal of fine-grained sediments from the vicinity of the well screen. The well development will include surging the screen interval and purging fine-grained material out of the well in accordance with TGI – Monitoring Well Development (Appendix E). Purge water will be contained in Department of Transportation-approved 55-gallon steel drums and temporarily stored on site.

Arcadis will return to the site a minimum of 72 hours after the groundwater monitoring wells are developed to collect groundwater samples. Groundwater samples will be collected using low-flow methods and in accordance with the methodology described in the Arcadis TGI for Standard Groundwater Sampling for Monitoring Wells (Appendix E).

During purging, water quality parameters (dissolved oxygen, oxidation-reduction potential, pH, conductivity, and temperature) will be monitored. Groundwater elevation and sampling times will be recorded.

7.4.1 Laboratory Analysis

Groundwater samples will be preserved on ice, placed in a cooler, and sent to an Ecology-accredited laboratory under chain-of-custody protocol for the following analysis:

- GRO by NWTPH-Gx
- DRO and HO by NWTPH-Dx
- BTEX by USEPA Method 8260
- Dissolved Lead by USEPA Method 6000 series
- MTBE by USEPA Method 8260

Based on the 2007 benzo(a) pyrene exceedance in MW-7, groundwater in MW-7 will also be analyzed for cPAHs by USEPA Method 8270E

7.5 Soil Vapor Investigation

To further evaluate current soil vapor conditions and the results from the 2007 investigation, soil vapor samples will be collected from the three existing soil vapor points (VP-1, VP-2, and VP-3) shown on Figure 7.

Sample trains will be constructed and connected to soil vapor probes for purging and sampling. Sample trains will be constructed at each sample location to allow for purging and sample collection. Sampling trains will be assembled using 0.25-inch Teflon tubing (or equivalent) with stainless steel compression fittings and connected to the soil vapor probes. Prior to sampling, approximately 1,500 milliliters (mL) of stagnant air will be purged from the soil vapor probe and sample train to ensure samples are representative of subsurface conditions. The volume purged from the soil vapor probe is calculated based on the construction details of the existing soil vapor probes and a standard three-volume purge.

Soil vapor samples will be collected using 1-liter stainless steel passivated canisters individually cleaned and batch certified by a Washington-certified laboratory. Canisters will be connected to soil vapor sampling regulators set to less than 200 milliliters per minute (mL/min). Canisters will be allowed to collect for up to 10 minutes or when the remaining vacuum reaches 5 inches of mercury (inHg), whichever is

first. Soil vapor samples will be evaluated, and an additional sampling event will be completed to evaluate potential temporal and seasonal variability.

7.5.1 Quality Control Testing

Several quality control tests and sampling will be completed during the sampling event to ensure data quality. One duplicate sample will be collected from the soil vapor probes. An equipment blank sample will also be collected from the passivated canisters and sample train materials (tubing and fittings) to ensure equipment cleanliness.

Prior to soil vapor sampling, the sample train will be shut-in tested to evaluate the integrity of the sampling system. The sample train and soil vapor probe will be leak tested using a gaseous tracer (high purity helium) concurrently with purging to ensure no significant ambient air leakage had taken place. Purged soil vapor from purge volume testing will also be measured for helium as a pre-sampling leak detection procedure. Potential leakage will be calculated using the following formula:

$$\%\ Leakage = \frac{Helium\ Concentration\ in\ Sample\ or\ Purged\ Air\ (\%)}{Helium\ Concentration\ in\ Shroud\ (\%)}\ X\ 100$$

If leaks are observed in the field from shut-in or leak testing, fittings will be tightened or replaced, and the test will be repeated until no observable leaks are present.

7.5.2 Laboratory Analysis

Samples will be submitted to an Ecology-accredited laboratory under standard chain-of-custody procedures for analysis of the following analytes:

- Total petroleum hydrocarbons (TPH) with carbon chain specific results: EC5-8 (aliphatics), EC9-12 (aliphatics), and EC9-10 (aromatics) by TPH Massachusetts Air Phase Hydrocarbons (APH)
- BTEX, naphthalene, and MTBE by USEPA Method TO-15
- Oxygen, carbon dioxide, methane, and helium by ASTM Method 1946.

7.6 Quality Assurance and Quality Control Samples

The following quality assurance and quality control (QA/QC) samples will be collected during the sampling event.

- One field duplicate sample of soil vapor, groundwater, and soil will be collected and submitted as blind samples to the analytical laboratory per 10 samples
- One matrix spike/matrix spike duplicate per 20 samples
- One rinsate blank sample per day for decontaminated, non-dedicated sampling equipment, as needed
- One trip blank per cooler containing samples that will be analyzed for BTEX and GRO.

- One equipment blank sample will be collected from the vapor sampling equipment to ensure equipment cleanliness.

7.7 Sample Nomenclature

Samples will be identified with a unique alpha-numeric nomenclature that will include the type of sample and the location where the sample was collected. The following sample nomenclature will be used:

- Groundwater samples will be labeled with the monitoring well designation.
- QA samples will be given the following labels:
    - Field duplicate samples will be given the prefix “DUP-“ and the date the sample was collected. For example, a field duplicate for a groundwater sample collected on February 1, 2021 would be labeled DUP-1-020121.
    - Matrix spike and matrix spike duplicate samples will be labeled with the sample ID followed by an “MS” for matrix spike or “MSD” for matrix spike duplicate. For example, a matrix spike sample collected from MW-21 would be labeled MW-21-MS.
    - Rinsate blank samples will be given the prefix “RS-“ and the date the sample was collected. For example, a rinsate blank for decontaminated, non-dedicated sampling equipment collected on February 1, 2021 would be labeled RS-1-020121.
    - Trip blank samples will be given the prefix “TB-“ followed by the date of the shipment. For example, a trip blank sample collected on February 1, 2021 would be labeled TB-020121.

7.8 Sample Labeling, Handling, and Chain of Custody

Sampling handling and packaging will be performed in accordance with the procedures outlined in the Standard Operating Procedure for Sample Chain of Custody (Appendix E). All sample container labels will be completed with the following information:

- Project name and project number
- Sample designation
- Name or initials of the sampler
- Date and time of sample collection.

7.9 Equipment Decontamination and Residuals Management

Equipment decontamination will be performed using the procedures outlined in the TGI for Field Equipment Decontamination (Appendix E). Site personnel will perform decontamination of all equipment prior to leaving the site and between sample locations.

All water, decontamination liquids, personal protective equipment, and other waste generated during the field sampling activities will be managed in accordance with applicable local, state, and federal requirements.

Waste profiles will be generated for each waste stream to be transported off site as required by the selected disposal facility. Disposal characterization samples will be collected as needed to meet facility requirements.

7.10 Management of Investigation-Derived Wastes

Soil cuttings, purged groundwater, and equipment rinse water generated during investigation activities will be contained in Department of Transportation-approved 55-gallon steel drums. The investigation-derived waste (IDW) will be labeled and stored on site pending disposal. Following receipt of laboratory analytical data, the soil and water IDW will be collected and transported for appropriate disposal at a certified waste disposal facility.

8 QUALITY ASSURANCE PROJECT PLAN

8.1 Field Instruments and Equipment

Prior to field sampling, each piece of field equipment will be inspected to confirm that it is operational and calibrated in accordance with the manufacturer's instruction manual or the analytical method used. All meters that require charging or batteries will be fully charged or have fresh batteries. If instrument servicing is required, the maintenance arrangements will be made for timely service. Field instruments will be maintained according to the instructions provided by the manufacturer. Logbooks for each piece of equipment will be maintained in project records.

8.2 Laboratory Instruments and Equipment

Laboratory instrument and equipment documentation procedures include details of any observed problems, corrective measure(s), routine maintenance, and instrument repair (including information regarding the repair and the individual who performed the repair). Preventive maintenance of laboratory equipment generally will follow the guidelines recommended by the manufacturer. A malfunctioning instrument will be repaired immediately by in-house laboratory staff or through a service call from the manufacturer. Paperwork associated with service calls and preventive maintenance calls will be kept on file by the laboratory.

The laboratory manager will be responsible for the routine maintenance of instruments used in the particular laboratory. Any routine preventive maintenance carried out is logged into the appropriate logbooks. The frequency of routine maintenance is dictated by the nature of samples being analyzed, the requirements of the method used, and/or the judgment of the laboratory manager.

All major instruments are backed up by comparable (if not equivalent) instrument systems in the event of unscheduled downtime. An inventory of spare parts is also available to minimize equipment/instrument downtime.

8.3 Data Management

The purpose of data management is to confirm that the necessary data are accurate and readily accessible to meet the analytical and reporting objectives of the project. The field activities will include a significant number of samples that require a structured, comprehensive, and efficient program for management of data.

Data management procedures will be employed to efficiently process the information collected, such that the data are readily accessible and accurate.

8.3.1 Field Data Management

Field activities require consistent documentation and accurate record keeping. Complete and accurate record keeping will be maintained, including field notes and chain-of-custody forms. Field notes will include detailed observations and measurements made during the site work. Field notes will be dated and signed. Erroneous entries on paper field notes will be corrected by a single line strike-out of the original entry, initialing, dating, and then documenting the proper information. Monitoring well locations will be surveyed to accurately record their locations. The survey crew will use its own field notes and will supply the sampling location coordinates to Arcadis.

Chain-of-custody forms will be used to document and track sample possession from the time of collection to the time of disposal. A chain-of-custody form will accompany each field sample collected, and one copy of the form will be filed in the field office. Field personnel are trained on the proper use of the chain-of-custody procedure.

All paper field documentation will be scanned and saved to the Arcadis electronic project folder. Field documentation will be submitted electronically to Ecology as an attachment to the RI report. Hard copies will be stored in the Arcadis Seattle, Washington, office.

8.3.2 Analytical Data Management and Data Validation

Analytical data packages received from the laboratory will be reviewed and compared against the information on the chain-of-custody form to confirm that the correct analyses were performed for each sample and that results for all samples submitted for analysis were received. Any discrepancies noted will be promptly corrected in coordination with the laboratory.

In accordance with the AO, data validation during this project will be performed consistent with USEPA Stage 2B criteria, which involves completeness and compliance checks of sample receipt conditions and sample-related and instrument-related quality control results. Data validation on this project will be completed by an independent third party.

Data collected as part of these activities will be uploaded in Ecology's EIM database under EIM identification number PMART005 within 30 days of analytical data validation. Data will be presented in tables showing laboratory results compared to applicable MTCA CULs.

8.4 Corrective Action

Corrective actions are required when field or analytical data are not within the objectives specified in this Quality Assurance Project Plan. Corrective actions include procedures to promptly investigate, document, evaluate, and correct data collection and/or analytical procedures. All corrective actions for situations including analytical or field equipment malfunctions, nonconformance or noncompliance with the QA requirements, or changes to the sampling procedures will be documented with the project records and maintained in the project file. All corrective action procedures must be initiated prior to continuing with the field or analytical procedure.

8.5 Laboratory Reports

The laboratory will maintain QA records related to analyses, QC, and corrective action. This information will be made available upon request. Routine reporting will include documenting all internal QC checks performed for the project.

9 SCHEDULE AND REPORTING

Following completion of the boring installations and sampling described above, Arcadis will prepare a technical report for submittal to Ecology. This RI report will document the results of the RI, and include the following, as described in Ecology's RI Checklist Guidance (Ecology 2020d):

- Introduction: General Site Information, Site History, Site Use
- Field Investigations: Previous Environmental Investigations, Site Characterization, Sampling/Analytical Results
- Conceptual Site Model
- Proposed Cleanup Standards, Terrestrial Ecological Evaluation
- Summary, Conclusions, and Recommendations
- Figures including Vicinity Map, Site Map, Conceptual Site Model
- Data tables, well logs, laboratory reports

Arcadis estimates that the groundwater monitoring well installations and soil boring installations will be conducted within 180 days of receiving Ecology approval of this RI WP, or agreed upon revisions of this RI WP, as set forth in the AO, contingent on access and permitting, and assuming it is safe to do so.

10. REFERENCES

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TABLES

Table 1. Historical Soil Analytical Results
Chevron Service Station No. 97502
640 Metcalf Street, Sedro-Woolley, Washington
Analytical results are presented in milligrams per kilogram (mg/kg)

Sample ID	Date	Depth	TPH	GRO	DRO	HO	Benzene	Toluene	Ethylbenzene	Total Xylenes	Lead	MTBE	Benzo(a)-anthracene	Chrysene	Benzo(b)-fluoranthene	Benzo(k)-fluoranthene	Benzo(a)-pyrene	Indeno(1,2,3-cd)-pyrene	Dibenz(a,h)-anthracene	EDC	TCE	PCE
MTCA Method A CULs			--	30/100	2,000	2,000	0.03	7	6	9	250	0.1	--	--	--	--	0.1	--	--	--	--	--
EMCON May 1991																						
MW-1/S-2	2/12/1991	6	--	16.2	<10	<10	0.047	0.26	0.13	2.25	--	--	--	--	--	--	--	--	--	--	--	--
MW-1/S-3	2/12/1991	8	--	43.7	<10	<10	0.16	0.86	0.49	6.13	--	--	--	--	--	--	--	--	--	--	--	--
MW-1/S-4	2/12/1991	11	--	43.4	<10	<10	0.84	1.16	0.38	3.07	--	--	--	--	--	--	--	--	--	--	--	--
MW-2/S-1	2/12/1991	6	--	<10	<10	<10	<0.025	<0.025	<0.025	0.038	--	--	--	--	--	--	--	--	--	--	--	--
MW-2/S-2	2/12/1991	8	--	<10	<10	<10	0.052	0.064	0.071	0.30	--	--	--	--	--	--	--	--	--	--	--	--
MW-2/S-3	2/12/1991	11	--	<10	<10	<10	0.089	0.063	0.10	0.34	--	--	--	--	--	--	--	--	--	--	--	--
MW-3/S-2	2/12/1991	8	--	42	<10	440	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-3/S-3	2/12/1991	11	--	12	<10	<100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-4/S-3	2/12/1991	8	--	<10	<10	<10	<0.025	<0.025	<0.025	<0.025	--	--	--	--	--	--	--	--	--	--	--	--
MW-4/S-4	2/12/1991	11	--	18.5	<10	<10	0.11	<0.025	0.033	0.11	--	--	--	--	--	--	--	--	--	--	--	--
MW-5/S-2	2/12/1991	8	--	<10	<10	<10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-5/S-3	2/12/1991	11	--	<10	<10	<10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EMCON July 1991																						
UOF-1	5/9/1991	7.5	--	--	--	--	17	83	23	112	--	--	--	--	--	--	--	--	--	--	--	--
UOW-1	5/9/1991	4	--	--	<10	1,720	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
UOW-2	5/9/1991	3.5	--	--	<10	1,760	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KTF-1	5/9/1991	7	--	--	<10	<40	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KTW-1	5/9/1991	4.5	--	--	<10	<40	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KTW-2	5/9/1991	4.5	--	--	<10	61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EMCON October 1991																						
MW-6/SS-3	10/7/1991	12.5	--	<10	<10	<40	<0.025	<0.025	<0.025	<0.025	--	--	--	--	--	--	--	--	--	--	--	--
MW-6/SS-4	10/7/1991	16	--	<10	<10	<40	<0.025	<0.025	<0.025	<0.025	--	--	--	--	--	--	--	--	--	--	--	--
MW-7/SS-3	10/7/1991	12.5	--	<10	<10	<40	1.05	0.597	0.113	0.881	--	--	--	--	--	--	--	--	--	--	--	--
MW-7/SS-4	10/7/1991	16	--	12	<10	<40	<0.025	<0.025	0.079	0.423	--	--	--	--	--	--	--	--	--	--	--	--
MW-8/SS-2	10/14/1991	7.5	--	<10	<10	<40	<0.025	<0.025	<0.025	<0.025	--	--	--	--	--	--	--	--	--	--	--	--
MW-8/SS-3	10/14/1991	12.5	--	<10	<10	<40	0.298	0.388	0.035	0.256	--	--	--	--	--	--	--	--	--	--	--	--
MW-9/SS-2	10/14/1991	7.5	--	<10	<10	<40	<0.025	<0.025	<0.025	<0.025	--	--	--	--	--	--	--	--	--	--	--	--
MW-9/SS-3	10/14/1991	10	--	1,860	5,080	<40	<0.025	0.185	1.69	13	--	--	--	--	--	--	--	--	--	--	--	--
EMCON April 1992																						
SBFD-4	2/7/1992	4	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SH-9	2/7/1992	9	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NH-8	2/7/1992	8	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HOF-5.5	2/12/1992	5.5	--	<10	164	<40	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HOWNE-4	2/12/1992	4	--	<10	<10	90	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HOWW-4	2/12/1992	4	--	<10	<10	<40	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OUOEW-8	2/12/1992	8	ND	<10	<10	<40	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EPIW-6	2/12/1992	6	--	2,900	--	--	0.384	32	27	210	--	--	--	--	--	--	--	--	--	--	--	--
EPIF-9.5	2/12/1992	9.5	--	9,400	--	--	7.59	10.4	130	680	--	--	--	--	--	--	--	--	--	--	--	--
WGTW-7	2/11/1992	7	--	50	--	--	<0.025	<0.025	<0.025	0.08	--	--	--	--	--	--	--	--	--	--	--	--
NGTW-7	2/11/1992	7	--	240	--	--	<0.025	0.048	0.591	5.68	--	--	--	--	--	--	--	--	--	--	--	--
EGTW-7	2/11/1992	7	--	360	--	--	0.189	0.117	0.812	4.66	--	--	--	--	--	--	--	--	--	--	--	--
SGTW-7	2/11/1992	7	--	3,600	--	--	2.63	10.01	21	26	--	--	--	--	--	--	--	--	--	--	--	--
WGTF-11	2/11/1992	11	--	600	61	<40	0.559	0.746	1.68	9.41	--	--	--	--	--	--	--	--	--	--	--	--
CGTF-11	2/11/1992	11	--	<10	--	--	<0.025	<0.025	<0.025	<0.025	--	--	--	--	--	--	--	--	--	--	--	--
EGTF-10.5	2/11/1992	10.5	--	<10	--	--	<0.025	<0.025	<0.025	<0.025	ND	--	--	--	--	--	--	--	--	--	--	--
EMCON March 1993																						
FGTE-NWW-10	6/16/1992	10	--	ND	--	--	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--
FGTE-NEW-10	6/16/1992	10	--	ND	--	--	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--
FGTE-ENW-10	6/16/1992	10	--	ND	--	--	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--
FGTE-ESW-10	6/16/1992	10	--	ND	--	--	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--
FGTE-NWW-7	6/22/1992	7	--	8	--	--	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--
FGTE-NEW-7	6/22/1992	7	--	ND	--	--	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--
FGTE-WW-8	6/24/1992	8	--	27	--	--	ND	ND	ND	0.2	--	--	--	--	--	--	--	--	--	--	--	--
FPIA-EW-8	7/3/1992	8	--	550	--	--	0.4	3.5	11.9	31	--	--	--	--	--	--	--	--	--	--	--	--
FPIA-ESW-8	7/3/1992	8	--	810	--	--	0.59	10.3	5.6	55	--	--	--	--	--	--	--	--	--	--	--	--
FPIA-WWS-8	7/6/1992	8	--	ND	--	--	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--
FPIA-SWC-8	7/6/1992	8	--	ND	--	--	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--
FPIA-SWW-8	7/6/1992	8	--	16	--	--	0.25	0.9	0.2	2.3	--	--	--	--	--	--	--	--	--	--	--	--
FUOE-SW-8	6/1/1992	8	--	--	53	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FUOE-F-12	6/1/1992	12	--	--	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FUOE-NEC-8	6/2/1992	8	--	--	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FUOE-EW-8	6/2/1992	8	--	--	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FUOE-NW-10	6/2/1992	10	--	--	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FUOE-NEC-10	6/2/1992	10	--	--	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FUOE-WW-8	6/4/1992	8	--	34	ND	1100	0.09	0.2	ND	1.5	--	--	--	--	--	--	--	--	--	--	--	--
FUOE-NWC-7	6/10/1992	7	--	--	ND	2,130	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP-MW-9-10	6/10/1992	10	--	ND	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--
VA-WW-6	6/3/1992	6	--	ND	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--
VA-NW-10	6/3/1992	10	--	380	ND	160	ND	51	3.6	12.8	--	--	--	--	--	--	--	--	--	--	--	--
VA-SEF-12	6/3/1992	12	--	279	ND	ND	ND	42	3.2	11.5	--	--	--	--	--	--	--	--	--	--	--	--
VA-WW-12	6/3/1992	12	--	ND	ND	200	ND	0.5	ND	0.2	--	--	--	--	--	--	--	--	--	--	--	--

Table 1. Historical Soil Analytical Results
Chevron Service Station No. 97502
640 Metcalf Street, Sedro-Woolley, Washington
Analytical results are presented in milligrams per kilogram (mg/kg)

Sample ID	Date	Depth	TPH	GRO	DRO	HO	Benzene	Toluene	Ethylbenzene	Total Xylenes	Lead	MTBE	Benzo(a)-anthracene	Chrysene	Benzo(b)-fluoranthene	Benzo(k)-fluoranthene	Benzo(a)-pyrene	Indeno(1,2,3-cd)-pyrene	Dibenz(a,h)-anthracene	EDC	TCE	PCE
MTCA Method A CULs			**--**	**30/100**	**2,000**	**2,000**	**0.03**	**7**	**6**	**9**	**250**	**0.1**	**--**	**--**	**--**	**--**	**0.1**	**--**	**--**	**--**	**--**	**--**
FHOE-SW-4	8/18/1992	4	--	--	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Delta August 2002																						
MW-10	7/1/2002	10	--	<5	<10	<25	<0.0300	<0.0500	<0.0500	0.244	--	--	--	--	--	--	--	--	--	--	--	--
MW-11	7/1/2002	10	--	<5	<10	<25	<0.0300	0.0836	0.05	0.273	--	--	--	--	--	--	--	--	--	--	--	--
Cambria July 2006																						
B-12	5/2/2006	10	--	5.1	<3	<10	<0.0009	<0.0009	0.005	0.019	--	--	--	--	--	--	--	--	--	--	--	--
B-12	5/2/2006	15	--	<1	<3	<10	<0.0005	0.002	0.013	0.047	--	--	--	--	--	--	--	--	--	--	--	--
B-13	5/2/2006	10	--	<1	<3	<10	<0.0005	<0.0009	<0.0009	<0.0009	--	--	--	--	--	--	--	--	--	--	--	--
B-13	5/2/2006	15	--	18	9.5	<10	0.001	0.004	0.047	0.095	--	--	--	--	--	--	--	--	--	--	--	--
B-14	5/2/2006	10	--	<1	<3	13	<0.0005	<0.0009	<0.0009	<0.0009	--	--	--	--	--	--	--	--	--	--	--	--
B-14	5/2/2006	15	--	10	<3	<10	<0.0005	<0.0009	<0.0009	<0.0009	--	--	--	--	--	--	--	--	--	--	--	--
CRA April 2008																						
GB-1	4/1/2008	5	--	97.0	150.0	95.0	0.0009	<0.001	<0.001	<0.001	<0.171	<0.0005	0.010	0.014	0.023	0.0085	0.015	0.011	0.0033	<0.001	<0.001	<0.001
GB-1	4/1/2008	8	--	37.0	34.0	48.0	0.003	0.002	<0.0009	0.005	<0.175	<0.0005	0.0095	0.013	0.020	0.0081	0.014	0.0096	0.0028	<0.0009	<0.0009	<0.0009
GB-2	4/1/2008	5	--	**110.0**	190.0	79.0	0.003	0.004	0.001	0.008	13.6	<0.0006	0.010	0.016	0.022	0.0084	0.014	0.0083	0.0026	<0.001	<0.001	<0.001
GB-2	4/2/2008	11.5	--	<1.6	<3.8	<13.0	<0.0006	<0.001	<0.001	<0.001	<0.186	<0.0006	<0.00085	<0.00043	0.0011	<0.00085	<0.00085	<0.00085	<0.00085	<0.001	<0.001	<0.001
GB-3	4/1/2008	11	--	**330.0**	98.0	<12.0	<0.033	<0.066	<0.066	<0.066	31.1	<0.033	0.0077	0.011	0.014	0.0054	0.0093	0.0049	0.0015	<0.066	<0.066	<0.066
GB-3	4/1/2008	2	--	**340.0**	430.0	87.0	0.002	0.002	<0.001	0.001	<0.167	<0.0006	0.019	0.026	0.035	0.016	0.025	0.015	0.0047	<0.001	<0.001	<0.001
GB-3	4/1/2008	5	--	**320.0**	370.0	180.0	0.004	0.005	0.003	0.011	<0.165	<0.0005	0.027	0.037	0.047	0.021	0.034	0.019	0.0056	<0.001	<0.001	<0.001
GB-4	4/1/2008	11.5	--	47.0	15.0	<13.0	<0.030	<0.059	<0.059	<0.059	0.748	<0.030	<0.00086	<0.00043	<0.00086	<0.00086	<0.00086	<0.00086	<0.00086	<0.059	<0.059	<0.059
GB-4	4/1/2008	2	--	**380.0**	430.0	62.0	<0.036	<0.071	<0.071	<0.071	18.3	<0.036	0.022	0.030	0.040	0.017	0.027	0.018	0.0065	<0.071	<0.071	<0.071
GB-4	4/1/2008	5	--	28.0	35.0	30.0	0.002	0.002	<0.001	0.003	12.6	<0.0005	0.0044	0.0068	0.0088	0.0049	0.0066	0.0047	0.0013	<0.001	<0.001	<0.001
GB-5	4/2/2008	5.5	--	<1.7	<4.0	<13.0	<0.0006	<0.001	<0.001	<0.001	5.21	<0.0006	<0.00089	0.00064	0.00091	<0.00089	<0.00089	<0.00089	<0.00089	<0.001	<0.001	<0.001
GB-5	4/2/2008	11.5	--	<1.6	<3.9	<13.0	<0.0006	<0.001	<0.001	<0.001	<0.191	<0.0006	<0.00086	<0.00043	<0.00086	<0.00086	<0.00086	<0.00086	<0.00086	<0.001	<0.001	<0.001
GB-5	4/2/2008	8	--	19.0	<3.9	<13.0	<0.0006	<0.001	<0.001	<0.001	<0.191	<0.0006	<0.00086	0.00086	<0.00086	<0.00086	<0.00086	<0.00086	<0.00086	<0.001	<0.001	<0.001

Notes:
30/100 = GRO MTCA Method A CUL with benzene present is 30 mg/kg and without benzene present is 100 mg/kg
Grey text indicates soil that has been excavated
BOLD and highlighted values are greater than their respective MTCA Method A CUL
BOLD values are non-detect below the laboratory MDL, but the MDL is greater than the MTCA Method A CUL
MW-1, MW-2, and MW-3 are over-excavated
Map of sample locations and laboratory results not available for non-detect analytes
Sample depth measured in feet below ground surface

Abbreviations:
ID = Identification
GB = Grab-groundwater sample
MW = Groundwater monitoring well
-- = Not applicable, not available, or not analyzed
ND = Not detected
MDL = Method detection limit
MTCA = Model Toxics Control Act Cleanup
CUL = Cleanup Level
USEPA = United States Environmental Protection Agency

Laboratory Qualifiers:
<n = Not detected at or above the laboratory MDL

Analytical Methods:
Samples analyzed by USEPA Method 418.1
TPH = Total Petroleum Hydrocarbons
Samples analyzed by NWTPH-Gx
GRO = Total Petroleum Hydrocarbons as Gasoline Range Organics
Samples analyzed by NWTPH-Dx
DRO = Total Petroleum Hydrocarbons as Diesel Range Organics
HO = Total Petroleum Hydrocarbons as Heavy Oil Range Organics
Samples analyzed by USEPA Method 8260B
BTEX = benzene, toluene, ethylbenzene, and total xylenes
MTBE = Methyl tertiary butyl ether
EDC = 1,2-Dichloroethane
TCE = Trichloroethene
PCE = Tetrachloroethene
Samples analyzed by USEPA Method 6020
Lead
Samples analyzed by USEPA Method 8270C-SIM
Benzo(a)anthracene
Chrysene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenz(a,h)anthracene

Table 2. Well Construction Details

Chevron Service Station No. 97502
640 Metcalf Street, Sedro-Woolley, Washington

Well ID	Installation Date	Decommission Date	Casing Diameter	Casing Elevation[1]	Top of Screen Depth	Bottom of Screen Depth	Total Well Depth	Min DTW	Max DTW
			inches	feet NAVD88	feet bgs	feet bgs	feet bgs	feet btoc	feet btoc
MW-1	2/6/1991	1992	4		4.5	14.5	15.0		
MW-2	2/6/1991	1992	4		4.5	19.5	20.0		
MW-3	2/7/1991	1992	4		4.0	19.0	19.5		
MW-4	2/7/1991	NA	4	56.37	4.0	19.0	19.5	6.48	11.84
MW-5	2/7/1991	NA	4	56.54	4.5	19.5	20.0	6.41	11.22
MW-6	10/7/1991	NA	2	57.07	5.0	20.0	20.0	6.83	12.06
MW-7	10/7/1991	NA	2	58.98	5.0	20.0	20.0	8.85	13.02
MW-8	10/14/1991	NA	2	56.56	7.5	17.5	17.5	6.95	12.31
MW-9	10/14/1991	2001	2		6.0	16.0	16.0	7.70	11.69
MW-10	7/1/2002	NA	2	56.21	7.0	20.0	20.0	7.35	12.88
MW-11	7/1/2002	NA	2	56.32	7.0	20.0	20.0	7.30	12.79
MW-12	5/2/2006	NA	4	56.79	5.0	20.0	20.0	7.13	12.68
MW-13	5/2/2006	NA	4	56.71	5.0	20.0	20.0	7.14	13.00
MW-14	5/2/2006	NA	4	56.51	5.0	20.0	20.0	7.16	10.94

Notes:

[1.] Casing elevation surveyed by Statewide Land Survey, Inc.

[2.] Sheen Observed

Shaded cells show decommissioned well.

bgs = below ground surface

MW = monitoring well; observation well used for DPE system monitoring and groundwater compliance monitoring

NA = not applicable

NAVD88 = North American Vertical Datum of 1988

Table 3. Current Groundwater Gauging Data and Select Analytical Results

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

update

Well	Date	TOC	DTW	GWE	NAPL	GRO	DRO	HO	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total Lead
MTCA Method A CULs						**800/1,000**	**500**	**500**	**5**	**1,000**	**700**	**1,000**	**15**
MW-4	8/17/2020	56.37	8.62	47.75	--	37.1 BJ	<66.7	<83.3	<0.0941	<0.278	<0.137	<0.174	<2.95
MW-5	8/18/2020	56.54	9.03	47.51	--	92.8 BJ	121 J	<83.3	<0.0941	<0.278	<0.137	<0.174	9.29
MW-6	8/18/2020	57.07	8.78	48.29	--	44.7 BJ	75.6 J	<83.3	<0.0941	<0.278	<0.137	<0.174	<2.95
MW-7	8/17/2020	58.98	11.45	47.53	--	**2,080**	**549**	143 J	0.561 J	23.7	101	488	<2.95
MW-8	8/18/2020	56.56	9.02	47.54	--	**6,210**	123 J	<83.3	<0.0941	<0.278	1.64	1.16 J	<2.95
MW-10	8/17/2020	56.21	9.45	46.76	--	582	222	<83.3	0.152 J	2.41	28.5	19.1	<2.95
MW-11	8/17/2020	56.32	9.14	47.18	--	**5,650**	**724**	<83.3	3.76	<0.278	4.91	2.28 J	<2.95
MW-12	8/17/2020	56.79	9.09	47.70	--	175 B	144 J	<83.3	<0.0941	0.473 J	0.440 J	0.803 J	<2.95
MW-13	8/17/2020	56.71	9.41	47.30	--	**2,290 [2,450]**	**731 [516]**	<83.3 [<83.3]	<0.0941 [<0.0941]	0.580 J [0.535 J]	20.1 [21.2]	39.4 [39.7]	<2.95 [<2.95]
MW-14	8/17/2020	56.51	9.65	46.86	--	**5,720**	480	<83.3	0.245 J	4.55	143	420	<2.95

Notes:

TOC elevations were surveyed on August 14, 2007, by Statewide Land Surveying, Inc. Vertical datum is NAVD 88 by GPS observations.

800/1,000 = GRO MTCA Method A CUL with benzene present is 800 µg/L and without is 1,000 µg/L

BOLD and highlighted values are greater than their respective MTCA Method A CUL

Abbreviations:

DTW = Depth to water in feet below TOC

GWE = Groundwater elevation in feet relative to NAVD 88

MW = Groundwater monitoring well

TOC = Top of casing in feet above NAVD 88

NAPL = Non-aqueous phase liquid thickness in feet

[21.2] = Blind duplicate sample results

-- = Not applicable, not available, or not analyzed

MDL = Method detection limit

MTCA = Model Toxics Control Act Cleanup

CUL = Cleanup Level

NAVD 88 = North American Vertical Datum of 1988

USEPA = United States Environmental Protection Agency

Laboratory Qualifiers:

<n = Not detected at or above the laboratory MDL

J = Estimated value; result is ≥ the MDL and < the Reported Detection Limit

B = The same analyte is found in the associated blank

Analytical Methods:

Samples analyzed by NWTPH-Gx

GRO = Total Petroleum Hydrocarbons as Gasoline Range Organics

Samples analyzed by NWTPH-Dx

DRO = Total Petroleum Hydrocarbons as Diesel Range Organics

HO = Total Petroleum Hydrocarbons as Heavy Oil Range Organics

Samples analyzed by USEPA Method 8260D

BTEX = benzene, toluene, ethylbenzene, and total xylenes

Samples analyzed by USEPA Method 6010D

Total lead

Table 4. Current Groundwater Analytical Results - cPAHs
Chevron Service Station No. 97502
640 Metcalf Street, Sedro-Woolley, Washington
Analytical results are presented in micrograms per liter (µg/L)

Well	Date	Benzo(a)-anthracene	Chrysene	Benzo(b)-fluoranthene	Benzo(k)-fluoranthene	Benzo(a)-pyrene	Indeno(1,2,3-cd)-pyrene	Dibenz(a,h)-anthracene	Total cPAHs	Naphthalene	1-Methylnaphthalene	2-Methylnaphthalene	Total Naphthalenes
MTCA Method A CULs		**--**	**--**	**--**	**--**	**0.1**	**--**	**--**	**0.1**	**--**	**--**	**--**	**160**
MW-4	8/17/2020	<0.0203	<0.0179	<0.0168	<0.0202	<0.0184	<0.0158	<0.0160	0.0137	<0.0917	<0.0687	<0.0674	0.114
MW-5	8/18/2020	<0.0203	<0.0179	<0.0168	<0.0202	<0.0184	<0.0158	<0.0160	0.0137	<0.0917	<0.0687	<0.0674	0.114
MW-6	8/18/2020	<0.0203	<0.0179	<0.0168	<0.0202	<0.0184	<0.0158	<0.0160	0.0137	<0.0917	<0.0687	<0.0674	0.114
MW-7	8/17/2020	<0.0203	<0.0179	<0.0168	<0.0202	<0.0184	<0.0158	<0.0160	0.0137	24.1	2.94	3.00	30.0
MW-8	8/18/2020	<0.0203	<0.0179	<0.0168	<0.0202	<0.0184	<0.0158	<0.0160	0.0137	0.105 J	0.239 J	0.261	0.605
MW-10	8/17/2020	<0.0203	<0.0179	<0.0168	<0.0202	<0.0184	<0.0158	<0.0160	0.0137	9.85	3.89	1.40	15.14
MW-11	8/17/2020	<0.0203	<0.0179	<0.0168	<0.0202	<0.0184	<0.0158	<0.0160	0.0137	55.5	22.3	22.7	100.5
MW-12	8/17/2020	<0.0203	<0.0179	<0.0168	<0.0202	<0.0184	<0.0158	<0.0160	0.0137	<0.0917	<0.0687	<0.0674	0.114
MW-13	8/17/2020	<0.0203 [<0.0203]	<0.0179 [<0.0179]	<0.0168 [<0.0168]	<0.0202 [<0.0202]	<0.0184 [<0.0184]	<0.0158 [<0.0158]	<0.0160 [<0.0160]	0.0137 [0.0137]	13.3 [15.2]	13.6 [15.8]	9.72 [11.3]	36.6 [42.3]
MW-14	8/17/2020	<0.0203	<0.0179	<0.0168	<0.0202	<0.0184	<0.0158	<0.0160	0.0137	42.2	6.24	7.30	55.7

Notes:
Total cPAHs and Naphthalenes are derived according to MTCA Cleanup Regulation Table 740-1 [d]

Abbreviations:
cPAH = Carcinogenic Polycyclic Aromatic Hydrocarbon
MW = Groundwater monitoring well
[21.2] = Blind duplicate sample results
-- = Not applicable, not available, or not analyzed
MDL = Method detection limit
MTCA = Model Toxics Control Act Cleanup
CUL = Cleanup Level
USEPA = United States Environmental Protection Agency

Laboratory Qualifiers:
<n = Not detected at or above the laboratory MDL
J = Estimated value; result is ≥ the MDL and < the Reported Detection Limit

Analytical Methods:
Samples analyzed by USEPA Method 8270E-SIM
Benzo(a)anthracene
Chrysene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenz(a,h)anthracene
Naphthalene
1-Methylnaphthalene
2-Methylnaphthalene

Table 5. Historical Groundwater Gauging Data and Select Analytical Results

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	TOC	DTP	DTW	GWE	NAPL	GRO	DRO	DRO w/ Silica Gel	HO	HO w/ Silica Gel	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	Dissolved Lead	Total Lead	EDB	Comments
MTCA Method A CULs							**800/1,000**	**500**	**500**	**500**	**500**	**5**	**1,000**	**700**	**1,000**	**20**	**15**	**15**	**0.01**	
GB-1	4/1/2008	--	--	--	--	--	<250	150	--	110	--	<4	<4	<4	<4	<4	--	--	<4	
GB-2	4/2/2008	--	--	--	--	--	100 [130]	330	--	<98	--	<0.5 [<0.5]	<0.5 [<0.5]	<0.5 [<0.5]	<0.5 [<0.5]	<0.5 [<0.5]	--	8.5	--	
GB-3	4/1/2008	--	--	--	--	--	79.0	88.0	--	<94.0	--	<0.5	<0.5	0.7	<0.5	<0.5	--	--	--	
GB-4	4/1/2008	--	--	--	--	--	<50.0	<81.0	--	<100.0	--	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--	
GB-5	4/2/2008	--	--	--	--	--	**1100.0**	**990.0**	--	<97.0	--	<0.5	<0.5	<0.5	<0.5	<0.5	--	**27.8**	--	
MW-4	1/29/1992	--	--	--	--	--	**14,000**	ND	--	ND	--	**4,400**	340	**2,000**	**1,600**	--	--	--	--	
MW-4	9/25/1992	56.37	--	--	--	--	**25,000**	**5,060**	--	ND	--	**2,800**	830	**4,600**	**4,000**	--	--	--	--	
MW-4	2/24/1993	56.37	--	10.42	45.95	--	**7,970**	**3,460**	--	ND	--	**352**	2	418	**1,360**	--	--	--	--	
MW-4	5/17/1993	56.37	--	10.20	46.17	--	**9,180**	**2,630**	--	ND	--	**314**	281	**981**	**1,610**	--	--	--	--	
MW-4	8/2/1993	56.37	--	10.44	45.93	--	--	**1,390**	--	ND	--	--	--	--	--	--	--	--	--	
MW-4	8/24/1993	56.37	--	--	--	--	**14,900**	--	--	--	--	**152**	614	499	**2,880**	--	--	--	--	
MW-4	11/3/1993	56.37	--	11.67	44.70	--	**16,100**	**1,092**	--	ND	--	**114**	605	79	**1,980**	--	--	--	--	
MW-4	2/15/1994	56.37	--	11.54	44.83	--	**16,300**	**1,070**	--	ND	--	**203**	552	210	**1,810**	--	--	--	--	
MW-4	5/20/1994	56.37	--	11.00	45.37	--	**11,400**	**1,230**	--	ND	--	**92.2**	357	20	612	--	--	--	--	
MW-4	8/23/1994	56.37	--	11.84	44.53	--	**12,400**	**830**	--	ND	--	**67.1**	489	77	**1,740**	--	--	--	--	
MW-4	11/16/1994	56.37	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-4	2/10/1995	56.37	--	11.23	45.14	--	**11,000**	**1,700**	--	ND	--	**95**	160	310	890	--	--	ND	--	
MW-4	5/12/1995	56.37	--	10.80	45.57	--	**12,000**	**1,600**	--	ND	--	**55**	34	380	890	--	--	ND	--	
MW-4	8/11/1995	56.37	--	11.40	44.97	--	**11,000**	**1,000**	--	ND	--	**27**	33	340	980	--	--	ND	--	
MW-4	11/2/1995	56.37	--	11.73	44.64	--	**12,000**	**1,400**	--	**940**	--	**24**	24	220	430	--	--	ND	--	
MW-4	1/31/1996	56.37	--	9.62	46.75	--	**6,200**	**900**	--	ND	--	**17**	6.4	250	410	--	--	--	--	
MW-4	5/9/1996	56.37	--	9.88	46.49	--	97.7	253	--	ND	--	1.7	0.975	7.01	78	--	--	--	--	
MW-4	2/3/1997	56.37	--	8.83	47.54	--	ND	ND	--	ND	--	ND	ND	2.1	1.98	--	--	--	--	
MW-4	8/5/1997	56.37	--	10.10	46.27	--	172	ND	--	ND	--	0.876	0.635	7.36	17.3	--	--	--	--	
MW-4	2/11/1998	56.37	--	9.97	46.40	--	ND	ND	--	ND	--	1.15	0.975	0.997	2.66	--	--	--	--	
MW-4	8/27/1998	56.37	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-4	3/13/2000	56.37	--	9.75	46.62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-4	9/19/2000	56.37	--	10.71	45.66	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-4	3/20/2001	56.37	--	10.45	45.92	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-4	8/21/2001	56.37	--	11.08	45.29	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-4	7/2/2005	56.37	--	7.86	48.51	--	<48	--	<80	--	<100	<0.5	<0.5	<0.5	<0.5	<0.5	--	3.3	<0.5	
MW-4	9/15/2005	56.37	--	8.93	47.44	--	**1,200**	--	310	--	<100	<0.5	<0.5	<0.5	<0.5	<0.5	--	1.2	--	
MW-4	12/31/2005	56.37	--	8.64	47.73	--	<48	--	<82	--	<100	<0.5	<0.5	<0.5	<0.5	<0.5	<0.87	<0.87	--	
MW-4	3/11/2006	56.37	--	8.00	48.37	--	<48	--	<81	--	<100	<0.5	<0.5	<0.5	<0.5	<0.5	<0.87	<0.87	--	
MW-4	6/13/2006	56.37	--	7.59	48.78	--	<48	--	<82	--	<100	<0.5	<0.5	<0.5	<0.5	<0.5	<0.51	<0.51	--	
MW-4	8/10/2006	56.37	--	8.58	47.79	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-4	12/5/2006	56.37	--	8.48	47.89	--	<260	79 J	--	<260	--	<1.0	<1.0	<1.0	<3.0	<1.0	0.085 BJ	4.8 B	--	
MW-4	1/24/2007	56.37	--	7.71	48.66	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-4	5/8/2007	56.37	--	7.92	48.45	--	110	<130	--	--	--	<1.0	<1.0	<1.0	<2.0	<1.0	<2.0	3.5	--	
MW-4	6/4/2007	56.37	--	9.72	46.65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-4	9/5/2007	56.37	--	8.76	47.61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-4	12/19/2007	56.37	--	9.07	47.30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-4	3/6/2008	56.37	--	7.78	48.59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-4	6/16/2008	56.37	--	7.08	49.29	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-4	9/11/2008	56.37	--	7.35	49.02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-4	11/20/2008	56.37	--	7.38	48.99	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-4	3/4/2009	56.37	--	6.89	49.48	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-4	6/4/2009	56.37	--	7.21	49.16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-4	9/22/2009	56.37	--	9.04	47.33	--	<50	110	--	<70	--	--	--	--	--	--	--	--	--	
MW-4	9/23/2009	56.37	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-4	10/1/2009	56.37	--	9.80	46.57	--	**2,000**	**520**	--	<67	--	--	--	--	--	--	--	--	--	
MW-4	10/8/2009	56.37	--	10.11	46.26	--	330	**570**	--	<69	--	--	--	--	--	--	--	--	--	
MW-4	10/15/2009	56.37	--	10.18	46.19	--	420	**1,000**	--	<66	--	--	--	--	--	--	--	--	--	
MW-4	10/22/2009	56.37	--	10.03	46.34	--	370	**1,100**	--	<66	--	--	--	--	--	--	--	--	--	
MW-4	11/18/2009	56.37	--	9.11	47.26	--	**1,500**	**860**	--	<70	--	--	--	--	--	--	--	--	--	
MW-4	12/3/2009	56.37	--	8.16	48.21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	

Table 5. Historical Groundwater Gauging Data and Select Analytical Results

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	TOC	DTP	DTW	GWE	NAPL	GRO	DRO	DRO w/ Silica Gel	HO	HO w/ Silica Gel	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	Dissolved Lead	Total Lead	EDB	Comments
MTCA Method A CULs							**800/1,000**	**500**	**500**	**500**	**500**	**5**	**1,000**	**700**	**1,000**	**20**	**15**	**15**	**0.01**	
MW-4	12/16/2009	56.37	--	--	--	--	<50	53 J	--	<69	--	--	--	--	--	--	--	--	--	
MW-4	1/27/2010	56.37	--	8.50	47.87	--	58	--	<30	--	<70	--	--	--	--	--	--	--	--	
MW-4	2/12/2010	56.37	--	8.60	47.77	--	<50	--	<30	--	<69	--	--	--	--	--	--	--	--	
MW-4	3/30/2010	56.37	--	7.66	48.71	--	63	--	<30	--	<69	--	--	--	--	--	--	--	--	
MW-4	6/18/2010	56.37	--	7.80	48.57	--	<50	--	<30	--	<69	--	--	--	--	--	--	--	--	
MW-4	9/2/2010	56.37	--	9.33	47.04	--	**1,600**	**770**	--	<71	--	--	--	--	--	--	--	--	--	
MW-4	12/7/2010	56.37	--	9.33	47.04	--	440	--	320	--	<72	--	--	--	--	--	--	--	--	
MW-4	3/7/2011	56.37	--	6.98	49.39	--	<50	--	<30	--	<69	--	--	--	--	--	--	--	--	
MW-4	6/9/2011	56.37	--	6.48	49.89	--	110	--	37	--	73	--	--	--	--	--	--	--	--	
MW-4	9/16/2011	56.37	--	8.10	48.27	--	<50	--	<31	--	**870**	--	--	--	--	--	--	--	--	
MW-4	12/13/2011	56.37	--	8.65	47.72	--	530	--	<29	--	<68	--	--	--	--	--	--	--	--	
MW-4	12/19/2011	56.37	--	8.65	47.72	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-4	3/15/2012	56.37	--	9.75	46.62	--	<50	--	<30	--	<69	--	--	--	--	--	--	--	--	
MW-4	6/13/2012	56.37	--	7.00	49.37	--	<50	--	<30	--	<71	--	--	--	--	--	--	--	--	
MW-4	9/10/2012	56.37	--	8.40	47.97	--	160	--	74	--	<69	--	--	--	--	--	--	--	--	
MW-4	12/10/2012	56.37	--	7.31	49.06	--	<50	--	<30	--	<69	--	--	--	--	--	--	--	--	
MW-4	3/11/2013	56.37	--	6.68	49.69	--	<50	--	<29	--	<67	--	--	--	--	--	--	--	--	
MW-4	6/12/2013	56.37	--	6.91	49.46	--	<50	<28	--	<66	--	--	--	--	--	--	--	--	--	
MW-4	9/18/2013	56.37	--	8.08	48.29	--	150	120	--	<67	--	--	--	--	--	--	--	--	--	
MW-4	12/11/2013	56.37	--	7.64	48.73	--	<50	<28	--	<66	--	--	--	--	--	--	--	--	--	
MW-4	3/12/2014	56.37	--	7.64	48.73	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-4	9/27/2014	56.37	--	8.11	48.26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-4	8/17/2020	56.37	--	8.62	47.75	--	37.1 BJ	<66.7	--	<83.3	--	<0.0941	<0.278	<0.137	<0.174	--	--	<2.95	--	
MW-5	1/29/1992	--	--	--	--	--	**2,000**	**2,000**	--	ND	--	**345**	32	213	95	--	--	--	--	
MW-5	9/25/1992	56.54	--	--	--	--	**2,740**	**4,100**	--	ND	--	**833**	80	491	172	--	--	--	--	
MW-5	2/24/1993	56.54	--	9.35	47.19	--	509	**6,620**	--	ND	--	**254**	ND	7	6	--	--	--	--	
MW-5	5/17/1993	56.54	--	9.21	47.33	--	ND	410	--	ND	--	**15.5**	ND	2	2	--	--	--	--	
MW-5	8/2/1993	56.54	--	9.59	46.95	--	--	ND	--	ND	--	--	--	--	--	--	--	--	--	
MW-5	8/24/1993	56.54	--	--	--	--	260	--	--	--	--	**62**	8	ND	9	--	--	--	--	
MW-5	11/3/1993	56.54	--	11.00	45.54	--	**1,780**	**1,800**	--	ND	--	**243**	1	38	27	--	--	--	--	
MW-5	2/15/1994	56.54	--	10.76	45.78	--	**950**	**1,610**	--	ND	--	**914**	165	49	148	--	--	--	--	
MW-5	5/20/1994	56.54	--	10.15	46.39	--	**3,180**	**2,200**	--	ND	--	**599**	108	22	129	--	--	--	--	
MW-5	8/23/1994	56.54	--	10.95	45.59	--	**3,310**	**2,160**	--	ND	--	**701**	140	45	207	--	--	--	--	
MW-5	11/16/1994	56.54	--	11.22	45.32	--	**1,090**	**1,620**	--	ND	--	**258**	54	15	135	--	--	--	--	
MW-5	2/10/1995	56.54	--	10.36	46.18	--	**4,200**	**2,000**	--	310	--	**560**	24	140	180	--	--	ND	--	
MW-5	5/12/1995	56.54	--	9.86	46.68	--	**1,200**	**2,200**	--	ND	--	**480**	13	110	120	--	--	ND	--	
MW-5	8/11/1995	56.54	--	10.68	45.86	--	**4,400**	**1,700**	--	ND	--	**400**	14	140	180	--	--	ND	--	
MW-5	11/2/1995	56.54	--	10.89	45.65	--	**4,600**	**1,800**	--	ND	--	**500**	16	110	160	--	--	ND	--	
MW-5	1/31/1996	56.54	--	8.40	48.14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	5/9/1996	56.54	--	8.73	47.81	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	2/3/1997	56.54	--	7.20	49.34	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	8/5/1997	56.54	--	9.36	47.18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	2/11/1998	56.54	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	8/27/1998	56.54	--	10.14	46.40	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	1/19/1999	56.54	--	8.31	48.23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	8/30/1999	56.54	--	9.58	46.96	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	3/13/2000	56.54	--	8.57	47.97	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	9/19/2000	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Well inaccessible
MW-5	3/20/2001	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Well inaccessible
MW-5	8/21/2001	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Well inaccessible
MW-5	3/11/2002	56.54	--	8.50	48.04	--	<50	--	<250	--	**<750**	<0.50	<0.50	<0.50	<1.5	<2.5	--	--	--	
MW-5	7/3/2002	56.54	--	8.96	47.58	--	<50	--	<250	--	**<750**	<0.50	<0.50	<0.50	<1.5	<2.5	--	--	--	
MW-5	9/13/2002	56.54	--	10.43	46.11	--	72	--	<250	--	<250	0.85	<0.50	<0.50	<1.5	<2.5	--	--	--	
MW-5	12/16/2002	56.54	--	10.59	45.95	--	730	--	**820**	--	<250	**80**	1.6	6.7	<1.5	<5.0	--	--	--	
MW-5	3/6/2003	56.54	--	9.84	46.70	--	<50	--	<250	--	<250	0.54	<0.50	<0.50	<1.5	<2.5	--	--	--	
MW-5	6/4/2003	56.54	--	9.30	47.24	--	<50	--	<250	--	<250	**5.3**	<0.5	<0.5	<1.5	<2.5	--	--	--	
MW-5	9/11/2003	56.54	--	10.86	45.68	--	**990**	--	**1,300**	--	<250	**110**	1.7	7.7	<1.5	<2.5	--	--	--	
MW-5	12/17/2003	56.54	--	8.86	47.68	--	<50	--	<250	--	<250	<0.5	<0.5	<0.5	<1.5	<2.5	--	--	--	
MW-5	3/17/2004	56.54	--	8.22	48.32	--	<50	--	<250	--	<250	<0.5	<0.5	<0.5	<1.5	<2.5	--	--	--	
MW-5	6/11/2004	56.54	--	8.42	48.12	--	<50	--	<250	--	<250	<0.5	<0.5	<0.5	<1.5	<2.5	--	--	--	
MW-5	9/21/2004	56.54	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Well inaccessible

Table 5. Historical Groundwater Gauging Data and Select Analytical Results

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	TOC	DTP	DTW	GWE	NAPL	GRO	DRO	DRO w/ Silica Gel	HO	HO w/ Silica Gel	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	Dissolved Lead	Total Lead	EDB	Comments
MTCA Method A CULs							**800/1,000**	**500**	**500**	**500**	**500**	**5**	**1,000**	**700**	**1,000**	**20**	**15**	**15**	**0.01**	
MW-5	12/21/2004	56.54	--	6.85	49.69	--	<50	--	<250	--	<250	<0.5	<0.5	<0.5	<1.5	<2.5	--	--	--	
MW-5	7/2/2005	56.54	--	8.31	48.23	--	<48	--	100	--	<100	<0.5	<0.5	<0.5	<0.5	<0.5	--	4.1	<0.5	
MW-5	9/15/2005	56.54	--	9.48	47.06	--	130	--	100	--	<98	<0.5	<0.5	<0.5	<0.5	<0.5	--	4.7	--	
MW-5	12/31/2005	56.54	--	8.98	47.56	--	<48	--	<80	--	<100	<0.5	<0.5	<0.5	<0.5	<0.5	<0.87	2.7	--	
MW-5	3/11/2006	56.54	--	8.18	48.36	--	<48	--	<80	--	<100	<0.5	<0.5	<0.5	<0.5	<0.5	<0.87	1.3	--	
MW-5	6/13/2006	56.54	--	7.89	48.65	--	<48	--	<79	--	<99	<0.5	<0.5	<0.5	<0.5	<0.5	<0.51	<0.51	--	
MW-5	8/10/2006	56.54	--	8.90	47.64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	12/5/2006	56.54	--	8.82	47.72	--	100	64 J	--	90	--	<1.0	0.071 J	<1.0	<3.0	<1.0	0.050 BJ	12 B	--	
MW-5	1/24/2007	56.54	--	8.13	48.41	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	5/8/2007	56.54	--	8.19	48.35	--	58	<130	--	--	--	<1.0	<1.0	<1.0	<2.0	<1.0	<2.0	**18**	--	
MW-5	6/4/2007	56.54	--	8.59	47.95	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	9/5/2007	56.54	--	9.07	47.47	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	12/19/2007	56.54	--	9.24	47.30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	3/6/2008	56.54	--	8.22	48.32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	6/16/2008	56.54	--	7.04	49.50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	9/11/2008	56.54	--	7.48	49.06	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	11/20/2008	56.54	--	7.45	49.09	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	3/4/2009	56.54	--	6.92	49.62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	6/4/2009	56.54	--	7.30	49.24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	12/3/2009	56.54	--	8.38	48.16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	3/30/2010	56.54	--	7.65	48.89	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	6/18/2010	56.54	--	8.07	48.47	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	9/2/2010	56.54	--	9.64	46.90	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	12/7/2010	56.54	--	9.56	46.98	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	3/7/2011	56.54	--	7.10	49.44	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	6/9/2011	56.54	--	6.41	50.13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	9/16/2011	56.54	--	8.40	48.14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	12/13/2011	56.54	--	9.00	47.54	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	12/19/2011	56.54	--	8.90	47.64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	3/15/2012	56.54	--	8.80	47.74	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	6/13/2012	56.54	--	7.15	49.39	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	9/10/2012	56.54	--	8.76	47.78	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	12/10/2012	56.54	--	7.82	48.72	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	3/11/2013	56.54	--	6.98	49.56	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	6/12/2013	56.54	--	7.22	49.32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	9/18/2013	56.54	--	8.60	47.94	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	12/11/2013	56.54	--	8.10	48.44	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	3/12/2014	56.54	--	8.86	47.68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-5	9/27/2014	56.54	--	8.63	47.91	**--**	--	--	--	--	--	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	
MW-5	8/18/2020	56.54	--	9.03	47.51	**--**	92.8 BJ	121 J	--	<83.3	--	<0.0941	<0.278	<0.137	<0.174	--	--	9.29	--	
MW-6	1/29/1992	--	--	--	--	--	ND	ND	--	ND	--	**39**	3	2	8	--	--	--	--	
MW-6	9/25/1992	57.07	--	--	--	--	ND	ND	--	ND	--	**5.5**	ND	ND	ND	--	--	--	--	
MW-6	2/24/1993	57.07	--	9.33	47.74	--	ND	360	--	ND	--	**8.6**	ND	ND	1	--	--	--	--	
MW-6	5/17/1993	57.07	--	9.03	48.04	--	ND	**930**	--	ND	--	**19**	ND	ND	1	--	--	--	--	
MW-6	8/2/1993	57.07	--	9.99	47.08	--	--	290	--	ND	--	--	--	--	--	--	--	--	--	
MW-6	8/24/1993	57.07	--	--	--	--	ND	--	--	--	--	**5**	ND	ND	ND	--	--	--	--	
MW-6	11/3/1993	57.07	--	10.35	46.72	--	ND	ND	--	ND	--	ND	ND	ND	ND	--	--	--	--	
MW-6	2/15/1994	57.07	--	10.14	46.93	--	ND	ND	--	ND	--	ND	ND	ND	ND	--	--	--	--	
MW-6	5/20/1994	57.07	--	9.79	47.28	--	ND	270	--	ND	--	**7.7**	ND	ND	ND	--	--	--	--	
MW-6	8/23/1994	57.07	--	10.49	46.58	--	ND	ND	--	ND	--	ND	ND	ND	ND	--	--	--	--	
MW-6	11/16/1994	57.07	--	10.47	46.60	--	ND	440	--	ND	--	ND	ND	ND	ND	--	--	--	--	
MW-6	2/10/1995	57.07	--	9.84	47.23	--	ND	240	--	240	--	ND	ND	ND	ND	--	--	ND	--	
MW-6	5/12/1995	57.07	--	9.64	47.43	--	ND	270	--	ND	--	ND	ND	ND	ND	--	--	ND	--	
MW-6	8/11/1995	57.07	--	10.13	46.94	--	ND	ND	--	ND	--	ND	ND	ND	ND	--	--	ND	--	
MW-6	11/2/1995	57.07	--	10.27	46.80	--	ND	390	--	ND	--	ND	ND	ND	ND	--	--	ND	--	
MW-6	1/31/1996	57.07	--	8.48	48.59	--	59	270	--	ND	--	ND	ND	ND	ND	--	--	--	--	
MW-6	5/9/1996	57.07	--	8.78	48.29	--	ND	494	--	ND	--	0.587	ND	ND	ND	--	--	--	--	
MW-6	2/3/1997	57.07	--	7.75	49.32	--	ND	280	--	**1,100**	--	ND	ND	ND	ND	--	--	--	--	
MW-6	8/5/1997	57.07	--	9.00	48.07	--	54.6	ND	--	ND	--	ND	ND	ND	ND	--	--	--	--	
MW-6	2/11/1998	57.07	--	9.48	47.59	--	ND	269	--	ND	--	0.917	ND	ND	ND	--	--	--	--	
MW-6	8/27/1998	57.07	--	9.81	47.26	--	ND	ND	--	ND	--	ND	ND	ND	ND	ND	--	ND	--	

Table 5. Historical Groundwater Gauging Data and Select Analytical Results

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	TOC	DTP	DTW	GWE	NAPL	GRO	DRO	DRO w/ Silica Gel	HO	HO w/ Silica Gel	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	Dissolved Lead	Total Lead	EDB	Comments
MTCA Method A CULs							**800/1,000**	**500**	**500**	**500**	**500**	**5**	**1,000**	**700**	**1,000**	**20**	**15**	**15**	**0.01**	
MW-6	1/19/1999	57.07	--	8.28	48.79	--	ND	287	--	ND	--	0.835	ND	ND	ND	--	--	--	--	
MW-6	8/30/1999	57.07	--	9.40	47.67	--	ND	ND	--	ND	--	ND	ND	ND	ND	--	--	--	--	
MW-6	3/13/2000	57.07	--	8.53	48.54	--	ND	317	--	ND	--	ND	ND	ND	ND	--	--	--	--	
MW-6	9/19/2000	57.07	--	9.52	47.55	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	3/20/2001	57.07	--	9.17	47.90	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	8/21/2001	57.07	--	9.78	47.29	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	3/11/2002	57.07	--	8.09	48.98	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	7/3/2002	57.07	--	8.36	48.71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	9/13/2002	57.07	--	9.49	47.58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	12/16/2002	57.07	--	10.02	47.05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	3/6/2003	57.07	--	9.23	47.84	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	6/4/2003	57.07	--	8.78	48.29	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	9/11/2003	57.07	--	10.33	46.74	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	12/17/2003	57.07	--	8.40	48.67	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	3/17/2004	57.07	--	7.51	49.56	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	6/11/2004	57.07	--	7.59	49.48	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	9/21/2004	57.07	--	7.43	49.64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	12/21/2004	57.07	--	7.22	49.85	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	7/2/2005	57.07	--	8.30	48.77	--	<48	--	<80	--	<100	<0.5	<0.5	<0.5	<0.5	<0.5	--	**15.6**	<0.5	
MW-6	9/15/2005	57.07	--	9.22	47.85	--	<48	--	<82	--	<100	<0.5	<0.5	<0.5	<0.5	<0.5	--	**28.9**	--	
MW-6	12/31/2005	57.07	--	8.75	48.32	--	<48	--	<81	--	<100	<0.5	<0.5	<0.5	<0.5	<0.5	<0.87	4.1	--	
MW-6	3/11/2006	57.07	--	8.22	48.85	--	<48	--	<81	--	<100	<0.5	<0.5	<0.5	<0.5	<0.5	<0.87	<0.87	--	
MW-6	6/13/2006	57.07	--	7.98	49.09	--	<48	--	<80	--	<100	<0.5	<0.5	<0.5	<0.5	<0.5	<0.51	<0.51	--	
MW-6	8/10/2006	57.07	--	8.82	48.25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	12/5/2006	57.07	--	8.53	48.54	--	<50	49 J	--	110 J	--	<1.0	<1.0	<1.0	<3.0	<1.0	0.050 BJ	**45 B**	--	
MW-6	1/24/2007	57.07	--	7.88	49.19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	5/8/2007	57.07	--	8.04	49.03	--	<50	<130	--	--	--	<1.0	<1.0	<1.0	<2.0	<1.0	<2.0	**18**	--	
MW-6	6/4/2007	57.07	--	8.78	48.29	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	9/5/2007	57.07	12.57	9.85	47.22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	12/19/2007	57.07	--	9.21	47.86	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	3/6/2008	57.07	--	8.34	48.73	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	6/16/2008	57.07	--	7.72	49.35	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	9/11/2008	57.07	--	7.98	49.09	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	11/20/2008	57.07	--	7.90	49.17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	3/4/2009	57.07	--	7.68	49.39	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	6/4/2009	57.07	--	8.06	49.01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	12/3/2009	57.07	--	8.29	48.78	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	3/30/2010	57.07	--	8.26	48.81	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	6/18/2010	57.07	--	8.23	48.84	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	9/2/2010	57.07	--	9.30	47.77	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	12/7/2010	57.07	--	9.10	47.97	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	3/7/2011	57.07	--	7.52	49.55	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	6/9/2011	57.07	--	7.27	49.80	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	9/16/2011	57.07	--	8.52	48.55	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	12/13/2011	57.07	--	8.60	48.47	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	12/19/2011	57.07	--	8.52	48.55	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	3/15/2012	57.07	--	8.50	48.57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	6/13/2012	57.07	--	7.40	49.67	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	9/10/2012	57.07	--	8.60	48.47	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	12/10/2012	57.07	--	7.61	49.46	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	3/11/2013	57.07	--	7.07	50.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	6/12/2013	57.07	--	6.83	50.24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	9/18/2013	57.07	--	8.44	48.63	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	12/11/2013	57.07	--	7.81	49.26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	3/12/2014	57.07	--	12.06	45.01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	9/27/2014	57.07	--	8.48	48.59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-6	8/18/2020	57.07	--	8.78	48.29	--	44.7 BJ	75.6 J	--	<83.3	--	<0.0941	<0.278	<0.137	<0.174	--	--	<2.95	--	
MW-7	1/29/1992	--	--	--	--	--	**30,000**	ND	--	ND	--	**3,400**	870	**2,900**	**4,500**	--	--	--	--	
MW-7	9/25/1992	58.98	--	--	--	--	**2,770**	ND	--	ND	--	**863**	81	509	168	--	--	--	--	
MW-7	2/24/1993	58.98	9.84	9.99	49.11	0.15	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	5/17/1993	58.98	9.75	9.90	49.20	0.15	--	--	--	--	--	--	--	--	--	--	--	--	--	

Table 5. Historical Groundwater Gauging Data and Select Analytical Results

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	TOC	DTP	DTW	GWE	NAPL	GRO	DRO	DRO w/ Silica Gel	HO	HO w/ Silica Gel	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	Dissolved Lead	Total Lead	EDB	Comments
MTCA Method A CULs							**800/1,000**	**500**	**500**	**500**	**500**	**5**	**1,000**	**700**	**1,000**	**20**	**15**	**15**	**0.01**	
MW-7	8/2/1993	58.98	--	9.99	48.99	--	--	**13,800**	--	ND	--	--	--	--	--	--	--	--	--	
MW-7	8/24/1993	58.98	--	--	--	--	**88,000**	--	--	--	--	**1,100**	620	**2,200**	**13,000**	--	--	--	--	
MW-7	11/3/1993	58.98	--	11.01	47.97	--	**100,000**	**59,000**	--	ND	--	**2,500**	898	**6,300**	**6,470**	--	--	--	--	
MW-7	2/15/1994	58.98	--	10.85	48.13	--	**31,000**	**1,340**	--	ND	--	**1,210**	751	**2,910**	**3,960**	--	--	--	--	
MW-7	5/20/1994	58.98	--	10.34	48.64	--	**47,000**	**4,950**	--	ND	--	**1,200**	700	**2,000**	**4,200**	--	--	--	--	
MW-7	8/23/1994	58.98	--	11.13	47.85	--	**25,400**	**11,200**	--	**800**	--	**1,070**	844	**2,200**	**4,130**	--	--	--	--	
MW-7	11/16/1994	58.98	--	11.70	47.28	--	**56,000**	**52,700**	--	**3,150**	--	**380**	917	**2,500**	**8,100**	--	--	--	--	
MW-7	2/10/1995	58.98	--	10.62	48.36	--	**93,000**	**69,000**	--	ND	--	**1,200**	**3,700**	**1,300**	**8,100**	--	--	**24**	--	
MW-7	5/12/1995	58.98	10.14	10.14	48.84	Sheen	**37,000**	**19,000**	--	**2,800**	--	**1,300**	**2,800**	**1,100**	**6,400**	--	--	8.2	--	
MW-7	8/11/1995	58.98	10.79	10.79	48.19	Sheen	**61,000**	**1,600**	--	ND	--	**440**	**2,000**	**1,300**	**6,100**	--	--	5.8	--	
MW-7	11/2/1995	58.98	11.12	11.12	47.86	Sheen	**94,000**	**57,000**	--	ND	--	**360**	**1,300**	**1,000**	**5,500**	--	--	5.5	--	
MW-7	1/31/1996	58.98	--	9.20	49.78	--	**27,000**	**3,700**	--	ND	--	**250**	**1,100**	650	**3,800**	--	--	--	--	
MW-7	5/9/1996	58.98	9.40	9.40	49.58	Sheen	**163,000**	**11,600**	--	ND	--	**638**	**2,390**	**1,850**	**10,600**	--	--	--	--	
MW-7	2/3/1997	58.98	--	8.85	88.76	--	**10,600**	**961**	--	ND	--	**11.1**	10.6	32.3	185	--	--	--	--	
MW-7	8/5/1997	58.98	9.56	9.56	49.42	Sheen	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	2/11/1998	58.98	9.52	9.52	49.46	Sheen	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	8/27/1998	58.98	10.29	10.30	48.69	0.01	**62,000**	**2,600**	--	ND	--	**1,600**	**7,440**	**1,340**	**9,210**	--	--	**24**	--	
MW-7	1/19/1999	58.98	--	9.44	49.54	--	**9,190**	**1,480**	--	ND	--	**59.6**	**2,070**	251	935	--	--	--	--	
MW-7	8/30/1999	58.98	10.07	10.07	48.91	Sheen	**26,900**	**5,580**	--	ND	--	**100**	**1,040**	413	**2,640**	--	--	--	--	
MW-7	3/13/2000	58.98	9.30	9.30	49.68	Sheen	**49,600**	**4,330**	--	ND	--	**795**	**4,500**	**1,080**	**7,190**	--	--	--	--	
MW-7	9/19/2000	58.98	10.14	10.28	48.81	0.14	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	3/20/2001	58.98	9.84	9.98	49.04	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	8/21/2001	58.98	10.31	10.36	48.66	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	3/11/2002	58.98	--	9.23	49.75	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	7/3/2002	--	--	11.68	--	--	**37,000**	--	**3,900**	--	<750	**640**	**2,500**	550	**3,700**	<6.0	--	--	--	
MW-7	7/26/2002	--	--	10.81	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	8/17/2002	--	--	10.93	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	9/13/2002	--	12.33	12.36	--	0.03	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	10/15/2002	--	--	11.97	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	11/8/2002	--	--	12.41	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	12/16/2002	--	12.75	12.77	--	0.02	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	1/11/2003	--	10.77	10.81	--	0.04	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	2/14/2003	--	12.12	12.15	--	0.03	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	3/6/2003	--	11.92	11.94	--	0.02	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	4/22/2003	--	12.01	12.04	--	0.03	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	5/21/2003	--	12.01	12.04	--	0.03	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	6/4/2003	--	--	11.84	--	--	**96,000**	--	**6,300**	--	**600**	**580**	**4,100**	**1,500**	**10,000**	<20	--	--	--	
MW-7	7/17/2003	--	12.87	12.90	--	0.03	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	8/12/2003	--	12.04	12.06	--	0.02	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	9/11/2003	--	12.95	13.01	--	0.06	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	10/20/2003	--	12.78	12.82	--	0.04	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	12/17/2003	--	--	11.32	--	--	**53,000**	--	**15,000**	--	<2,400	**80**	820	530	**4,700**	11	--	--	--	
MW-7	3/17/2004	--	10.88	10.90	--	0.02	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	5/22/2004	--	--	11.39	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	6/11/2004	--	--	10.98	--	--	**1,600**	--	**8,800**	--	**2,200**	<1.0	1.3	8.2	57	<2.5	--	--	--	
MW-7	7/22/2004	--	11.42	11.44	--	0.02	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	9/1/2004	--	11.02	11.04	--	0.02	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	9/21/2004	--	--	10.79	--	--	**10,000**	--	**19,000**	--	**2,300**	<5.0	28	66	500	<5.0	--	--	--	
MW-7	12/21/2004	--	--	10.31	--	--	**25,000**	--	**5,700**	--	**1,000**	<5.0	180	270	**2,100**	<5.0	--	--	--	
MW-7	7/2/2005	58.98	--	11.01	47.97	--	520	--	**23,000**	--	**3,000**	<0.5	<0.5	<0.5	<0.5	<0.5	--	**786**	<0.5	
MW-7	9/15/2005	58.98	--	11.84	47.14	--	**7,400**	--	**2,900**	--	**800**	**43**	**1,200**	130	740	<1	--	**203**	--	
MW-7	12/31/2005	58.98	--	11.61	47.37	--	**20,000**	--	**3,600**	--	<490	**45**	**1,900**	470	**2,600**	<3	12.8	**34.8**	--	
MW-7	3/11/2006	58.98	--	10.99	47.99	--	**2,900**	--	**730**	--	**550**	<0.5	10	16	140	<0.5	2.4	**32.4**	--	
MW-7	6/13/2006	58.98	--	10.81	48.17	--	**160,000**	--	**14,000**	--	<2,000	**8**	**1,100**	640	**4,800**	<3	**15.5**	**159**	--	
MW-7	8/10/2006	58.98	11.77	11.80	47.20	0.03	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	12/5/2006	58.98	--	11.57	47.41	--	**45,000**	**210,000**	--	**4,300**	--	3.1	**1,300**	**950**	**7,100**	<1.0	**92 B**	**920 B**	--	
MW-7	1/24/2007	58.98	10.50	10.62	48.46	0.12	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	5/8/2007	58.98	10.81	10.88	48.16	0.07	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	6/4/2007	58.98	--	11.56	47.42	--	**9,200**	**2,200**	--	<190	--	**14**	360	67	520	<0.5	--	**26.2**	<0.5	
MW-7	9/5/2007	58.98	12.57	12.69	46.39	0.12	--	--	--	--	--	--	--	--	--	--	--	--	--	

Table 5. Historical Groundwater Gauging Data and Select Analytical Results

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	TOC	DTP	DTW	GWE	NAPL	GRO	DRO	DRO w/ Silica Gel	HO	HO w/ Silica Gel	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	Dissolved Lead	Total Lead	EDB	Comments
MTCA Method A CULs							**800/1,000**	**500**	**500**	**500**	**500**	**5**	**1,000**	**700**	**1,000**	**20**	**15**	**15**	**0.01**	
MW-7	12/19/2007	58.98	--	12.22	46.76	--	**15,000**	--	**21,000**	--	<2,500	<1	210	250	**1,500**	<1	--	**52.5**	<1	In analyzing DRO w/ silica gel, the observed sample pattern includes #2 fuel/diesel and an additional pattern that elutes earlier in the DRO range.
MW-7	3/6/2008	58.98	11.00	11.03	47.97	0.03	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	6/16/2008	58.98	10.22	10.25	48.75	0.03	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	9/11/2008	58.98	10.45	10.47	48.53	0.02	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	11/20/2008	58.98	10.46	10.47	48.52	0.01	**56,000**	--	**54,000**	--	<8,600	**<13**	71	590	**4,300**	<13	--	--	<13	In analyzing DRO w/ silica gel, the observed sample pattern is not typical of #2 fuel/diesel, eluting in the DRO range earlier than #2 fuel.
MW-7	3/4/2009	58.98	--	9.67	49.31	--	**2,400**	--	**13,000**	--	<680	<0.5	<0.5	4	65	<0.5	--	--	<0.5	In analyzing DRO w/ silica gel, the observed sample pattern includes #2 fuel/diesel and an additional pattern that elutes earlier in the DRO range.
MW-7	6/4/2009	58.98	--	10.04	48.94	--	**2,800**	--	140	--	<68	<0.5	<0.5	0.9	18	<0.5	--	--	<0.5	
MW-7	9/22/2009	58.98	--	12.08	46.90	Sheen	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	9/23/2009	58.98	--	13.02	45.96	--	**370,000**	**530,000**	--	**110,000 J**	--	--	--	--	--	--	--	--	--	
MW-7	9/24/2009	58.98	--	12.69	46.29	--	**160,000**	**48,000**	--	**27,000 J**	--	--	--	--	--	--	--	--	--	
MW-7	10/1/2009	58.98	--	12.63	46.35	--	**22,000**	**4,800**	--	**27,000**	--	--	--	--	--	--	--	--	--	
MW-7	10/8/2009	58.98	--	12.81	46.17	--	**16,000**	**590**	--	440 J	--	--	--	--	--	--	--	--	--	
MW-7	10/15/2009	58.98	--	12.95	46.03	--	**14,000**	**790**	--	430	--	--	--	--	--	--	--	--	--	
MW-7	10/22/2009	58.98	--	12.86	46.12	--	**11,000**	430	--	95 J	--	--	--	--	--	--	--	--	--	
MW-7	11/18/2009	58.98	--	12.12	46.86	--	**24,000**	**1,400**	--	**1,600 J**	--	--	--	--	--	--	--	--	--	
MW-7	12/3/2009	58.98	--	11.27	47.71	--	**37,000**	--	**18,000**	--	<1,700	**<10**	560	**770**	**4,800**	<10	--	--	<10	In analyzing DRO w/ silica gel, the observed sample pattern includes #2 fuel/diesel and an additional pattern that elutes earlier in the DRO range.
MW-7	12/16/2009	58.98	--	--	--	--	**22,000**	**2,000**	--	**970 J**	--	--	--	--	--	--	--	--	--	
MW-7	1/27/2010	58.98	--	11.24	47.74	--	**33,000**	--	**9,700**	--	**1,700**	--	--	--	--	--	--	--	--	In analyzing DRO w/ silica gel, the observed sample pattern includes #2 fuel/diesel and an additional pattern that elutes earlier in the DRO range.
MW-7	2/12/2010	58.98	--	11.30	47.68	--	**36,000**	--	**5,200**	--	410	--	--	--	--	--	--	--	--	In analyzing DRO w/ silica gel, the observed sample pattern is not typical of #2 fuel/diesel, eluting in the DRO range earlier than #2 fuel.

Table 5. Historical Groundwater Gauging Data and Select Analytical Results

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	TOC	DTP	DTW	GWE	NAPL	GRO	DRO	DRO w/ Silica Gel	HO	HO w/ Silica Gel	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	Dissolved Lead	Total Lead	EDB	Comments
MTCA Method A CULs							**800/1,000**	**500**	**500**	**500**	**500**	**5**	**1,000**	**700**	**1,000**	**20**	**15**	**15**	**0.01**	
MW-7	3/30/2010	58.98	--	10.85	48.13	--	**32,000**	--	**8,400**	--	<1,400	--	--	--	--	--	--	--	--	In analyzing DRO w/ silica gel, the observed sample pattern includes #2 fuel/diesel and an additional pattern that elutes earlier in the DRO range.
MW-7	6/18/2010	58.98	--	10.71	48.27	--	**2,500**	--	**1,100**	--	350	<0.5	2	2	30	--	--	--	--	In analyzing DRO w/ silica gel, the observed sample pattern includes #2 fuel/diesel and an additional pattern that elutes later in the DRO range.
MW-7	9/2/2010	58.98	--	12.21	46.77	--	**22,000**	**3,500**	--	370	--	2	480	**720**	**4,200**	--	--	--	--	
MW-7	12/7/2010	58.98	--	12.85	46.13	--	**30,000**	460	--	--	<72	<3	380	**800**	**4,500**	--	--	--	--	
MW-7	3/7/2011	58.98	--	9.71	49.27	--	<50	--	**2,000**	--	**1,100**	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-7	6/9/2011	58.98	--	9.28	49.70	--	<50	--	**780**	--	360	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-7	9/16/2011	58.98	--	10.90	48.08	--	<50	--	330	--	<69	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-7	12/13/2011	58.98	--	11.40	47.58	--	**2,100**	--	33	--	<67	0.9	91	82	440	--	--	--	--	
MW-7	12/19/2011	58.98	--	11.33	47.65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-7	3/15/2012	58.98	--	9.80	49.18	--	<50	--	120	--	<69	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-7	6/13/2012	58.98	--	9.60	49.38	--	230	--	86	--	<72	<0.5	<0.5	0.8	<0.5	--	--	--	--	
MW-7	9/10/2012	58.98	--	11.20	47.78	--	240	--	**860**	--	<700	<0.5	4	5	29	--	--	--	--	In analyzing HO w/ silica gel, the observed sample pattern includes #2 fuel/diesel, eluting in the DRO range later than #2 fuel.
MW-7	12/10/2012	58.98	--	10.21	48.77	--	<50	--	300	--	140	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-7	3/11/2013	58.98	--	9.41	49.57	--	<50	--	330	--	200	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-7	6/12/2013	58.98	--	9.85	49.13	--	<50	82	--	<68	--	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-7	9/18/2013	58.98	--	11.16	47.82	--	**1,300**	190	--	<67	--	0.8	150	41	210	--	--	--	--	
MW-7	12/11/2013	58.98	--	10.67	48.31	--	<50	360	--	190	--	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-7	3/12/2014	58.98	--	9.18	49.80	--	<50	--	--	--	--	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-7	9/27/2014	58.98	--	11.23	47.75	--	<50	--	--	--	--	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-7	8/17/2020	58.98	--	11.45	47.53	--	**2,080**	**549**	--	143 J	--	0.561 J	23.7	101	488	--	--	<2.95	--	
MW-8	1/29/1992	--	--	--	--	--	**37,000**	**2,000**	--	ND	--	**4,600**	320	**8,900**	**1,600**	--	--	--	--	
MW-8	9/25/1992	56.56	--	--	--	--	**24,000 [25,000]**	**5,350**	--	ND	--	**6,100 [6,400]**	378/376	**8,000 [8,200]**	**1,600 [1,700]**	--	--	--	--	
MW-8	2/24/1993	56.56	--	9.90	46.66	--	**28,000**	**590**	--	ND	--	**520**	200	**8,300**	950	--	--	--	--	
MW-8	5/17/1993	56.56	--	9.63	46.93	--	**34,000**	**540**	--	ND	--	**2,000**	180	**11,000**	770	--	--	--	--	
MW-8	8/2/1993	56.56	--	10.19	46.37	--	--	**970**	--	ND	--	--	--	--	--	--	--	--	--	
MW-8	8/24/1993	56.56	--	--	--	--	**68,000**	--	--	--	--	**1,050**	220	**16,000**	**1,660**	--	--	--	--	
MW-8	11/3/1993	56.56	--	11.28	45.28	--	**2,100**	**1,340**	--	ND	--	**18.9**	ND	ND	200	--	--	--	--	
MW-8	2/15/1994	56.56	--	11.15	45.41	--	**2,860**	**1,630**	--	ND	--	**942**	140	377	286	--	--	--	--	
MW-8	5/20/1994	56.56	--	10.56	46.00	--	**14,000**	**910**	--	ND	--	**740**	130	**3,600**	410	--	--	--	--	
MW-8	8/23/1994	56.56	--	11.41	45.15	--	**7,990**	**1,830**	--	ND	--	**2,060**	298	**1,160**	**1,160**	--	--	--	--	
MW-8	11/16/1994	56.56	--	11.70	44.86	--	**17,600**	**2,160**	--	ND	--	**1,130**	207	**2,700**	892	--	--	--	--	
MW-8	2/10/1995	56.56	--	10.87	45.69	--	**10,000**	**1,600**	--	**500**	--	**1,100**	**1,300**	180	820	--	--	**17**	--	
MW-8	5/12/1995	56.56	--	10.37	46.19	--	**19,000**	**870**	--	ND	--	**1,200**	**5,700**	240	**1,000**	--	--	ND	--	
MW-8	8/11/1995	56.56	--	10.98	45.58	--	**9,000**	**990**	--	ND	--	**470**	860	320	**1,300**	--	--	ND	--	
MW-8	11/2/1995	56.56	--	11.35	45.21	--	**11,000**	**1,700**	--	**1,100**	--	**820**	710	300	**1,200**	--	--	ND	--	
MW-8	1/31/1996	56.56	--	9.03	47.53	--	**15,000**	**510**	--	ND	--	**370**	**4,600**	170	710	--	--	--	--	
MW-8	5/9/1996	56.56	--	9.37	47.19	--	**17,000**	300	--	ND	--	**421**	**6,200**	198	807	--	--	--	--	
MW-8	2/3/1997	56.56	--	8.27	48.29	--	**11,600**	360	--	ND	--	**258**	**3,750**	225	910	--	--	--	--	
MW-8	8/5/1997	56.56	--	9.46	47.10	--	**9,160**	ND	--	ND	--	ND	**1,810**	167	615	--	--	--	--	
MW-8	2/11/1998	56.56	--	9.97	46.59	--	**6,310**	ND	--	ND	--	**476**	680	158	585	--	--	--	--	
MW-8	8/27/1998	56.56	--	10.50	46.06	--	**2,810**	ND	--	ND	--	ND	425	113	448	ND	--	--	--	
MW-8	1/19/1999	56.56	--	9.12	47.44	--	ND	271	--	ND	--	ND	249	27.4	96.1	--	--	--	--	

Table 5. Historical Groundwater Gauging Data and Select Analytical Results

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	TOC	DTP	DTW	GWE	NAPL	GRO	DRO	DRO w/ Silica Gel	HO	HO w/ Silica Gel	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	Dissolved Lead	Total Lead	EDB	Comments
MTCA Method A CULs							**800/1,000**	**500**	**500**	**500**	**500**	**5**	**1,000**	**700**	**1,000**	**20**	**15**	**15**	**0.01**	
MW-8	8/30/1999	56.56	--	10.01	46.55	--	**1,180**	**623**	--	ND	--	**15.8**	17.8	57.9	198	--	--	--	--	
MW-8	3/13/2000	56.56	--	9.19	47.37	--	**1,990**	318	--	ND	--	**11.5**	168	73.4	255	--	--	--	--	
MW-8	9/19/2000	56.56	--	10.21	46.35	--	**1,540**	268	--	ND	--	ND	ND	66.3	239	ND	--	--	--	
MW-8	3/20/2001	56.56	--	10.10	46.46	--	ND	--	--	--	--	ND	ND	ND	117	ND	--	--	--	
MW-8	8/21/2001	56.56	--	12.31	44.25	--	**5,230**	309	--	<500	--	**33.8**	6.81	58.9	196	**27.3**	--	--	--	
MW-8	3/11/2002	56.56	--	9.14	47.42	--	**1,100**	--	250	--	<750	**6.4**	41	73	250	<2.5	--	--	--	
MW-8	7/3/2002	56.56	--	9.60	46.96	--	**1,100**	--	<250	--	<750	<2.0	<5.0	69	230	<2.5	--	--	--	
MW-8	9/13/2002	56.56	--	9.99	46.57	--	**920**	--	309	--	<250	**<20**	2.1	34	150	**67**	--	--	--	
MW-8	12/16/2002	56.56	--	11.00	45.56	--	**1,300**	--	**520**	--	<250	**<50**	4.8	30	69	<20	--	--	--	
MW-8	3/6/2003	56.56	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Well inaccessible
MW-8	6/4/2003	56.56	--	9.85	46.71	--	680	--	300	--	<250	**<50**	1.9	31	110	**<50**	--	--	--	
MW-8	9/11/2003	56.56	--	11.08	45.48	--	**2,400**	--	**650**	--	<250	**31**	14	110	170	<5.0	--	--	--	
MW-8	3/6/2003	56.56	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Well inaccessible
MW-8	3/17/2004	56.56	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Well inaccessible
MW-8	6/11/2004	56.56	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Well inaccessible
MW-8	9/21/2004	56.56	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Well inaccessible
MW-8	12/21/2004	56.56	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Well inaccessible
MW-8	8/10/2006	56.56	--	9.30	47.26	--	580	210	--	<110	--	1	<0.5	14	29	<0.5	<0.047	8.5	--	
MW-8	12/5/2006	56.56	--	9.26	47.30	--	**850**	230 J	--	170 J	--	0.64 J	0.49 J	24	62.9	<1.0	0.51 BJ	**15 B**	--	
MW-8	1/24/2007	56.56	--	8.41	48.15	--	690	180	--	<270	--	<1.0	<1.0	30	98.1	<1.0	<2.0	**19**	--	
MW-8	5/8/2007	56.56	--	8.65	47.91	--	**1,200**	410	--	--	--	<2.0	28	37	155	<2.0	<2.0	13	--	
MW-8	6/4/2007	56.56	--	9.03	47.53	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-8	9/5/2007	56.56	--	9.70	46.86	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-8	12/19/2007	56.56	--	9.88	46.68	--	570	--	**1,200**	--	**860**	<0.5	0.7	3	4	<0.5	--	8	<0.5	In analyzing DRO w/ silica gel, the observed sample pattern includes #2 fuel/diesel and an additional pattern that elutes later in the DRO range.
MW-8	3/6/2008	56.56	--	8.48	48.08	--	260	--	--	--	--	<0.5	<0.5	8	17	--	--	--	--	
MW-8	6/16/2008	56.56	--	7.72	48.84	--	190	--	--	--	--	<1	<1	3	4	--	--	--	--	
MW-8	9/11/2008	56.56	--	8.10	48.46	--	510	--	--	--	--	<1	<1	16	25	--	--	--	--	
MW-8	11/20/2008	56.56	--	8.22	48.34	--	280	--	--	--	--	<0.5	<0.5	3	6	--	--	--	--	
MW-8	3/4/2009	56.56	--	7.39	49.17	--	180	--	--	--	--	<0.5	<0.5	4	8	--	--	--	--	
MW-8	6/4/2009	56.56	--	7.68	48.88	--	730	--	--	--	--	<3	<3	20	47	--	--	--	--	
MW-8	9/22/2009	56.56	--	9.69	46.87	--	550	**880**	--	**1,300**	--	--	--	--	--	--	--	--	--	
MW-8	10/1/2009	56.56	--	10.28	46.28	--	380	76 J	--	94 J	--	--	--	--	--	--	--	--	--	
MW-8	10/8/2009	56.56	--	10.51	46.05	--	620	89 J	--	<69	--	--	--	--	--	--	--	--	--	
MW-8	10/15/2009	56.56	--	10.65	45.91	--	420	340	--	310 J	--	--	--	--	--	--	--	--	--	
MW-8	10/22/2009	56.56	--	10.60	45.96	--	480	77 J	--	<67	--	--	--	--	--	--	--	--	--	
MW-8	11/18/2009	56.56	--	9.71	46.85	--	510	140	--	<70	--	--	--	--	--	--	--	--	--	
MW-8	12/3/2009	56.56	--	8.87	47.69	--	580	--	--	--	--	<1	<1	7	28	--	--	--	--	
MW-8	12/16/2009	56.56	--	--	--	--	420	240	--	<66	--	--	--	--	--	--	--	--	--	
MW-8	1/27/2010	56.56	--	8.90	47.66	--	790	--	190	--	<69	--	--	--	--	--	--	--	--	
MW-8	2/12/2010	56.56	--	8.98	47.58	--	570	--	180	--	<70	--	--	--	--	--	--	--	--	
MW-8	3/30/2010	56.56	--	8.45	48.11	--	710	--	91	--	<70	--	--	--	--	--	--	--	--	
MW-8	6/18/2010	56.56	--	8.32	48.24	--	**1,000**	--	390	--	380	--	--	--	--	--	--	--	--	
MW-8	9/2/2010	56.56	--	9.87	46.69	--	390 J	290	--	330	--	--	--	--	--	--	--	--	--	
MW-8	12/7/2010	56.56	--	9.81	46.75	--	610	--	309	--	470	--	--	--	--	--	--	--	--	
MW-8	3/7/2011	56.56	--	7.46	49.10	--	520	--	**590**	--	**530**	--	--	--	--	--	--	--	--	
MW-8	6/9/2011	56.56	--	6.95	49.61	--	280	--	**19,000**	--	<3,500	--	--	--	--	--	--	--	--	
MW-8	9/16/2011	56.56	--	8.48	48.08	--	500	--	76	--	170	--	--	--	--	--	--	--	--	
MW-8	12/13/2011	56.56	--	9.10	47.46	--	460	--	66	--	130	--	--	--	--	--	--	--	--	
MW-8	12/19/2011	56.56	--	9.02	47.54	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-8	3/15/2012	56.56	--	9.70	46.86	--	<50	--	<29	--	<68	--	--	--	--	--	--	--	--	

Table 5. Historical Groundwater Gauging Data and Select Analytical Results

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	TOC	DTP	DTW	GWE	NAPL	GRO	DRO	DRO w/ Silica Gel	HO	HO w/ Silica Gel	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	Dissolved Lead	Total Lead	EDB	Comments
MTCA Method A CULs							**800/1,000**	**500**	**500**	**500**	**500**	**5**	**1,000**	**700**	**1,000**	**20**	**15**	**15**	**0.01**	
MW-8	6/13/2012	56.56	--	7.35	49.21	--	330	--	430	--	**610**	--	--	--	--	--	--	--	--	In analyzing HO w/ silica gel, the observed sample pattern includes #2 fuel/diesel, eluting in the DRO range later than #2 fuel.
MW-8	9/10/2012	56.56	--	8.80	47.76	--	220	--	<30	--	<69	--	--	--	--	--	--	--	--	
MW-8	12/10/2012	56.56	--	8.05	48.51	--	630	--	220	--	310	--	--	--	--	--	--	--	--	
MW-8	3/11/2013	56.56	--	7.24	49.32	--	510	--	**580**	--	**830**	--	--	--	--	--	--	--	--	In analyzing HO w/ silica gel, the observed sample pattern includes #2 fuel/diesel and an additional pattern that elutes later in the DRO range.
MW-8	6/12/2013	56.56	--	7.43	49.13	--	610	200	--	360	--	--	--	--	--	--	--	--	--	
MW-8	9/18/2013	56.56	--	8.82	47.74	--	380	48	--	96	--	--	--	--	--	--	--	--	--	
MW-8	12/11/2013	56.56	--	8.36	48.20	--	500	100	--	190	--	--	--	--	--	--	--	--	--	
MW-8	3/12/2014	56.56	--	7.02	49.54	--	--	**500**	--	**510**	--	--	--	--	--	--	--	--	--	In analyzing HO, the observed sample
MW-8	9/27/2014	56.56	--	8.86	47.70	**--**	--	**16,000**	--	--	--	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	
MW-8	8/182020	56.56	--	9.02	47.54	**--**	**6,210**	123 J	--	<83.3	**--**	<0.0941	<0.278	1.64	1.16 J	**--**	**--**	<2.95	**--**	
MW-9	1/29/1992	--	--	--	--	--	ND	**1,000**	--	ND	--	1.0	1.0	ND	4.0	--	--	--	--	
MW-9	9/25/1992	57.79	--	--	--	--	370	**1,970**	--	ND	--	1.2	ND	1.0	2.0	--	--	--	--	
MW-9	2/24/1993	57.79	--	10.07	47.72	--	439	**2,340**	--	ND	--	**27**	ND	ND	1.0	--	--	--	--	
MW-9	5/17/1993	57.79	--	9.75	48.04	--	330	**770**	--	ND	--	**5.9**	1.0	ND	2.0	--	--	--	--	
MW-9	8/2/1993	57.79	--	10.20	47.59	--	--	**1,560**	--	ND	--	--	--	--	--	--	--	--	--	
MW-9	8/24/1993	57.79	--	--	--	--	**5,590**	--	--	--	--	4.0	14	12	409	--	--	--	--	
MW-9	11/3/1993	57.79	--	11.43	46.36	--	**1,070**	**990**	--	ND	--	1.9	1.0	ND	2.0	--	--	--	--	
MW-9	2/15/1994	57.79	--	11.27	46.52	--	**853**	**750**	--	ND	--	2.1	ND	ND	2.0	--	--	--	--	
MW-9	5/20/1994	57.79	--	10.75	47.04	--	740	**1,610**	--	ND	--	0.6	ND	ND	ND	--	--	--	--	
MW-9	8/23/1994	57.79	--	11.69	46.10	--	640	**1,220**	--	ND	--	0.7	ND	ND	ND	--	--	--	--	
MW-9	11/16/1994	57.79	--	10.88	46.91	--	ND	300	--	ND	--	ND	ND	ND	ND	--	--	--	--	
MW-9	2/10/1995	57.79	--	10.94	46.85	--	**950**	**890**	--	400	--	ND	ND	1.5	6.0	--	--	ND	--	
MW-9	5/12/1995	57.79	--	10.49	47.30	--	**910**	**740**	--	ND	--	ND	ND	ND	ND	--	--	ND	--	
MW-9	8/11/1995	57.79	--	11.14	46.65	--	**1,200**	**1,800**	--	ND	--	0.63	ND	ND	1.2	--	--	ND	--	
MW-9	11/2/1995	57.79	--	11.49	46.30	--	**990**	**980**	--	ND	--	0.68	ND	ND	ND	--	--	3.5	--	
MW-9	1/31/1996	57.79	--	8.98	48.81	--	740	**710**	--	ND	--	2.6	ND	ND	ND	--	--	--	--	
MW-9	5/9/1996	57.79	--	9.31	48.48	--	128	477	--	ND	--	ND	0.74	ND	ND	--	--	--	--	
MW-9	2/3/1997	57.79	--	7.70	50.09	--	190	355	--	ND	--	ND	ND	ND	ND	--	--	--	--	
MW-9	8/5/1997	57.79	--	9.85	47.94	--	236	447	--	ND	--	ND	ND	ND	ND	--	--	--	--	
MW-9	2/11/1998	57.79	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-9	8/27/1998	57.79	--	10.72	47.07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-9	1/19/1999	57.79	--	8.87	48.92	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-9	8/30/1999	57.79	--	10.18	47.61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-9	3/13/2000	57.79	--	9.13	48.66	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-9	9/19/2000	57.79	--	10.41	47.38	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-9	3/20/2001	57.79	--	10.07	47.72	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-9	8/21/2001	57.79	--	10.79	47.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-10	12/16/2002	--	--	10.41	--	--	**1,800**	--	<250	--	<250	**<10**	3.5	31	98	9.3	<8.90	--	--	
MW-10	3/6/2003	--	--	9.74	--	--	99	--	<250	--	<250	<1.0	<0.50	<0.50	<1.5	<2.5	--	--	--	
MW-10	6/4/2003	--	--	9.28	--	--	<50	--	<320	--	<400	2.4	<0.5	2.4	<1.5	<2.5	--	--	--	
MW-10	9/11/2003	--	--	11.18	--	--	**12,000**	--	330	--	<250	**71**	380	430	**1,500**	<10	--	--	--	
MW-10	12/17/2003	--	--	9.15	--	--	<50/<50	--	<250/<250	--	<250/<250	<0.5/2.8	<0.5/1.4	<0.5/1.5	<1.5/1.8	<2.5/<2.5	--	--	--	
MW-10	6/11/2004	--	--	8.95	--	--	<50	--	**<800**	--	<1,000	2.5	<0.5	<0.5	<1.5	<2.5	--	--	--	
MW-10	9/21/2004	--	--	8.90	--	--	120	--	<250	--	<250	**9.6**	0.8	1.2	<1.5	<5.0	--	--	--	
MW-10	12/21/2004	--	--	8.61	--	--	780	--	<250	--	<250	**27**	19	13	25	<5.0	--	--	--	
MW-10	7/2/2005	56.21	--	8.98	47.23	--	**1,100**	--	470	--	<500	**8**	6	10	190	<0.5	--	1.3	<0.5	
MW-10	9/15/2005	56.21	--	9.48	46.73	--	**17,000**	--	**980**	--	280	**32**	**1,200**	520	**2,600**	<1	--	<0.87	--	

Table 5. Historical Groundwater Gauging Data and Select Analytical Results

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	TOC	DTP	DTW	GWE	NAPL	GRO	DRO	DRO w/ Silica Gel	HO	HO w/ Silica Gel	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	Dissolved Lead	Total Lead	EDB	Comments
MTCA Method A CULs							**800/1,000**	**500**	**500**	**500**	**500**	**5**	**1,000**	**700**	**1,000**	**20**	**15**	**15**	**0.01**	
MW-10	12/31/2005	56.21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Well inaccessible
MW-10	3/11/2006	56.21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Well inaccessible
MW-10	6/13/2006	56.21	--	8.98	47.23	--	**2,800**	--	**670**	--	<210	4	68	92	360	<0.5	<0.51	1.3	--	
MW-10	8/10/2006	56.21	--	9.53	46.68	--	**16,000**	**620**	--	<100	--	**6**	330	390	**1,600**	<1	0.4	1	--	
MW-10	12/5/2006	56.21	--	10.03	46.18	--	**22,000**	**1,400**	--	**530**	--	**15**	380	**700**	**3,800**	<10	0.57 BJ	2.6 B	--	
MW-10	1/24/2007	56.21	--	9.30	46.91	--	**12,000**	**1,300**	--	<260	--	**7.7**	48	310	**1,450**	<5.0	<2.0	<2.0	--	
MW-10	5/8/2007	56.21	--	9.41	46.80	--	**13,000**	**610**	--	--	--	**<10**	370	350	**1,790**	<10	<2.0	<2.0	--	
MW-10	6/4/2007	56.21	--	9.24	46.97	--	**15,000**	--	320	<100	--	**6**	160	370	**1,900**	<1	--	1.2	<1	
MW-10	9/5/2007	56.21	--	10.50	45.71	--	**13,000**	--	480	--	<110	3	210	340	**1,400**	<1	--	0.88	<1	
MW-10	12/19/2007	56.21	--	10.45	45.76	--	**8,700**	--	**530**	--	<200	**14**	44	250	850	<0.5	--	1.9	<0.5	In analyzing DRO w/ silica gel, the observed sample pattern is not typical of #2 fuel/diesel.
MW-10	3/6/2008	56.21	--	9.08	47.13	--	**2,100**	--	140	--	<100	**7**	29	61	210	<0.5	--	--	<0.5	
MW-10	6/16/2008	56.21	--	8.62	47.59	--	**1,500**	--	410	--	<100	0.6	44	51	190	<0.5	--	--	<0.5	
MW-10	9/11/2008	56.21	--	8.77	47.44	--	**7,000**	--	92	--	<99	2	140	170	**1,000**	<0.5	--	--	<0.5	
MW-10	11/20/2008	56.21	--	9.01	47.20	--	**7,700**	--	150	--	<69	<3	83	190	**1,300**	<3	--	--	<3	
MW-10	3/4/2009	56.21	--	7.86	48.35	--	**3,600**	--	85	--	<69	0.9	38	95	390	<0.5	--	--	<0.5	
MW-10	6/4/2009	56.21	--	8.10	48.11	--	**5,000**	--	<300	--	<700	2	73	170	440	<0.5	--	--	<0.5	
MW-10	9/22/2009	56.21	--	10.03	46.18	--	**15,000**	**610**	--	<81	--	--	--	--	--	--	--	--	--	
MW-10	9/24/2009	56.21	--	10.04	46.17	--	**22,000**	**800**	--	150 J	--	--	--	--	--	--	--	--	--	
MW-10	10/1/2009	56.21	--	10.44	45.77	--	**14,000**	460	--	<66	--	--	--	--	--	--	--	--	--	
MW-10	10/8/2009	56.21	--	10.64	45.57	--	**13,000**	330	--	<69	--	--	--	--	--	--	--	--	--	
MW-10	10/15/2009	56.21	--	10.80	45.41	--	**17,000**	**560**	--	<66	--	--	--	--	--	--	--	--	--	
MW-10	10/22/2009	56.21	--	10.82	45.39	--	**12,000**	420	--	<68	--	--	--	--	--	--	--	--	--	
MW-10	11/18/2009	56.21	--	10.14	46.07	--	**11,000**	36 J	--	<72	--	--	--	--	--	--	--	--	--	
MW-10	12/3/2009	56.21	--	9.28	46.93	--	**5,600**	--	350	--	<67	2	33	200	480	<0.5	--	--	<0.5	
MW-10	12/16/2009	56.21	--	--	--	--	**2,800**	140	--	<69	--	--	--	--	--	--	--	--	--	
MW-10	1/27/2010	56.21	--	8.81	47.40	--	**2,000**	--	210	--	<70	--	--	--	--	--	--	--	--	
MW-10	2/12/2010	56.21	--	8.83	47.38	--	**1,800**	--	120	--	<69	--	--	--	--	--	--	--	--	
MW-10	3/30/2010	56.21	--	8.80	47.41	--	130	--	44	--	<69	--	--	--	--	--	--	--	--	
MW-10	6/18/2010	56.21	--	8.55	47.66	--	120	--	63	--	<69	<0.5	<0.5	4	2	--	--	--	--	
MW-10	9/2/2010	56.21	--	10.01	46.20	--	**3,900**	380	--	120	--	2	7	140	260	--	--	--	--	
MW-10	12/7/2010	56.21	--	10.07	46.14	--	**7,600**	--	230	--	290	3	70	240	700	--	--	--	--	
MW-10	3/7/2011	56.21	--	7.79	48.42	--	700	--	170	--	340	2	3	23	22	--	--	--	--	
MW-10	6/9/2011	56.21	--	7.30	48.91	--	**3,600**	--	**6,200**	--	<340	3	40	130	370	--	--	--	--	
MW-10	9/16/2011	56.21	--	8.60	47.61	--	**5,100**	--	100	--	<68	1	13	190	370	--	--	--	--	
MW-10	12/13/2011	56.21	--	9.08	47.13	--	560	--	<60	--	<140	0.6	1	11	10	--	--	--	--	
MW-10	12/19/2011	56.21	--	9.00	47.21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-10	3/15/2012	56.21	--	7.80	48.41	--	77	--	<30	--	<69	<0.5	<0.5	1	<0.5	--	--	--	--	
MW-10	6/13/2012	56.21	--	7.45	48.76	--	620	--	35	--	<72	0.8	6	38	15	--	--	--	--	
MW-10	9/10/2012	56.21	--	8.75	47.46	--	**4,200**	--	220	--	<68	1	35	87	220	--	--	--	--	
MW-10	12/10/2012	56.21	--	8.12	48.09	--	**1,700**	--	56	--	<69	0.6	19	31	210	--	--	--	--	
MW-10	3/11/2013	56.21	--	7.54	48.67	--	**1,200**	--	37	--	<66	0.5	6	18	48	--	--	--	--	
MW-10	6/12/2013	56.21	--	7.55	48.66	--	**1,800**	59	--	<67	--	0.9	13	47	150	--	--	--	--	
MW-10	9/18/2013	56.21	--	8.93	47.28	--	**4,000**	200	--	<67	--	0.8	17	29	330	--	--	--	--	
MW-10	12/11/2013	56.21	--	8.56	47.65	--	**3,100**	76	--	<69	--	1	10	54	140	--	--	--	--	
MW-10	3/12/2014	56.21	--	12.79	43.42	--	**1,700**	--	--	--	--	<0.5	6	28	83	--	--	--	--	
MW-10	9/27/2014	56.21	--	8.97	47.24	--	**2,300**	--	--	--	--	<0.5	<0.5	0.7	0.6	--	--	--	--	
MW-10	8/17/2020	56.21	--	9.45	46.76	--	582	222	--	<83.3	--	0.152 J	2.41	28.5	19.1	--	--	<2.95	--	
MW-11	12/16/2002	--	--	11.68	--	--	**22,000**	--	430	--	<250	**170**	980	**740**	**3,000**	**70**	<8.90	--	--	
MW-11	3/6/2003	--	--	10.34	--	--	**19,000**	--	**790**	--	280	**150**	70	680	**2,300**	<50	--	--	--	
MW-11	6/4/2003	--	--	9.83	--	--	**16,000**	--	**600**	--	<250	**88**	590	480	**2,100**	<20	--	--	--	
MW-11	9/11/2003	--	--	10.26	--	--	63	--	<250	--	<250	<0.5	<0.5	<0.5	<1.5	<2.5	--	--	--	
MW-11	12/17/2003	--	--	9.61	--	--	**5,300/83**	--	260/<250	--	<250/<250	**46/1.4**	67/0.8	220/3.9	770/9.4	**21/<2.5**	--	--	--	
MW-11	6/11/2004	--	--	9.12	--	--	**4,700**	--	**<800**	--	<1,000	**35**	19	190	520	<2.5	--	--	--	
MW-11	9/21/2004	--	--	9.42	--	--	**3,800**	--	<250	--	<250	**28**	28	140	540	<10	--	--	--	
MW-11	12/21/2004	--	--	8.46	--	--	**1,400**	--	<250	--	<250	**19**	7.6	65	93	<2.5	--	--	--	
MW-11	7/2/2005	56.32	--	9.32	47.00	--	**1,100**	--	410	--	<100	**7**	3	29	110	<1	--	0.98	<1	
MW-11	9/15/2005	56.32	--	10.38	45.94	--	**2,800**	--	<400	--	<500	**15**	10	170	360	<0.5	--	<0.87	--	

Table 5. Historical Groundwater Gauging Data and Select Analytical Results

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	TOC	DTP	DTW	GWE	NAPL	GRO	DRO	DRO w/ Silica Gel	HO	HO w/ Silica Gel	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	Dissolved Lead	Total Lead	EDB	Comments
MTCA Method A CULs							**800/1,000**	**500**	**500**	**500**	**500**	**5**	**1,000**	**700**	**1,000**	**20**	**15**	**15**	**0.01**	
MW-11	12/31/2005	56.32	--	10.31	46.01	--	**8,700**	--	350	--	<200	**29**	140	310	**1,000**	<0.5	<0.87	<0.87	--	
MW-11	3/11/2006	56.32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Well inaccessible
MW-11	6/13/2006	56.32	--	11.68	44.64	--	**3,500**	--	**510**	--	<99	**26**	15	170	350	<0.5	<0.51	<0.51	--	
MW-11	8/10/2006	56.32	--	10.20	46.12	--	**3,700**	150	--	<110	--	**13**	11	<0.5	330	<0.5	<0.047	0.5	--	
MW-11	12/5/2006	56.32	--	10.67	45.65	--	**6,500**	**730**	--	100 J	--	**36**	21	270	894	<10	0.085 BJ	0.49 BJ	--	
MW-11	1/24/2007	56.32	--	9.85	46.47	--	**4,300**	320	--	<300	--	**28**	14	180	557	<5.0	<2.0	<2.0	--	
MW-11	5/8/2007	56.32	--	10.07	46.25	--	420	<130	--	--	--	3.1	<2.0	21	12	<2.0	<2.0	<2.0	--	
MW-11	6/4/2007	56.32	--	9.85	46.47	--	**950**	<400	--	<500	--	**5**	2	53	82	<1	--	1	<1	
MW-11	9/5/2007	56.32	--	11.13	45.19	--	**1,000**	--	250	--	<96	**10**	5	35	41	<2	--	0.45	<2	
MW-11	12/19/2007	56.32	--	10.85	45.47	--	**1,300**	--	**1,800**	--	<1,000	**12**	12	46	82	<1	--	0.1	<1	
MW-11	3/6/2008	56.32	--	9.48	46.84	--	270	--	<79	--	<98	0.8	1	20	36	<0.5	--	--	<0.5	
MW-11	6/16/2008	56.32	--	8.43	47.89	--	<50	--	<81	--	<100	<0.5	<0.5	0.6	<0.5	<0.5	--	--	<0.5	
MW-11	9/11/2008	56.32	--	8.85	47.47	--	94	--	<79	--	<99	<0.5	<0.5	4	3	<0.5	--	--	<0.5	
MW-11	11/20/2008	56.32	--	9.82	46.50	--	740	--	45	--	<69	<0.5	2	40	62	<0.5	--	--	<0.5	
MW-11	3/4/2009	56.32	--	7.89	48.43	--	710	--	95	--	<68	0.9	5	37	58	<0.5	--	--	<0.5	
MW-11	6/4/2009	56.32	--	8.10	48.22	--	210	--	<300	--	<700	0.5	1	6	8	<0.5	--	--	<0.5	
MW-11	9/22/2009	56.32	--	11.05	45.27	--	**2,500**	110	--	<66	--	--	--	--	--	--	--	--	--	
MW-11	9/24/2009	56.32	--	11.17	45.15	--	**1,900**	130	--	<66	--	--	--	--	--	--	--	--	--	
MW-11	10/1/2009	56.32	--	11.31	45.01	--	**2,900**	74 J	--	<66	--	--	--	--	--	--	--	--	--	
MW-11	10/8/2009	56.32	--	11.42	44.90	--	**2,100**	63 J	--	<68	--	--	--	--	--	--	--	--	--	
MW-11	10/15/2009	56.32	--	11.57	44.75	--	**3,200**	150	--	<69	--	--	--	--	--	--	--	--	--	
MW-11	10/22/2009	56.32	--	11.46	44.86	--	**2,900**	100 J	--	<70	--	--	--	--	--	--	--	--	--	
MW-11	11/18/2009	56.32	--	10.64	45.68	--	**3,100**	140	--	<70	--	--	--	--	--	--	--	--	--	
MW-11	12/3/2009	56.32	--	9.77	46.55	--	**2,300**	--	130	--	<68	3	8	130	320	<0.5	--	--	<0.5	
MW-11	12/16/2009	56.32	--	--	--	--	**3,600**	130	--	<70	--	--	--	--	--	--	--	--	--	
MW-11	1/27/2010	56.32	--	9.35	46.97	--	**5,000**	--	200	--	<64	--	--	--	--	--	--	--	--	
MW-11	2/12/2010	56.32	--	9.46	46.86	--	**3,800**	--	220	--	<70	--	--	--	--	--	--	--	--	
MW-11	3/30/2010	56.32	--	9.42	46.90	--	**5,000**	--	150	--	<69	--	--	--	--	--	--	--	--	
MW-11	6/18/2010	56.32	--	8.72	47.60	--	670	--	75	--	<69	2	2	16	66	--	--	--	--	
MW-11	9/2/2010	56.32	--	10.59	45.73	--	**2,900**	200	--	<69	--	3	8	130	330	--	--	--	--	
MW-11	12/7/2010	56.32	--	10.38	45.94	--	**2,500**	--	130	--	<70	3	7	120	270	--	--	--	--	
MW-11	3/7/2011	56.32	--	7.91	48.41	--	**1,300**	--	61	--	<69	0.9	3	61	65	--	--	--	--	
MW-11	6/9/2011	56.32	--	7.35	48.97	--	**1,400**	--	**67,000**	--	<6,800	2	5	68	62	--	--	--	--	
MW-11	9/16/2011	56.32	--	8.70	47.62	--	**850**	--	34	--	<68	2	3	39	22	--	--	--	--	
MW-11	12/13/2011	56.32	--	9.75	46.57	--	**1,800**	--	49	--	<68	3	5	97	160	--	--	--	--	
MW-11	12/19/2011	56.32	--	9.62	46.70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-11	3/15/2012	56.32	--	7.95	48.37	--	**1,500**	--	<30	--	<70	3	3	78	94	--	--	--	--	
MW-11	6/13/2012	56.32	--	7.55	48.77	--	**2,200**	--	57	--	<70	**7**	7	160	180	--	--	--	--	
MW-11	9/10/2012	56.32	--	8.94	47.38	--	**1,300**	--	<300	--	<700	<5	<5	24	31	--	--	--	--	
MW-11	12/10/2012	56.32	--	8.40	47.92	--	**1,700**	--	94	--	<68	**6**	6	63	120	--	--	--	--	
MW-11	3/11/2013	56.32	--	7.56	48.76	--	**3,200**	--	88	--	<70	**7**	9	150	190	--	--	--	--	
MW-11	6/12/2013	56.32	--	7.68	48.64	--	**3,600**	98	--	<66	--	**9**	12	190	250	--	--	--	--	
MW-11	9/18/2013	56.32	--	9.53	46.79	--	**4,000**	210	--	<66	--	**6**	9	170	230	--	--	--	--	
MW-11	12/11/2013	56.32	--	9.04	47.28	--	**2,700**	100	--	<67	--	4	7	140	210	--	--	--	--	
MW-11	3/12/2014	56.32	--	12.88	43.44	--	**5,100**	--	--	--	--	**7**	14	260	340	--	--	--	--	
MW-11	9/27/2014	56.32	--	9.51	46.81	**--**	**2,200**	--	--	--	--	<0.5	<0.5	0.8	<0.5	**--**	**--**	**--**	**--**	
MW-11	8/17/2020	56.32	--	9.14	47.18	**--**	**5,650**	**724**	**--**	<83.3	**--**	3.76	<0.278	4.91	2.28 J	**--**	<2.95	**--**	**--**	
MW-12	8/10/2006	--	--	9.23	--	--	**89,000**	**62,000**	--	<21,000	--	4	230	**990**	**4,400**	<3	4.3	**164**	--	
MW-12	12/5/2006	--	--	9.04	--	--	**14,000**	**3,700**	--	76 J	--	1.6	52	280	**1,390**	<1.0	4.2 J	**20 B**	--	
MW-12	1/24/2007	--	--	8.24	--	--	**9,500**	**1,600**	--	<250	--	<5.0	34	89	**1,140**	<5.0	11	**65**	--	
MW-12	5/8/2007	--	--	8.59	--	--	**9,400**	**1,400**	--	--	--	3.2	61	77	540	<2.0	2	14	--	
MW-12	6/4/2007	56.79	--	9.05	47.74	--	**12,000**	**330,017**	--	<100	--	<3	19	120	560	<3	--	7.9	<3	
MW-12	9/5/2007	56.79	--	10.18	46.61	--	**3,100**	--	**2,900**	--	<110	<0.5	1	31	55	<0.5	--	2.5	<0.5	
MW-12	12/19/2007	56.79	--	9.72	47.07	--	**2,200**	--	**6,800**	--	<490	<0.5	0.5	24	19	<0.5	--	13.4	<0.5	In analyzing DRO w/ silica gel, the observed sample pattern includes #2 fuel/diesel and an additional pattern that elutes earlier in the DRO range.

Table 5. Historical Groundwater Gauging Data and Select Analytical Results

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	TOC	DTP	DTW	GWE	NAPL	GRO	DRO	DRO w/ Silica Gel	HO	HO w/ Silica Gel	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	Dissolved Lead	Total Lead	EDB	Comments
MTCA Method A CULs							**800/1,000**	**500**	**500**	**500**	**500**	**5**	**1,000**	**700**	**1,000**	**20**	**15**	**15**	**0.01**	
MW-12	3/6/2008	56.79	--	8.56	48.23	--	**7,100**	--	**1,500**	--	<100	**12**	250	180	**1,100**	<0.5	--	--	<0.5	In analyzing DRO w/ silica gel, the observed sample pattern is not typical of #2 fuel/diesel.
MW-12	6/16/2008	56.79	7.98	8.03	48.80	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-12	9/11/2008	56.79	8.12	8.17	48.66	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-12	11/20/2008	56.79	8.15	8.27	48.62	0.12	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-12	3/4/2009	56.79	7.52	7.56	49.26	0.04	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-12	6/4/2009	56.79	7.74	7.80	49.04	0.06	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-12	9/22/2009	56.79	9.51	10.21	47.14	0.70	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-12	9/23/2009	56.79	--	12.68	44.11	--	**980,000**	**460,000**	--	**530,000**	--	--	--	--	--	--	--	--	--	
MW-12	9/24/2009	56.79	--	9.81	46.98	--	**44,000**	**30,000**	--	**35,000**	--	--	--	--	--	--	--	--	--	
MW-12	10/1/2009	56.79	--	10.23	46.56	--	**12,000 J**	**5,000**	--	**25,000**	--	--	--	--	--	--	--	--	--	
MW-12	10/8/2009	56.79	--	10.47	46.32	--	**3,700**	**3,800**	--	**14,000**	--	--	--	--	--	--	--	--	--	
MW-12	10/15/2009	56.79	--	10.60	46.19	--	**3,400**	**1,900 J**	--	**4800 J**	--	--	--	--	--	--	--	--	--	
MW-12	10/22/2009	56.79	--	10.45	46.34	--	**4,900**	**810 J**	--	**2,800**	--	--	--	--	--	--	--	--	--	
MW-12	11/18/2009	56.79	--	9.66	47.13	--	**3,200**	**1,400 J**	--	**1,800 J**	--	--	--	--	--	--	--	--	--	
MW-12	12/3/2009	56.79	--	8.80	47.99	--	**5,900**	--	**7,600**	--	**3,400**	**<10**	11	35	260	<10	--	--	<10	
MW-12	12/16/2009	56.79	--	--	--	--	**4,500**	**2,200**	--	**4,300**	--	--	--	--	--	--	--	--	--	
MW-12	1/27/2010	56.79	--	8.93	47.86	--	**9,900**	--	**15,000**	--	<1,800	--	--	--	--	--	--	--	--	
MW-12	2/12/2010	56.79	--	9.00	47.79	--	**5,100**	--	**5,000**	--	450	--	--	--	--	--	--	--	--	In analyzing DRO w/ silica gel, the observed sample pattern is not typical of #2 fuel/diesel.
MW-12	3/30/2010	56.79	--	8.35	48.44	--	**4,900**	--	**5,800**	--	<350	--	--	--	--	--	--	--	--	
MW-12	6/18/2010	56.79	--	8.39	48.40	--	**6,900**	--	**4,600**	--	<360	<0.5	5	82	290	--	--	--	--	
MW-12	9/2/2010	56.79	--	9.87	46.92	--	**2,600**	**5,100**		<350	--	<0.5	1	29	29	--	--	--	--	
MW-12	12/7/2010	56.79	--	9.74	47.05	--	**5,000**	--	**2,700**	--	150	<0.5	0.9	28	37	--	--	--	--	
MW-12	3/7/2011	56.79	--	7.53	49.26	--	110	--	**2,200**	--	270	<0.5	<0.5	0.9	3	--	--	--	--	
MW-12	6/9/2011	56.79	--	7.14	49.65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-12	9/16/2011	56.79	--	8.53	48.26	--	**3,100**	--	**1,300**	--	<68	<0.5	0.5	15	48	--	--	--	--	
MW-12	12/13/2011	56.79	--	9.05	47.74	--	**3,800**	--	330	--	<69	<0.5	<0.5	10	16	--	--	--	--	
MW-12	12/19/2011	56.79	--	8.96	47.83	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-12	3/15/2012	56.79	--	9.77	47.02	--	<50	--	320	--	<82	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-12	6/13/2012	56.79	--	7.40	49.39	--	<50	--	110	--	<67	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-12	9/10/2012	56.79	--	8.35	48.44	--	**3,200**	--	**5,800**	--	<68	<0.5	<0.5	9	4	--	--	--	--	
MW-12	12/10/2012	56.79	--	7.84	48.95	--	150	--	81	--	<69	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-12	3/11/2013	56.79	--	7.13	49.66	--	150	--	120	--	<66	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-12	6/12/2013	56.79	--	7.32	49.47	--	310	**540**	--	<67	--	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-12	9/18/2013	56.79	--	8.68	48.11	--	**1,500**	**1,500**	--	<66	--	<0.5	<0.5	1	0.9	--	--	--	--	
MW-12	12/11/2013	56.79	--	8.24	48.55	--	97	110	--	<66	--	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-12	3/12/2014	56.79	--	7.72	49.07	--	130	280	--	<70	--	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-12	9/27/2014	56.79	--	8.70	48.09	--	<50	<30	--	--	--	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-12	8/17/2020	56.79	--	9.09	47.70	--	175 B	144 J	--	<83.3	--	<0.0941	0.473 J	0.440 J	0.803 J	--	--	<2.95	--	
MW-13	8/10/2006	--	--	9.83	--	--	**15,000**	**5,300**	--	<2,200	--	**5**	47	260	**1,400**	<1	4.3	**29.6**	--	
MW-13	12/5/2006	--	--	9.68	--	--	**5,000**	**1,700**	--	270	--	0.99 J	33	110	590	<1.0	1.5 BJ	**17 B**	--	
MW-13	1/24/2007	--	--	8.93	--	--	**2,300**	190	--	<260	--	1.5	21	41	242	<1.0	<2.0	**22**	--	
MW-13	5/8/2007	--	--	9.17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-13	6/4/2007	56.71	11.15	13.00	45.19	1.85	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-13	9/5/2007	56.71	11.70	11.96	44.96	0.26	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-13	12/19/2007	56.71	10.51	10.83	46.14	0.32	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-13	3/6/2008	56.71	9.05	9.37	47.60	0.32	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-13	6/16/2008	56.71	8.25	8.49	48.41	0.24	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-13	9/11/2008	56.71	8.64	8.83	48.03	0.19	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-13	11/20/2008	56.71	8.77	8.94	47.91	0.17	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-13	3/4/2009	56.71	7.68	7.73	49.02	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-13	6/4/2009	56.71	7.94	7.99	48.76	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-13	9/22/2009	56.71	9.86	9.89	46.84	0.03	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-13	9/23/2009	56.71	--	12.98	43.73	--	**96,000**	**31,000**	--	**49,000 J**	--	--	--	--	--	--	--	--	--	

Table 5. Historical Groundwater Gauging Data and Select Analytical Results

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	TOC	DTP	DTW	GWE	NAPL	GRO	DRO	DRO w/ Silica Gel	HO	HO w/ Silica Gel	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	Dissolved Lead	Total Lead	EDB	Comments
MTCA Method A CULs							**800/1,000**	**500**	**500**	**500**	**500**	**5**	**1,000**	**700**	**1,000**	**20**	**15**	**15**	**0.01**	
MW-13	9/24/2009	56.71	--	12.12	44.59	--	**13,000**	**3,300**	--	**<1,400**	--	--	--	--	--	--	--	--	--	
MW-13	10/1/2009	56.71	12.59	12.60	44.12	0.01	**9,700**	**8,000**	--	**500 J**	--	--	--	--	--	--	--	--	--	
MW-13	10/8/2009	56.71	--	12.46	44.25	--	**8,000**	**760**	--	350	--	--	--	--	--	--	--	--	--	
MW-13	10/15/2009	56.71	12.70	12.71	44.01	0.01	**8,400**	**930**	--	<68	--	--	--	--	--	--	--	--	--	
MW-13	10/22/2009	56.71	--	12.50	44.21	--	**6,500**	**760**	--	<68	--	--	--	--	--	--	--	--	--	
MW-13	11/18/2009	56.71	--	10.73	45.98	--	**8,900**	**1,400**	--	370	--	--	--	--	--	--	--	--	--	
MW-13	12/3/2009	56.71	--	9.68	47.03	--	**11,000**	--	**5,600**	--	<680	**8**	30	300	**1,400**	<0.5	--	--	<0.5	
MW-13	12/16/2009	56.71	--	--	--	--	**8,700**	**1,400**	--	<66	--	--	--	--	--	--	--	--	--	
MW-13	1/27/2010	56.71	--	9.45	47.26	--	**16,000**	--	**3,700**	--	**670**	--	--	--	--	--	--	--	--	
MW-13	2/12/2010	56.71	--	9.55	47.16	--	**11,000**	--	**1,700**	--	<71	--	--	--	--	--	--	--	--	
MW-13	3/30/2010	56.71	--	9.24	47.47	--	**15,000**	--	**9,300**	--	<700	--	--	--	--	--	--	--	--	
MW-13	6/18/2010	56.71	--	9.00	47.71	--	**10,000**	--	**3,900**	--	<350	**5**	23	360	**1,300**	--	--	--	--	
MW-13	9/2/2010	56.71	--	10.56	46.15	--	**11,000**	**3,300**	--	<350	--	**5**	23	280	**1,100**	--	--	--	--	
MW-13	12/7/2010	56.71	--	10.46	46.25	--	**9,100**	--	**770**	--	<71	2	20	200	**1,100**	--	--	--	--	
MW-13	3/7/2011	56.71	--	7.68	49.03	--	**4,200**	--	<30	--	<70	<0.5	<0.5	2	9	--	--	--	--	
MW-13	6/9/2011	56.71	--	7.20	49.51	--	**1,800**	--	160	--	<69	<0.5	0.6	10	45	--	--	--	--	
MW-13	9/16/2011	56.71	--	9.05	47.66	--	**6,400**	--	**3,000**	--	<140	3	7	160	590	--	--	--	--	
MW-13	12/13/2011	56.71	--	9.60	47.11	--	**7,600**	--	**3,600**	--	<350	<3	11	190	810	--	--	--	--	
MW-13	12/19/2011	56.71	--	9.60	47.11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-13	3/15/2012	56.71	--	9.25	47.46	--	<50	--	<30	--	<70	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-13	6/13/2012	56.71	--	7.60	49.11	--	<50	--	<31	--	<72	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-13	9/10/2012	56.71	--	9.38	47.33	--	**6,000**	--	**660**	--	<68	<5	7	140	620	--	--	--	--	
MW-13	12/10/2012	56.71	--	8.28	48.43	--	**3,000**	--	**750**	--	<69	<5	<5	55	310	--	--	--	--	
MW-13	3/11/2013	56.71	--	7.42	49.29	--	**1,300**	--	490	--	<71	<0.5	0.8	18	91	--	--	--	--	
MW-13	6/12/2013	56.71	--	7.63	49.08	--	750	<29	--	<67	--	<0.5	1	23	100	--	--	--	--	
MW-13	9/18/2013	56.71	--	9.42	47.29	--	**5,500**	**500**	--	<67	--	0.6	7	170	670	--	--	--	--	
MW-13	12/11/2013	56.71	--	8.78	47.93	--	**4,500**	290	--	<67	--	<0.5	7	170	710	--	--	--	--	
MW-13	3/12/2014	56.71	--	7.14	49.57	Sheen	<50	35	--	<67	--	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-13	9/27/2014	56.71	**--**	9.47	47.24	**--**	<50	<29	--	--	--	<0.5	<0.5	<0.5	<0.5	**--**	**--**	**--**	--	
MW-13	8/17/2020	56.71	--	9.41	47.30	**--**	**2,290 [2,450]**	**731 [516]**	**--**	<83.3 [<83.3]	**--**	<0.0941 [<0.0941]	0.580 J [0.535 J]	20.1 [21.2]	39.4 [39.7]	**--**	**--**	<2.95 [<2.95]	**--**	
MW-14	8/10/2006	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Well dry
MW-14	12/5/2006	--	--	10.14	--	--	**19,000**	**1,500**	--	130 J	--	**31**	560	690	**3,300**	<10	0.055 BJ	8.1 B	--	
MW-14	1/24/2007	--	--	9.27	--	--	**32,000**	**2,300**	--	<260	--	**29**	**1,200**	**1,000**	**5,500**	<25	<2.0	**26**	--	
MW-14	5/8/2007	--	--	9.44	--	--	**1,700**	180	--	--	--	**6.2**	3.1	53	143	<2.0	<2.0	13	--	
MW-14	6/4/2007	56.51	--	9.58	46.93	--	**3,100**	<79	--	<98	--	**15**	7	110	290	<0.5	--	2.8	<0.5	
MW-14	9/5/2007	56.51	--	10.54	45.97	--	**3,000**	--	95	<100	--	**9**	17	140	370	<0.5	--	0.26	<0.5	
MW-14	12/19/2007	56.51	--	10.60	45.91	--	**11,000**	--	400	--	<500	**7**	39	240	**1,000**	<1	--	4.8	<1	
MW-14	3/6/2008	56.51	--	9.38	47.13	--	**2,300**	--	<160	--	<200	2	66	76	330	<0.5	--	--	<0.5	
MW-14	6/16/2008	56.51	--	8.78	47.73	--	200	--	<82	--	<100	2	0.6	6	14	<0.5	--	--	<0.5	
MW-14	9/11/2008	56.51	--	9.09	47.42	--	**1,800**	--	<79	--	<99	**9**	9	81	230	<0.5	--	--	<0.5	
MW-14	11/20/2008	56.51	--	9.31	47.20	--	**3,900**	--	120	--	<69	**12**	13	120	420	<0.5	--	--	<0.5	
MW-14	3/4/2009	56.51	--	8.14	48.37	--	**5,400**	--	450	--	<69	**21**	21	170	480	<1	--	--	<1	
MW-14	6/4/2009	56.51	--	8.39	48.12	--	520	--	<300	--	<700	3	1	10	27	<0.5	--	--	<0.5	
MW-14	9/22/2009	56.51	--	10.23	46.28	--	**7,300**	210	--	140 J	--	--	--	--	--	--	--	--	--	
MW-14	9/24/2009	56.51	--	10.30	46.21	--	**9,500**	**560 J**	--	**<700**	--	--	--	--	--	--	--	--	--	
MW-14	10/1/2009	56.51	--	10.68	45.83	--	**12,000**	270	--	<67	--	--	--	--	--	--	--	--	--	
MW-14	10/8/2009	56.51	--	10.80	45.71	--	**11,000**	220	--	<67	--	--	--	--	--	--	--	--	--	
MW-14	10/15/2009	56.51	--	10.94	45.57	--	**14,000**	370	--	<66	--	--	--	--	--	--	--	--	--	
MW-14	10/22/2009	56.51	--	10.94	45.57	--	**15,000**	260	--	<66	--	--	--	--	--	--	--	--	--	
MW-14	11/18/2009	56.51	--	10.39	46.12	--	**19,000**	**660**	--	<130	--	--	--	--	--	--	--	--	--	
MW-14	12/3/2009	56.51	--	9.61	46.90	--	**22,000**	--	**620**	--	<140	**6**	200	530	**2,800**	<0.5	--	--	<0.5	
MW-14	12/16/2009	56.51	--	--	--	--	**20,000**	**690**	--	<66	--	--	--	--	--	--	--	--	--	
MW-14	1/27/2010	56.51	--	9.24	47.27	--	**24,000**	--	440	--	<69	--	--	--	--	--	--	--	--	
MW-14	2/12/2010	56.51	--	9.29	47.22	--	**19,000**	--	370	--	<70	--	--	--	--	--	--	--	--	
MW-14	3/30/2010	56.51	--	9.21	47.30	--	**14,000**	--	300	--	<69	--	--	--	--	--	--	--	--	
MW-14	6/18/2010	56.51	--	8.90	47.61	--	**6,600**	--	160	--	<69	1	83	150	680	--	--	--	--	
MW-14	9/2/2010	56.51	--	10.33	46.18	--	**7,400**	320	--	<350	--	1	67	250	**1,100**	--	--	--	--	
MW-14	12/7/2010	56.51	--	10.25	46.26	--	**8,600**	--	270	--	<73	1	95	320	**1,600**	--	--	--	--	
MW-14	3/7/2011	56.51	--	8.14	48.37	--	**8,700**	--	440	--	<72	0.7	53	77	**1,100**	--	--	--	--	
MW-14	6/9/2011	56.51	--	7.61	48.90	--	**5,200**	--	100	--	<67	0.7	31	170	690	--	--	--	--	
MW-14	9/16/2011	56.51	--	8.85	47.66	--	**7,400**	--	50	--	<73	3	22	75	830	--	--	--	--	

Table 5. Historical Groundwater Gauging Data and Select Analytical Results

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	TOC	DTP	DTW	GWE	NAPL	GRO	DRO	DRO w/ Silica Gel	HO	HO w/ Silica Gel	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	Dissolved Lead	Total Lead	EDB	Comments
MTCA Method A CULs							**800/1,000**	**500**	**500**	**500**	**500**	**5**	**1,000**	**700**	**1,000**	**20**	**15**	**15**	**0.01**	
MW-14	12/13/2011	56.51	--	9.45	47.06	--	**8,600**	--	120	--	<68	<3	34	280	**1,400**	--	--	--	--	
MW-14	12/19/2011	56.51	--	9.40	47.11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
MW-14	3/15/2012	56.51	--	8.15	48.36	--	**13,000**	--	220	--	<68	<3	110	340	**2,100**	--	--	--	--	
MW-14	6/13/2012	56.51	--	7.80	48.71	--	**4,900**	--	76	--	<72	<1	19	100	470	--	--	--	--	
MW-14	9/10/2012	56.51	--	9.10	47.41	--	**13,000**	--	200	--	<70	<5	39	390	**1,600**	--	--	--	--	
MW-14	12/10/2012	56.51	--	8.52	47.99	--	**3,000**	--	53	--	<71	<5	11	60	390	--	--	--	--	
MW-14	3/11/2013	56.51	--	7.70	48.81	--	**17,000**	--	230	--	<67	<5	100	460	**2,500**	--	--	--	--	
MW-14	6/12/2013	56.51	--	7.90	48.61	--	**10,000**	120	--	<66	--	0.5	56	390	**1,800**	--	--	--	--	
MW-14	9/18/2013	56.51	--	9.28	47.23	--	**12,000**	190	--	<67	--	0.6	50	460	**2,300**	--	--	--	--	
MW-14	12/11/2013	56.51	--	8.90	47.61	--	**9,200**	90	--	<66	--	<3	39	310	**1,900**	--	--	--	--	
MW-14	3/12/2014	56.51	--	9.02	47.49	--	**18,000**	--	--	--	--	<1	54	580	**2,800**	--	--	--	--	
MW-14	9/27/2014	56.51	--	9.22	47.29	**--**	280	--	--	--	--	<0.5	<0.5	<0.5	<0.5	**--**	**--**	**--**	**--**	
MW-14	8/17/2020	56.51	--	9.65	46.86	**--**	**5,720**	480	--	<83.3	**--**	0.245 J	4.55	143	420	**--**	**--**	<2.95	**--**	

Notes:

TOC elevations were surveyed on August 14, 2007, by Statewide Land Surveying, Inc. Vertical datum is NAVD 88 by GPS observations.

800/1,000 = GRO MTCA Method A CUL with benzene present is 800 µg/L and without is 1,000 µg/L

BOLD and highlighted values are greater than their respective MTCA Method A CUL

BOLD values are non-detect below the laboratory MDL, but the MDL is greater than the MTCA Method A CUL

If NAPL is present, GWE is corrected according to the following formula: (TOC - DTW) + (0.8 x NAPL)

Abbreviations:

GB = Grab-groundwater sample

MW = Groundwater monitoring well

TOC = Top of casing in feet above NAVD 88

DTP = Depth to product in feet below TOC

DTW = Depth to water in feet below TOC

GWE = Groundwater elevation in feet relative to NAVD 88

NAPL = Non-aqueous phase liquid thickness in feet

[21.2] = Blind duplicate sample results

-- = Not applicable, not available, or not analyzed

ND = Not detected

MDL = Method detection limit

MTCA = Model Toxics Control Act Cleanup

CUL = Cleanup Level

NAVD 88 = North American Vertical Datum of 1988

USEPA = United States Environmental Protection Agency

Laboratory Qualifiers:

<n = Not detected at or above the laboratory MDL

J = Estimated value; result is ≥ the MDL and < the Reported Detection Limit

B = The same analyte is found in the associated blank

Analytical Methods:

Samples analyzed by NWTPH-Gx

GRO = Total Petroleum Hydrocarbons as Gasoline Range Organics,

Samples analyzed by NWTPH-Dx

DRO = Total Petroleum Hydrocarbons as Diesel Range Organics

HO = Total Petroleum Hydrocarbons as Heavy Oil Range Organics

Samples analyzed by NWTPH-Dx modified

DRO w/ Silica Gel = Total Petroleum Hydrocarbons as Diesel Range Organics with silica gel cleanup

HO w/ Silica Gel = Total Petroleum Hydrocarbons as Heavy Oil Range Organics with silica gel cleanup

Samples analyzed by USEPA Method 8260B/8260D

BTEX = benzene, toluene, ethylbenzene, and total xylenes

Table 5. Historical Groundwater Gauging Data and Select Analytical Results

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	TOC	DTP	DTW	GWE	NAPL	GRO	DRO	DRO w/ Silica Gel	HO	HO w/ Silica Gel	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	Dissolved Lead	Total Lead	EDB	Comments
MTCA Method A CULs							**800/1,000**	**500**	**500**	**500**	**500**	**5**	**1,000**	**700**	**1,000**	**20**	**15**	**15**	**0.01**	

MTBE = Methyl tertiary-butyl ether

EDB = 1,2-Dibromoethane (ethylene dibromide)

Samples analyzed by USEPA Method 6010D

Dissolved lead

Total lead

Table 6. Historical Groundwater Analytical Results - VOCs and sVOCs

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	MBAS	DIPE	ETBE	TAME	TBA	EDC
MTCA Method A CULs		**--**	**--**	**--**	**--**	**--**	**5**
GB-1	4/1/2008	--	<4	<4	<4	<80	<4
GB-2	4/2/2008	--	--	--	--	--	<0.5
GB-3	4/1/2008	--	--	--	--	--	<0.5
GB-4	4/1/2008	--	--	--	--	--	<0.5
GB-5	4/2/2008	--	--	--	--	--	<0.5
MW-4	7/2/2005	--	--	<0.5	<0.5	<5	<0.5
MW-4	10/1/2009	<40	--	--	--	--	--
MW-4	10/8/2009	<40	--	--	--	--	--
MW-4	10/15/2009	68 J	--	--	--	--	--
MW-4	10/22/2009	76 J	--	--	--	--	--
MW-4	11/18/2009	<40	--	--	--	--	--
MW-4	12/16/2009	<40	--	--	--	--	--
MW-4	1/27/2010	<40	--	--	--	--	--
MW-4	2/12/2010	<40	--	--	--	--	--
MW-4	6/18/2010	<40	--	--	--	--	--
MW-4	9/2/2010	<40	--	--	--	--	--
MW-4	12/7/2010	<40	--	--	--	--	--
MW-4	3/7/2011	<80	--	--	--	--	--
MW-4	6/9/2011	<40	--	--	--	--	--
MW-4	9/16/2011	<80	--	--	--	--	--
MW-4	12/19/2011	<40	--	--	--	--	--
MW-4	3/15/2012	<40	--	--	--	--	--
MW-4	6/13/2012	<200	--	--	--	--	--
MW-4	9/10/2012	<40	--	--	--	--	--
MW-4	12/10/2012	<40	--	--	--	--	--

Table 6. Historical Groundwater Analytical Results - VOCs and sVOCs

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	MBAS	DIPE	ETBE	TAME	TBA	EDC
MTCA Method A CULs		**--**	**--**	**--**	**--**	**--**	**5**
MW-5	7/2/2005	--	--	<0.5	<0.5	<5	<0.5
MW-6	7/2/2005	--	--	<0.5	<0.5	<5	<0.5
MW-7	7/2/2005	--	--	<0.5	<0.5	<5	<0.5
MW-7	6/4/2007	--	<0.5	<0.5	<0.5	<2	<0.5
MW-7	12/19/2007	-	<1	<1	<1	<4	<1
MW-7	11/20/2008	--	<13	<13	<13	<50	<13
MW-7	3/4/2009	--	<0.5	<0.5	<0.5	<2	<0.5
MW-7	6/4/2009	--	<0.5	<0.5	<0.5	<2	<0.5
MW-7	9/23/2009	3,000 J	--	--	--	--	--
MW-7	9/24/2009	330	--	--	--	--	--
MW-7	10/1/2009	100 J	--	--	--	--	--
MW-7	10/8/2009	42 J	--	--	--	--	--
MW-7	10/15/2009	<40	--	--	--	--	--
MW-7	10/22/2009	60 J	--	--	--	--	--
MW-7	11/18/2009	67 J	--	--	--	--	--
MW-7	12/3/2009	--	<10	<10	<10	<40	<10
MW-7	12/16/2009	<40	--	--	--	--	--
MW-7	1/27/2010	<40	--	--	--	--	--
MW-7	2/12/2010	58	--	--	--	--	--
MW-7	6/18/2010	270	--	--	--	--	--
MW-7	9/2/2010	240	--	--	--	--	--
MW-7	12/7/2010	230	--	--	--	--	--
MW-7	3/7/2011	<200	--	--	--	--	--
MW-7	6/9/2011	170	--	--	--	--	--
MW-7	9/16/2011	180	--	--	--	--	--
MW-7	12/19/2011	260	--	--	--	--	--
MW-7	3/15/2012	180	--	--	--	--	--

Table 6. Historical Groundwater Analytical Results - VOCs and sVOCs

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	MBAS	DIPE	ETBE	TAME	TBA	EDC
MTCA Method A CULs		**--**	**--**	**--**	**--**	**--**	**5**
MW-7	6/13/2012	100	--	--	--	--	--
MW-7	9/10/2012	130	--	--	--	--	--
MW-7	12/10/2012	80	--	--	--	--	--
MW-8	12/19/2007	--	<0.5	<0.5	<0.5	<2	<0.5
MW-8	10/1/2009	66 J	--	--	--	--	--
MW-8	10/8/2009	<40	--	--	--	--	--
MW-8	10/15/2009	<40	--	--	--	--	--
MW-8	10/22/2009	<40	--	--	--	--	--
MW-8	11/18/2009	<40	--	--	--	--	--
MW-8	12/3/2009	--	--	--	--	--	--
MW-8	12/16/2009	43 J	--	--	--	--	--
MW-8	1/27/2010	<40	--	--	--	--	--
MW-8	2/12/2010	170	--	--	--	--	--
MW-8	6/18/2010	100	--	--	--	--	--
MW-8	9/2/2010	55	--	--	--	--	--
MW-8	12/7/2010	51	--	--	--	--	--
MW-8	3/7/2011	<200	--	--	--	--	--
MW-8	6/9/2011	160	--	--	--	--	--
MW-8	9/16/2011	75	--	--	--	--	--
MW-8	12/19/2011	270	--	--	--	--	--
MW-8	3/15/2012	<80	--	--	--	--	--
MW-8	6/13/2012	110	--	--	--	--	--
MW-8	9/10/2012	<40	--	--	--	--	--
MW-8	12/10/2012	86	--	--	--	--	--
MW-10	7/2/2005	--	--	<0.5	<0.5	<5	<0.5
MW-10	6/4/2007	--	<1	<1	<1	<4	<1
MW-10	9/5/2007	--	<1	<1	<1	<4	<1
MW-10	12/19/2007	--	<0.5	<0.5	<0.5	<2	<0.5
MW-10	3/6/2008	--	<0.5	<0.5	<0.5	<2	<0.5

Table 6. Historical Groundwater Analytical Results - VOCs and sVOCs

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	MBAS	DIPE	ETBE	TAME	TBA	EDC
MTCA Method A CULs		**--**	**--**	**--**	**--**	**--**	**5**
MW-10	6/16/2008	--	<0.5	<0.5	<0.5	<2	<0.5
MW-10	9/11/2008	--	<0.5	<0.5	<0.5	<2	<0.5
MW-10	11/20/2008	--	<3	<3	<3	<10	<3
MW-10	3/4/2009	--	<0.5	<0.5	<0.5	<2	<0.5
MW-10	6/4/2009	--	<0.5	<0.5	<0.5	<2	<0.5
MW-10	9/24/2009	38 J	--	--	--	--	--
MW-10	10/1/2009	45 J	--	--	--	--	--
MW-10	10/8/2009	89 J	--	--	--	--	--
MW-10	10/15/2009	<40	--	--	--	--	--
MW-10	10/22/2009	52 J	--	--	--	--	--
MW-10	11/18/2009	170	--	--	--	--	--
MW-10	12/3/2009	--	<0.5	<0.5	<0.5	<2	<0.5
MW-10	12/16/2009	<40	--	--	--	--	--
MW-10	1/27/2010	<80	--	--	--	--	--
MW-10	2/12/2010	93	--	--	--	--	--
MW-10	3/30/2010	--	--	--	--	--	--
MW-10	6/18/2010	42	--	--	--	--	--
MW-10	9/2/2010	94	--	--	--	--	--
MW-10	12/7/2010	81	--	--	--	--	--
MW-10	3/7/2011	<200	--	--	--	--	--
MW-10	6/9/2011	67	--	--	--	--	--
MW-10	9/16/2011	130	--	--	--	--	--
MW-10	12/13/2011	--	--	--	--	--	--
MW-10	12/19/2011	580	--	--	--	--	--
MW-10	3/15/2012	<160	--	--	--	--	--
MW-10	6/13/2012	<40	--	--	--	--	--
MW-10	9/10/2012	<40	--	--	--	--	--
MW-10	12/10/2012	59	--	--	--	--	--
MW-11	7/2/2005	--	--	<1	<1	<10	<1

Table 6. Historical Groundwater Analytical Results - VOCs and sVOCs

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	MBAS	DIPE	ETBE	TAME	TBA	EDC
MTCA Method A CULs		**--**	**--**	**--**	**--**	**--**	**5**
MW-11	6/4/2007	--	<1	<1	<1	<4	<1
MW-11	9/5/2007	--	<2	<2	<2	18	<2
MW-11	12/19/2007	--	<1	<1	<1	<4	<1
MW-11	3/6/2008	--	<0.5	<0.5	<0.5	<2	<0.5
MW-11	6/16/2008	--	<0.5	<0.5	<0.5	<2	<0.5
MW-11	9/11/2008	--	<0.5	<0.5	<0.5	<2	<0.5
MW-11	11/20/2008	--	<0.5	<0.5	<0.5	<2	<0.5
MW-11	3/4/2009	--	<0.5	<0.5	<0.5	<2	<0.5
MW-11	6/4/2009	--	<0.5	<0.5	<0.5	<2	<0.5
MW-11	9/22/2009	--	--	--	--	--	--
MW-11	9/24/2009	46 J	--	--	--	--	--
MW-11	10/1/2009	41 J	--	--	--	--	--
MW-11	10/8/2009	<40	--	--	--	--	--
MW-11	10/15/2009	<40	--	--	--	--	--
MW-11	10/22/2009	<40	--	--	--	--	--
MW-11	11/18/2009	<40	--	--	--	--	--
MW-11	12/3/2009	--	<0.5	<0.5	<0.5	<2	<0.5
MW-11	12/16/2009	56 J	--	--	--	--	--
MW-11	1/27/2010	<80	--	--	--	--	--
MW-11	2/12/2010	50	--	--	--	--	--
MW-11	3/30/2010	--	--	--	--	--	--
MW-11	6/18/2010	88	--	--	--	--	--
MW-11	9/2/2010	93	--	--	--	--	--
MW-11	12/7/2010	54	--	--	--	--	--
MW-11	3/7/2011	<200	--	--	--	--	--
MW-11	6/9/2011	69	--	--	--	--	--
MW-11	9/16/2011	<160	--	--	--	--	--
MW-11	12/13/2011	--	--	--	--	--	--
MW-11	12/19/2011	150	--	--	--	--	--
MW-11	3/15/2012	100	--	--	--	--	--

Table 6. Historical Groundwater Analytical Results - VOCs and sVOCs

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	MBAS	DIPE	ETBE	TAME	TBA	EDC
MTCA Method A CULs		**--**	**--**	**--**	**--**	**--**	**5**
MW-11	6/13/2012	<40	--	--	--	--	--
MW-11	9/10/2012	120	--	--	--	--	--
MW-11	12/10/2012	66	--	--	--	--	--
MW-12	6/4/2007	--	<3	<3	<3	<10	<3
MW-12	9/5/2007	--	<0.5	<0.5	<0.5	3	<0.5
MW-12	12/19/2007	--	<0.5	<0.5	<0.5	34	<0.5
MW-12	3/6/2008	--	<0.5	<0.5	<0.5	5	<0.5
MW-12	9/23/2009	<140 J	--	--	--	--	--
MW-12	9/24/2009	310	--	--	--	--	--
MW-12	10/1/2009	61 J	--	--	--	--	--
MW-12	10/8/2009	44 J	--	--	--	--	--
MW-12	10/15/2009	<40	--	--	--	--	--
MW-12	10/22/2009	100 J	--	--	--	--	--
MW-12	11/18/2009	<40	--	--	--	--	--
MW-12	12/3/2009	--	<10	<10	<10	<40	<10
MW-12	12/16/2009	53	--	--	--	--	--
MW-12	1/27/2010	<40	--	--	--	--	--
MW-12	2/12/2010	<80	--	--	--	--	--
MW-12	3/30/2010	--	--	--	--	--	--
MW-12	6/18/2010	70	--	--	--	--	--
MW-12	9/2/2010	<40	--	--	--	--	--
MW-12	12/7/2010	44	--	--	--	--	--
MW-12	3/7/2011	<80	--	--	--	--	--
MW-12	6/9/2011	--	--	--	--	--	--
MW-12	9/16/2011	200	--	--	--	--	--
MW-12	12/13/2011	--	--	--	--	--	--
MW-12	12/19/2011	<160	--	--	--	--	--
MW-12	3/15/2012	90	--	--	--	--	--
MW-12	6/13/2012	<40	--	--	--	--	--

Table 6. Historical Groundwater Analytical Results - VOCs and sVOCs

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	MBAS	DIPE	ETBE	TAME	TBA	EDC
MTCA Method A CULs		**--**	**--**	**--**	**--**	**--**	**5**
MW-12	9/10/2012	<40	--	--	--	--	--
MW-12	12/10/2012	<40	--	--	--	--	--
MW-13	9/23/2009	250 J	--	--	--	--	--
MW-13	9/24/2009	--	--	--	--	--	--
MW-13	10/1/2009	100 J	--	--	--	--	--
MW-13	10/8/2009	66 J	--	--	--	--	--
MW-13	10/15/2009	<40	--	--	--	--	--
MW-13	10/22/2009	99 J	--	--	--	--	--
MW-13	11/18/2009	<140	--	--	--	--	--
MW-13	12/3/2009	--	<0.5	<0.5	<0.5	<2	<0.5
MW-13	12/16/2009	82 J	--	--	--	--	--
MW-13	1/27/2010	90	--	--	--	--	--
MW-13	2/12/2010	130	--	--	--	--	--
MW-13	3/30/2010	--	--	--	--	--	--
MW-13	6/18/2010	98	--	--	--	--	--
MW-13	9/2/2010	66	--	--	--	--	--
MW-13	12/7/2010	120	--	--	--	--	--
MW-13	3/7/2011	<80	--	--	--	--	--
MW-13	6/9/2011	190	--	--	--	--	--
MW-13	9/16/2011	130	--	--	--	--	--
MW-13	12/13/2011	--	--	--	--	--	--
MW-13	12/19/2011	340	--	--	--	--	--
MW-13	3/15/2012	140	--	--	--	--	--
MW-13	6/13/2012	40	--	--	--	--	--
MW-13	9/10/2012	60	--	--	--	--	--
MW-13	12/10/2012	<40	--	--	--	--	--
MW-14	6/4/2007	--	<0.5	<0.5	<0.5	<2	<0.5
MW-14	9/5/2007	--	<0.5	<0.5	<0.5	<2	<0.5

Table 6. Historical Groundwater Analytical Results - VOCs and sVOCs

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	MBAS	DIPE	ETBE	TAME	TBA	EDC
MTCA Method A CULs		**--**	**--**	**--**	**--**	**--**	**5**
MW-14	12/19/2007	--	<1	<1	<1	<4	<1
MW-14	3/6/2008	--	<0.5	<0.5	<0.5	<2	<0.5
MW-14	6/16/2008	--	<0.5	<0.5	<0.5	<2	<0.5
MW-14	9/11/2008	--	<0.5	<0.5	<0.5	<2	<0.5
MW-14	11/20/2008	--	<0.5	<0.5	<0.5	<2	<0.5
MW-14	3/4/2009	--	<1	<1	<1	<5	<1
MW-14	6/4/2009	--	<0.5	<0.5	<0.5	<2	<0.5
MW-14	9/22/2009	--	--	--	--	--	--
MW-14	9/24/2009	220 J	--	--	--	--	--
MW-14	10/1/2009	64 J	--	--	--	--	--
MW-14	10/8/2009	<40	--	--	--	--	--
MW-14	10/15/2009	<40	--	--	--	--	--
MW-14	10/22/2009	<40	--	--	--	--	--
MW-14	11/18/2009	<40	--	--	--	--	--
MW-14	12/3/2009	--	<0.5	<0.5	<0.5	<2	<0.5
MW-14	12/16/2009	80	--	--	--	--	--
MW-14	1/27/2010	<40	--	--	--	--	--
MW-14	2/12/2010	84	--	--	--	--	--
MW-14	3/30/2010	--	--	--	--	--	--
MW-14	6/18/2010	100	--	--	--	--	--
MW-14	9/2/2010	<80	--	--	--	--	--
MW-14	12/7/2010	100	--	--	--	--	--
MW-14	3/7/2011	<200	--	--	--	--	--
MW-14	6/9/2011	110	--	--	--	--	--
MW-14	9/16/2011	300	--	--	--	--	--
MW-14	12/13/2011	--	--	--	--	--	--
MW-14	12/19/2011	540	--	--	--	--	--
MW-14	3/15/2012	140	--	--	--	--	--
MW-14	6/13/2012	96	--	--	--	--	--
MW-14	9/10/2012	57	--	--	--	--	--

Table 6. Historical Groundwater Analytical Results - VOCs and sVOCs

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter (µg/L)

Well	Date	MBAS	DIPE	ETBE	TAME	TBA	EDC
MTCA Method A CULs		**--**	**--**	**--**	**--**	**--**	**5**
MW-14	12/10/2012	48	--	--	--	--	--

Notes:

BOLD values are non-detect below the laboratory MDL, but the MDL is greater than the MTCA Method A CUL

Abbreviations:

VOC = Volatile Organic Compound

sVOC = Semi-Volatile Organic Compound

GB = Grab-groundwater sample

MW = Groundwater monitoring well

-- = Not applicable, not available, or not analyzed

MDL = Method detection limit

MTCA = Model Toxics Control Act Cleanup

CUL = Cleanup Level

USEPA = United States Environmental Protection Agency

Laboratory Qualifiers:

<n = Not detected at or above the laboratory MDL

J = Estimated value; result is ≥ the MDL and < the Reported Detection Limit

Analytical Methods:

Samples analyzed by USEPA Method 5540C

M.B.A.S. = Methylene blue active substances

Samples analyzed by USEPA Method 8260B

DIPE = Di-isopropyl ether

ETBE = Ethyl tertiary-butyl ether

TAME = Tertiary amyl methyl ether

TBA = tertiary butyl alcohol

EDC = 1,2-Dichloroethane

Table 7. Historical Groundwater Analytical Results - cPAHs
Chevron Service Station No. 97502
640 Metcalf Street, Sedro-Woolley, Washington
Analytical results are presented in micrograms per liter (µg/L)

Well	Date	Benzo(a)-anthracene	Chrysene	Benzo(b)-fluoranthene	Benzo(k)-fluoranthene	Benzo(a)-pyrene	Indeno(1,2,3-cd)pyrene	Dibenz(a,h)-anthracene	Naphthalene	1-Methylnaphthalene	2-Methylnaphthalene
MTCA Method A CULs		**--**	**--**	**--**	**--**	**0.1**	**--**	**--**	**--**	**--**	**--**
GB-1	4/1/2008	0.015	0.024	0.028	0.017	0.021	0.018	<0.050	<5 [0.064]	--	--
GB-2	4/2/2008	0.027	0.040	0.052	0.028	0.037	0.031	<0.0097	0.43	--	--
GB-3	4/1/2008	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	1.0	--	--
GB-4	4/1/2008	<0.0095	<0.0095	<0.0095	<0.0095	<0.0095	<0.0095	<0.0095	0.16	--	--
GB-5	4/2/2008	<0.0098	<0.0098	<0.0098	<0.0098	<0.0098	<0.0098	<0.0098	16.0	--	--
MW-4	8/17/2020	<0.0203	<0.0179	<0.0168	<0.0202	<0.0184	<0.0158	<0.0160	<0.0917	<0.0687	<0.0674
MW-5	8/18/2020	<0.0203	<0.0179	<0.0168	<0.0202	<0.0184	<0.0158	<0.0160	<0.0917	<0.0687	<0.0674
MW-6	8/18/2020	<0.0203	<0.0179	<0.0168	<0.0202	<0.0184	<0.0158	<0.0160	<0.0917	<0.0687	<0.0674
MW-7	6/4/2007	0.22	0.26	0.24	<0.098	**0.19**	0.11	<0.098	--	--	--
MW-7	12/19/2007	0.25	0.34	0.28	0.11	**0.23**	0.14	0.047	--	--	--
MW-7	8/17/2020	<0.0203	<0.0179	<0.0168	<0.0202	<0.0184	<0.0158	<0.0160	24.1	2.94	3.00
MW-8	12/19/2007	0.010	0.011	0.018	<0.0099	0.013	<0.0099	<0.0099	--	--	--
MW-8	8/18/2020	<0.0203	<0.0179	<0.0168	<0.0202	<0.0184	<0.0158	<0.0160	0.105 J	0.239 J	0.261
MW-10	6/4/2007	0.021	0.021	0.022	0.012	0.017	0.012	<0.010	--	--	--
MW-10	9/5/2007	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	--	--	--
MW-10	12/19/2007	<0.0098	<0.0098	0.014	<0.0098	0.010	<0.0098	<0.0098	--	--	--
MW-10	8/17/2020	<0.0203	<0.0179	<0.0168	<0.0202	<0.0184	<0.0158	<0.0160	9.85	3.89	1.40
MW-11	6/4/2007	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	--	--	--
MW-11	9/5/2007	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	--	--	--
MW-11	12/19/2007	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	--	--	--
MW-11	8/17/2020	<0.0203	<0.0179	<0.0168	<0.0202	<0.0184	<0.0158	<0.0160	55.5	22.3	22.7
MW-12	6/4/2007	0.010	<0.0099	<0.0099	<0.0099	<0.0099	<0.0099	<0.0099	--	--	--
MW-12	9/5/2007	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	--	--	--
MW-12	12/19/2007	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	--	--	--
MW-12	8/17/2020	<0.0203	<0.0179	<0.0168	<0.0202	<0.0184	<0.0158	<0.0160	<0.0917	<0.0687	<0.0674
MW-13	8/17/2020	<0.0203 [<0.0203]	<0.0179 [<0.0179]	<0.0168 [<0.0168]	<0.0202 [<0.0202]	<0.0184 [<0.0184]	<0.0158 [<0.0158]	<0.0160 [<0.0160]	13.3 [15.2]	13.6 [15.8]	9.72 [11.3]
MW-14	6/4/2007	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	--	--	--
MW-14	9/5/2007	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	--	--	--
MW-14	12/19/2007	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	--	--	--
MW-14	8/17/2020	<0.0203	<0.0179	<0.0168	<0.0202	<0.0184	<0.0158	<0.0160	42.2	6.24	7.30

Notes:
BOLD and highlighted values are greater than their respective MTCA Method A CUL

Table 7. Historical Groundwater Analytical Results - cPAHs
Chevron Service Station No. 97502
640 Metcalf Street, Sedro-Woolley, Washington
Analytical results are presented in micrograms per liter (µg/L)

Well	Date	Benzo(a)-anthracene	Chrysene	Benzo(b)-fluoranthene	Benzo(k)-fluoranthene	Benzo(a)-pyrene	Indeno(1,2,3-cd)pyrene	Dibenz(a,h)-anthracene	Naphthalene	1-Methylnaphthalene	2-Methylnaphthalene
MTCA Method A CULs		**--**	**--**	**--**	**--**	**0.1**	**--**	**--**	**--**	**--**	**--**

Abbreviations:
cPAH = Carcinogenic Polycyclic Aromatic Hydrocarbon
GB = Grab-groundwater sample
MW = Groundwater monitoring well
[21.2] = Blind duplicate sample results
-- = Not applicable, not available, or not analyzed
ND = Not detected
MDL = Method detection limit
MTCA = Model Toxics Control Act Cleanup
CUL = Cleanup Level
USEPA = United States Environmental Protection Agency

Laboratory Qualifiers:
<n = Not detected at or above the laboratory MDL
J = Estimated value; result is ≥ the MDL and < the Reported Detection Limit

Analytical Methods:
Samples analyzed by USEPA Method 8270E-SIM
Benzo(a)anthracene
Chrysene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenz(a,h)anthracene
Naphthalene
1-Methylnaphthalene
2-Methylnaphthalene

Table 8. Historical Soil Vapor Data

Chevron Service Station No. 97502

640 Metcalf Street, Sedro-Woolley, Washington

Analytical results are presented in micrograms per liter ($\mu g/m^3$)

Sample ID	Date	Average Barometric Pressure (inches)	Methane (%)	Oygen (%)	Carbon Dioxide (%)	Benzene (ug/m3)	Toluene (ug/m3)	Ethylbenzene (ug/m3)	Total Xylenes (ug/m3)	Butane (ug/m3)	Propane (ug/m3)	Isopentane (ug/m3)
MTCA Method B Sub-Slab Soil Gas Screening Level				**--**	**--**	**10.60**	**76,190**	**15,238**	**1,524**	**--**		**--**
VP-1-5	10/5/2007	29.99	0.00027	9.9	<0.05	8.2	35.0	41.0	172.0	--	--	--
VP-1-8	10/5/2007	29.99	0.00028	13.0	<0.05	**17.0**	34.0	25.0	104.0	--	--	--
VP-2-5	10/5/2007	29.99	0.00033	11.0	<0.05	4.4	24.0	19.0	78.0	--	--	--
VP-2-8	10/5/2007	29.99	0.00027	11.0	<0.05	2.0	11.0	3.0	13.5	--	--	--
VP-3-5	10/5/2007	29.99	0.00043	13.0	<0.05	5.2	35.0	9.4	41.0	--	--	--
VP-3-8	10/5/2007	29.99	0.00034	13.0	<0.05	7.5	38.0	9.1	34.6	--	--	--
Resampling Event												
VP-1-5	12/6/2007	30.00	<0.00024	11	8.9	<3.8	<5.2	<4.5	<5.2	ND	ND	ND
VP-1-8A	12/6/2007	30.00	<0.00020	11	8.8	<3.2	<4.4	5.6	5.0	20.21 JN	ND	ND
VP-1-8A (Lab Dup)	12/6/2007	30.00	<0.00020	11	8.8	<3.2	<4.4	5.2	5.0	ND	ND	ND
VP-1-8B	12/6/2007	30.00	<0.00022	11	8.8	<3.4	<4.7	4.6	<4.7	ND	ND	ND
VP-2-5	12/6/2007	30.00	<0.00021	14	6.3	<3.4	8.4	<4.0	36.8	ND	ND	ND
VP-2-8	12/6/2007	30.00	<0.00022	13	6.6	<3.5	10	6.0	46	13.31 JN	ND	ND
VP-3-5	12/6/2007	30.00	<0.00022	19	1.9	<3.5	<4.8	5.1	10	14.98 JN	ND	ND
VP-3-8	12/6/2007	30.00	<0.00023	19	2.5	<3.6	7.1	9.9	31.9	17.83 JN	ND	ND
Ambient 1	12/6/2007	30.00	<0.00023	22	0.038	<3.6	<5.0	<4.3	<5.0	ND	ND	ND
Ambient 2	12/6/2007	30.00	<0.00021	22	0.048	<3.3	<4.5	5.9	<.5	ND	ND	ND
Ambient 2 (Lab Dup)	12/6/2007	30.00	--	--	==	<3.3	<4.5	5.5	<4.5	15.45 JN	ND	ND
Trip Blank	12/6/2007	30.00	<0.00010	<0.010	<0.010	<1.6	<2.2	<1.9	<2.2	ND	ND	ND

Notes:

BOLD and highlighted values are greater than their respective MTCA Method B Sub-Slab Soil Gas Screening Level

Abbreviations:

-- = not applicable or not analyzed

< = analyte was not detected at indicated reporting limit

DUP = Duplicate sample

ND = Not detected

MDL = Method detection limit

MTCA = Model Toxics Control Act Cleanup

CUL = Cleanup Level

USEPA = United States Environmental Protection Agency

Average Barometric Pressures taken from Weather Underground (www.wunderground.com); averages for October 5, 2007 and December 6, 2007 in Burlington, Washington

Laboratory Qualifiers:

<n = Not detected at or above the laboratory MDL

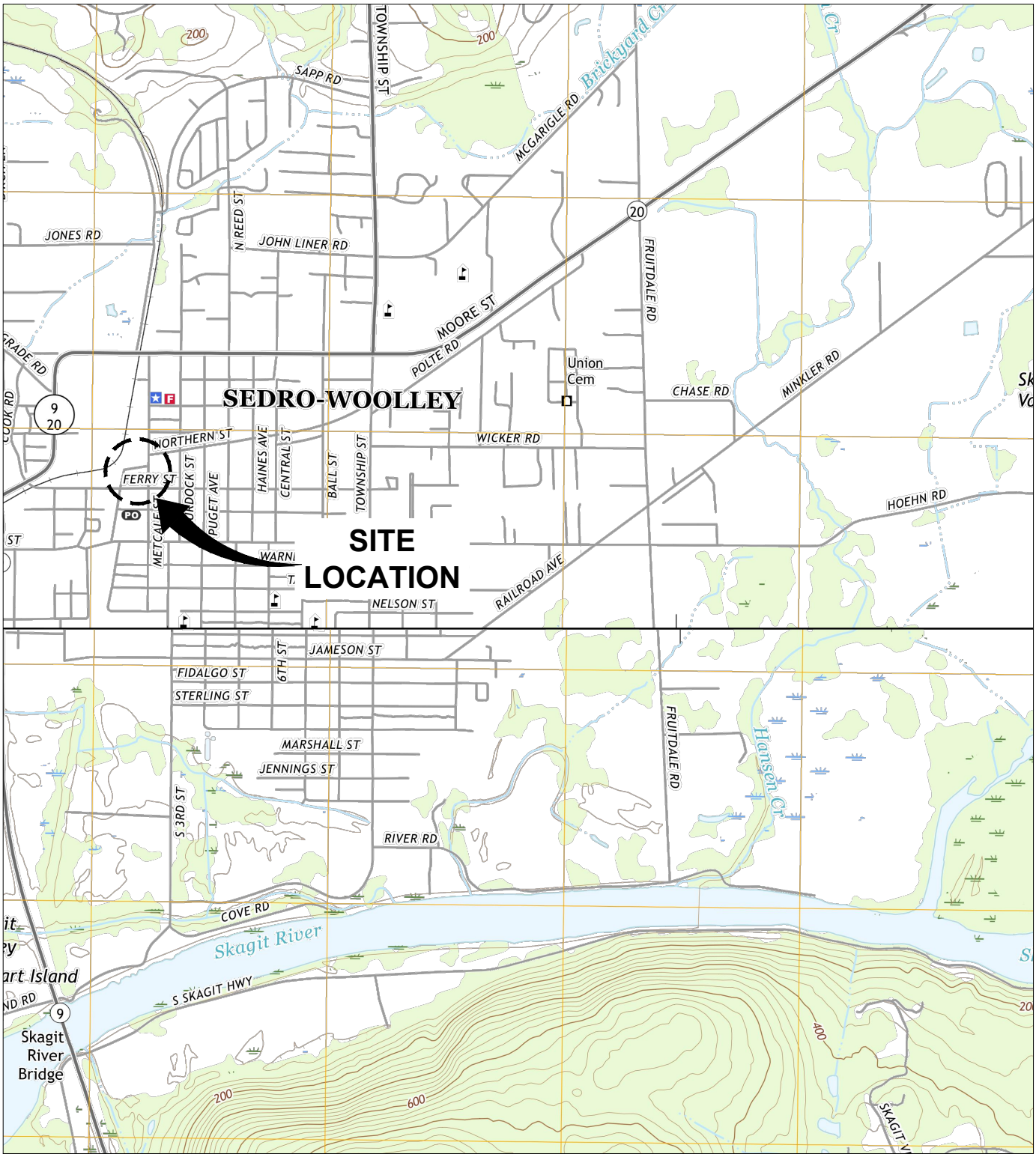
J = Estimated value; result is ≥ the MDL and < the Reported Detection Limit

N = Identification of the analyte is based on presumptive evidence

Reference:

Ecology. 2018. Ecology Implementation Memorandum No. 18, Draft Petroleum Vapor Intrusion (VI): Updated Screening Levels, Cleanup Levels, and Sampling Considerations. August 7.

FIGURES



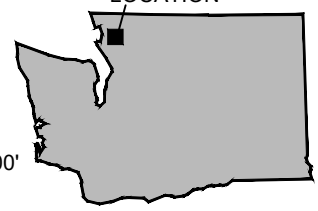
REFERENCE: BASE MAP USGS 7.5. MIN. TOPO. QUAD., NEWPORT BEACH, OE S, CA, PHOTOGRAPHED 2018

N

0 2,000' 4,000'

APPROXIMATE SCALE : 1 in. = 2,000 ft.

AREA LOCATION



WASHINGTON

FORMER CHEVRON STATION 9-7502
640 METCALF STREET
SEDRO-WOOLLEY, WASHINGTON

SITE LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE 1

C:\Users\jlharris\BIM 360\Arcadis\ANA - CHEVRON CORPORATION\Project Files\9-7502 Sedro-Woolley\2020\30045299\01-DWG\Figure 2_Site Plan.dwg LAYOUT: 2 SAVED: 11/11/2020 3:31 PM ACADVER: 23.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ARCADIS.CTB PLOTTED: 11/11/2020 3:35 PM BY: HARRIS, JESS
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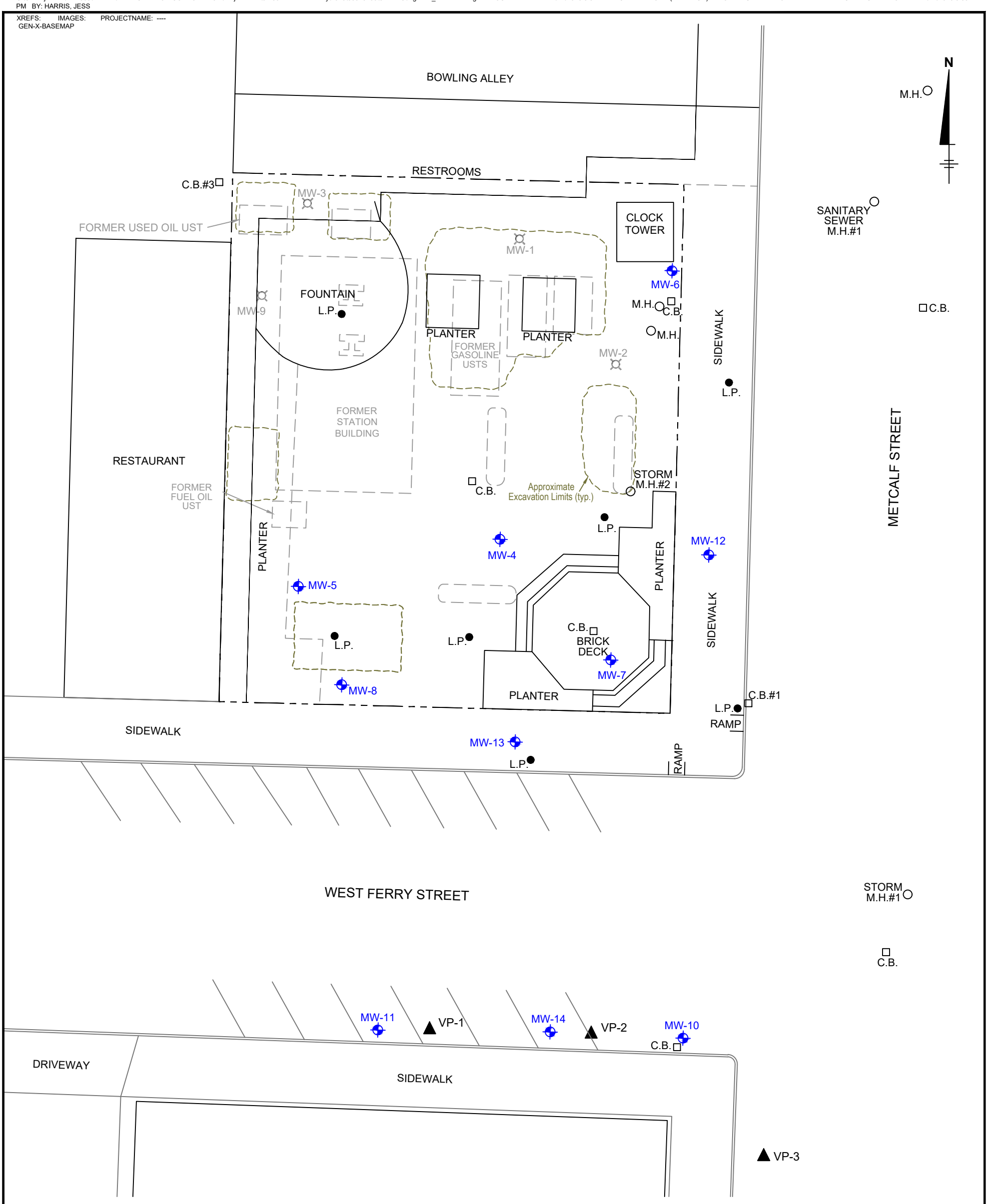

LEGEND

- APPROXIMATE BOUNDARY
- MW-4 MONITORING WELL LOCATION
- MW-1 DECOMMISSIONED MONITORING WELL
- VP-1 SOIL VAPOR POINT
- M.H. APPROXIMATE MANHOLE
- C.B. APPROXIMATE CATCH BASIN
- C.O. APPROXIMATE CLEAN OUT
- L.P. APPROXIMATE LIGHT POLE

0 20' 40'

APPROXIMATE SCALE : 1 in. = 40 ft.

FORMER CHEVRON STATION 9-7502
640 METCALF STREET
SEDRO-WOOLLEY, WASHINGTON

SITE PLAN

ARCADIS Design & Consultancy for natural and built assets

FIGURE 2

C:\Users\jlharris\BIM 360\Arcadis\ANA - CHEVRON CORPORATION\Project Files\9-7502 Sedro-Woolley\2020\30045299\01-DWG\Figure 5_MTCA Boundary Soil.dwg LAYOUT: 5 SAVED: 11/4/2020 10:31 PM ACADVER: 23.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ARCADIS.CTB PLOTTED: 11/11/2020 4:18 PM BY: HARRIS, JESS

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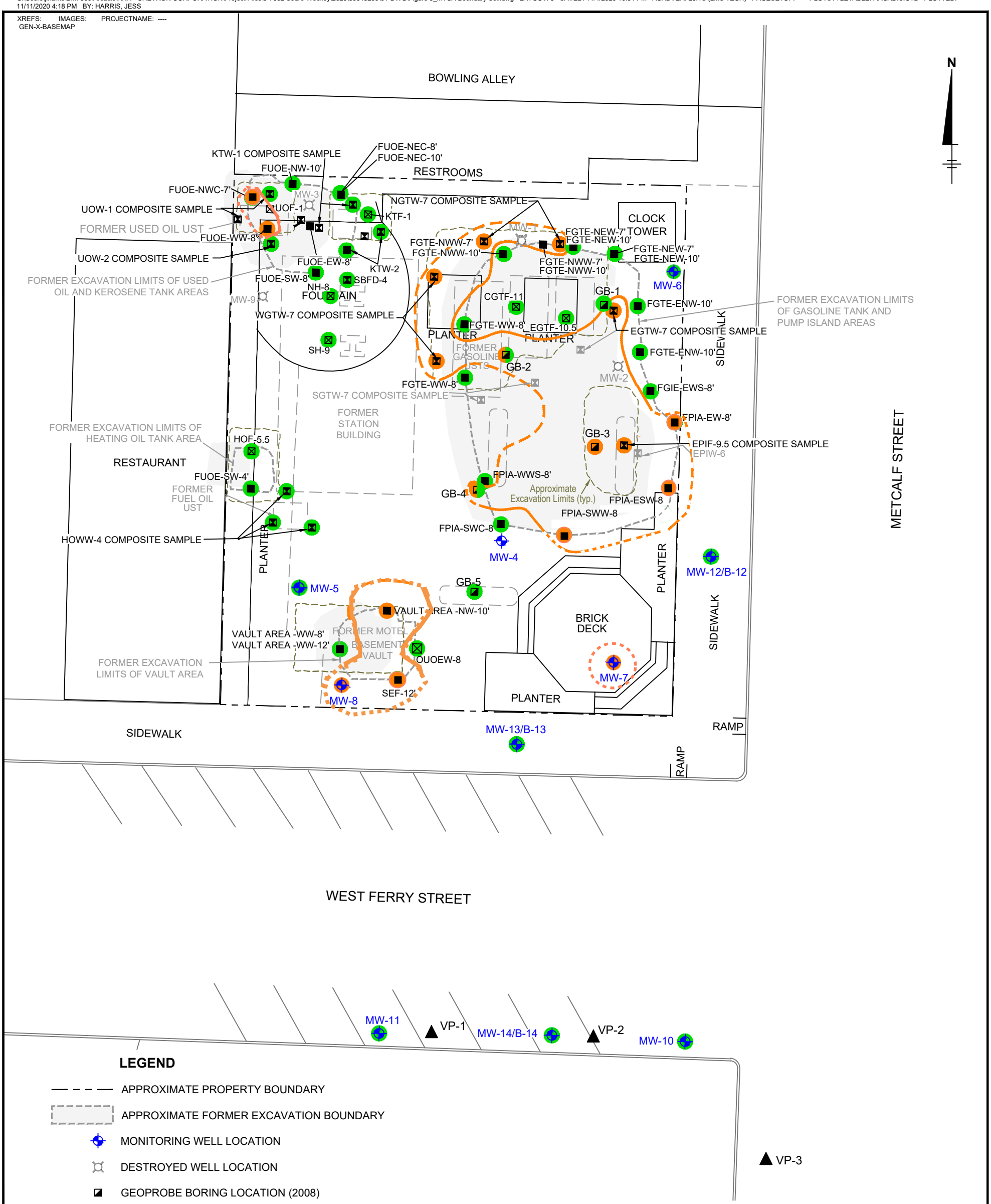

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- APPROXIMATE FORMER EXCAVATION BOUNDARY
- MONITORING WELL LOCATION
- DESTROYED WELL LOCATION
- GEOPROBE BORING LOCATION (2008)
- DISCRETE SOIL SAMPLE LOCATION (1992 TANK EXCAVATION)
- CONFIRMATION SOIL SAMPLE (1992 EXCAVATIONS)
- COMPOSITE SOIL SAMPLE
- SOIL VAPOR POINT LOCATION
- MTCA SITE BOUNDARY MAP FOR SOIL (DASHED WHERE INFERRED)

STATUS OF SOIL CONCENTRATIONS IN THE SAMPLE(S) COLLECTED ABOVE DEEPEST SAMPLE:

- BELOW MTCA METHOD A SOIL CULs
- ABOVE MTCA METHOD A SOIL CULs

STATUS OF SOIL CONCENTRATIONS IN THE DEEPEST SAMPLE(S):

- BELOW MTCA METHOD A SOIL CULs
- ABOVE MTCA METHOD A SOIL CULs

NOTES:

1. MTCA - MODEL TOXICS CONTROL ACT
2. CULs - CLEANUP LEVELS

0 20' 40'

APPROXIMATE SCALE : 1 in. = 40 ft.

FORMER CHEVRON STATION 9-7502
640 METCALF STREET
SEDRO-WOOLLEY, WASHINGTON

HISTORICAL SOIL MTCA BOUNDARY

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FIGURE 3

C:\Users\jlharris\BIM 360\Arcadis\ANA - CHEVRON CORPORATION\Project Files\9-7502 Sedro-Woolley\2020\30045299\01-DWG\Figure 3_Historic GW MTCA Boundary.dwg LAYOUT: 3 SAVED: 11/11/2020 3:56 PM ACADVER: 23.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ARCADIS.CTB
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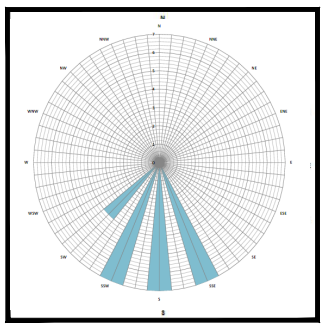

BOWLING ALLEY
RESTROOMS
C.B.#3
MW-3*
FORMER USED OIL UST
CLOCK TOWER
MW-1*
MW-6*
SANITARY SEWER M.H.#1
M.H.
N
FOUNTAIN
MW-9*
L.P.
PLANTER
PLANTER
GB-1
M.H.
C.B.
C.B.
FORMER GASOLINE USTS
GB-2
M.H.
SIDEWALK
MW-2*
L.P.
FORMER STATION BUILDING
RESTAURANT
GB-3
STORM M.H.#2
C.B.
GB-4
FORMER FUEL OIL UST
L.P.
METCALF STREET
PLANTER
MW-4
MW-12/B-12
GB-5
MW-5*
C.B.
BRICK DECK
L.P.
L.P.
MW-7
PLANTER
SIDEWALK
C.B.#1
L.P.
RAMP
MW-8
MW-13/B-13
SIDEWALK
L.P.
RAMP
WEST FERRY STREET
STORM M.H.#1
C.B.
MW-11
VP-1
MW-14
VP-2
MW-10
C.B.
DRIVEWAY
SIDEWALK
VP-3

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- MW-4 MONITORING WELL LOCATION
- MW-1 DECOMMISSIONED MONITORING WELL
- GB-4 GROUNDWATER GRAB SAMPLE LOCATION (2008)
- VP-1 SOIL VAPOR POINT LOCATION
- * WELL NOT SAMPLED IN PAST 4 SAMPLING EVENTS
- HISTORIC GROUNDWATER CONCENTRATIONS OBSERVED AT LEAST ONCE ABOVE MTCA METHOD A CULs
- HISTORIC GROUNDWATER CONCENTRATIONS OBSERVED BELOW MTCA METHOD A CULs
- HISTORIC MTCA SITE BOUNDARY MAP FOR GROUNDWATER (DASHED WHERE INFERRED)

NOTES:

1. MTCA - MODEL TOXICS CONTROL ACT
2. CULs - CLEANUP LEVELS

0 20' 40'
APPROXIMATE SCALE : 1 in. = 40 ft.

FORMER CHEVRON STATION 9-7502
640 METCALF STREET
SEDRO-WOOLLEY, WASHINGTON

HISTORICAL GROUNDWATER MTCA BOUNDARY

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4

C:\Users\jlharris\BIM 360\Arcadis\ANA - CHEVRON CORPORATION\Project Files\9-7502 Sedro-Woolley\2020\30045299\01-DWG\Figure 4_Current GW MTCA Boundary.dwg LAYOUT: 4 SAVED: 11/4/2020 10:24 PM ACADVER: 23.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ARCADIS.CTB
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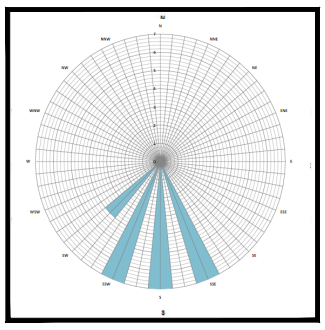

BOWLING ALLEY
RESTROOMS
C.B.#3
MW-3*
FORMER USED OIL UST
CLOCK TOWER
MW-1*
MW-6*
FOUNTAIN
MW-9*
L.P.
PLANTER
PLANTER
GB-1
M.H.
C.B.
M.H.
FORMER GASOLINE USTS
GB-2
MW-2*
SIDEWALK
L.P.
SANITARY SEWER M.H.#1
N
M.H.
C.B.
FORMER STATION BUILDING
GB-3
STORM M.H.#2
C.B.
GB-4
L.P.
RESTAURANT
FORMER FUEL OIL UST
PLANTER
MW-4
MW-12/B-12
GB-5
PLANTER
SIDEWALK
MW-5*
C.B.
BRICK DECK
L.P.
L.P.
MW-7
MW-8
PLANTER
C.B.#1
L.P.
RAMP
SIDEWALK
MW-13/B-13
L.P.
RAMP
METCALF STREET
WEST FERRY STREET
STORM M.H.#1
C.B.
MW-11
VP-1
MW-14/B-14
VP-2
MW-10
C.B.
DRIVEWAY
SIDEWALK
VP-3

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- MW-4 MONITORING WELL LOCATION
- MW-1 DECOMMISSIONED MONITORING WELL
- GB-4 GROUNDWATER GRAB SAMPLE LOCATION (2008)
- VP-1 SOIL VAPOR POINT LOCATION
- * WELL NOT SAMPLED IN PAST 4 SAMPLING EVENTS
- 2020 GROUNDWATER CONCENTRATIONS OBSERVED AT LEAST ONCE ABOVE MTCA METHOD A CULs
- 2020 GROUNDWATER CONCENTRATIONS OBSERVED BELOW MTCA METHOD A CULs
- HISTORIC MTCA SITE BOUNDARY MAP FOR GROUNDWATER (DASHED WHERE INFERRED)
- 2020 MTCA SITE BOUNDARY MAP FOR GROUNDWATER (DASHED WHERE INFERRED)

NOTES:

1. MTCA - MODEL TOXICS CONTROL ACT
2. CULs - CLEANUP LEVELS

0 20' 40'
APPROXIMATE SCALE : 1 in. = 40 ft.

FORMER CHEVRON STATION 9-7502
640 METCALF STREET
SEDRO-WOOLLEY, WASHINGTON

CURRENT GROUNDWATER MTCA BOUNDARY

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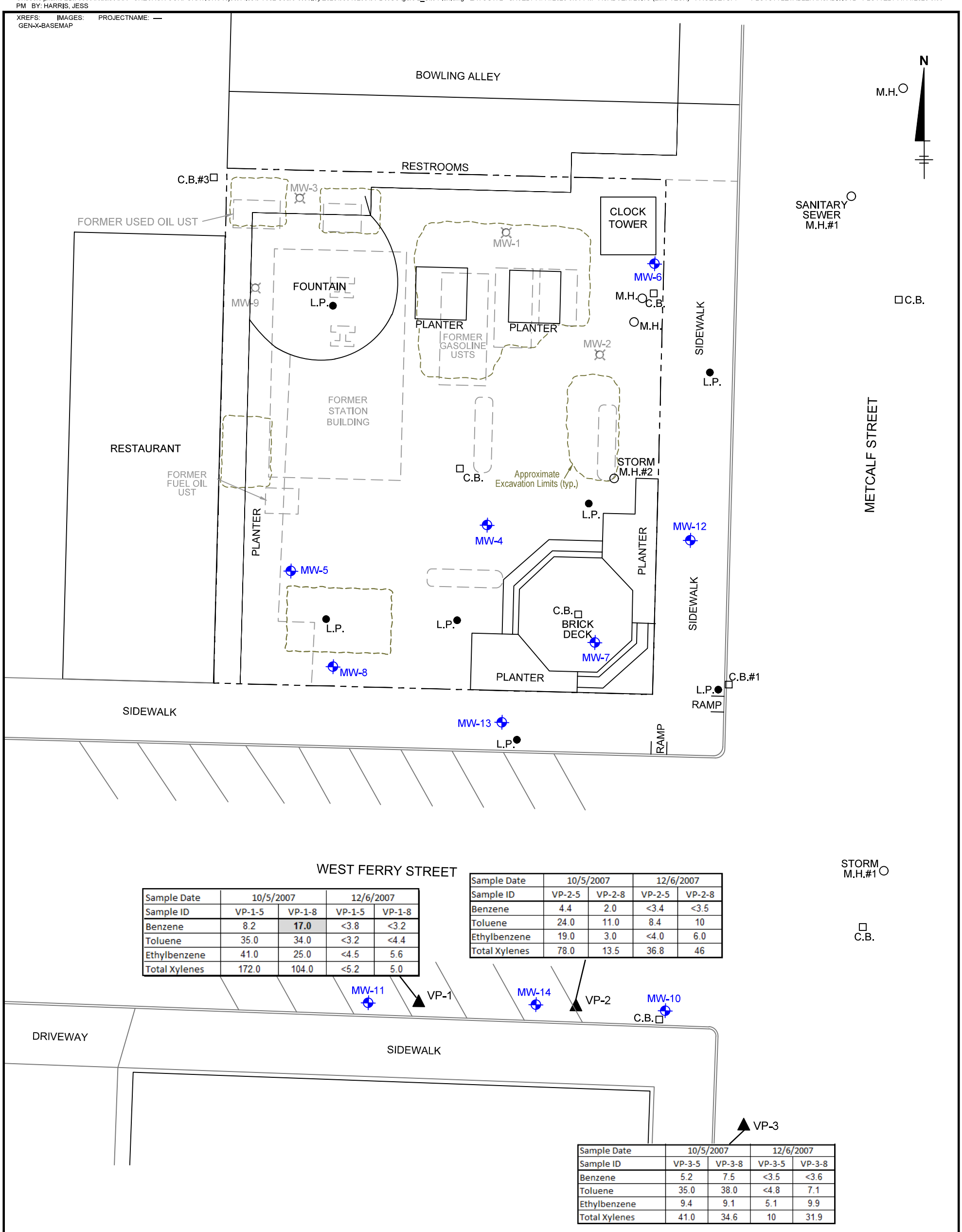
FIGURE
5



Sample Date	10/5/2007		12/6/2007	
Sample ID	VP-1-5	VP-1-8	VP-1-5	VP-1-8
Benzene	8.2	**17.0**	<3.8	<3.2
Toluene	35.0	34.0	<3.2	<4.4
Ethylbenzene	41.0	25.0	<4.5	5.6
Total Xylenes	172.0	104.0	<5.2	5.0

Sample Date	10/5/2007		12/6/2007	
Sample ID	VP-2-5	VP-2-8	VP-2-5	VP-2-8
Benzene	4.4	2.0	<3.4	<3.5
Toluene	24.0	11.0	8.4	10
Ethylbenzene	19.0	3.0	<4.0	6.0
Total Xylenes	78.0	13.5	36.8	46

Sample Date	10/5/2007		12/6/2007	
Sample ID	VP-3-5	VP-3-8	VP-3-5	VP-3-8
Benzene	5.2	7.5	<3.5	<3.6
Toluene	35.0	38.0	<4.8	7.1
Ethylbenzene	9.4	9.1	5.1	9.9
Total Xylenes	41.0	34.6	10	31.9

LEGEND

- APPROXIMATE BOUNDARY
- MW-4 MONITORING WELL LOCATION
- MW-1 DECOMMISSIONED MONITORING WELL
- VP-1 SOIL VAPOR POINT
- M.H. APPROXIMATE MANHOLE
- C.B. APPROXIMATE CATCH BASIN
- C.O. APPROXIMATE CLEAN OUT
- L.P. APPROXIMATE LIGHT POLE

NOTES:
SOIL VAPOR ANALYTICAL RESULTS ARE PRESENTED IN µg/m^3 (CRA 2008b).
BOLD AND HIGHLIGHTED VALUES ARE GREATER THAN MTCA METHOD B SUB-SLAB SOIL GAS SCREENING LEVEL.

0 20' 40'
APPROXIMATE SCALE : 1 in. = 40 ft.

FORMER CHEVRON STATION 9-7502
640 METCALF STREET
SEDRO-WOOLLEY, WASHINGTON

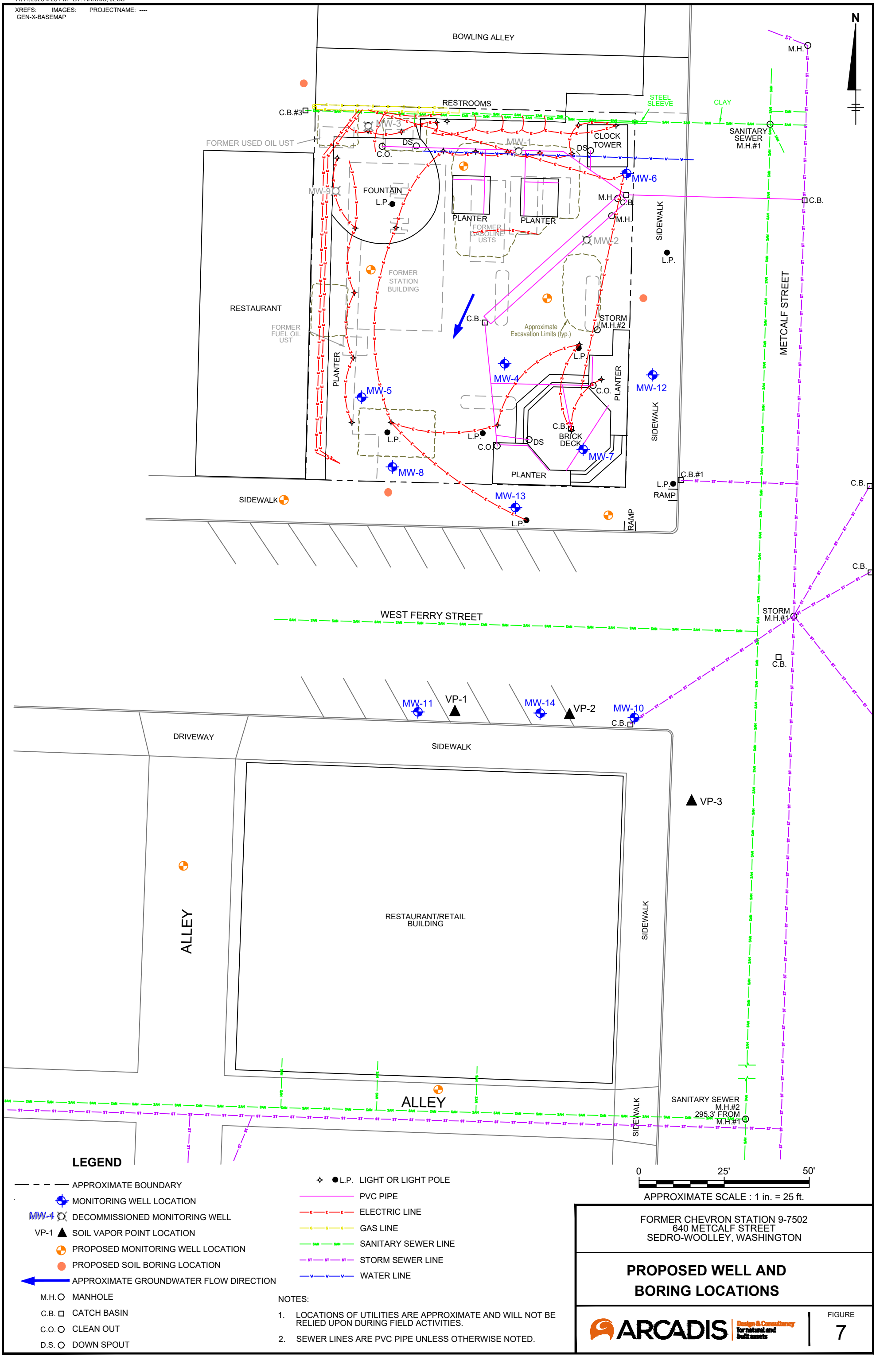
2007 SOIL VAPOR DATA (CRA 2008b)

ARCADIS Design & Consultancy for natural and built assets

FIGURE 6

C:\Users\jlharris\BIM 360\Arcadis\ANA - CHEVRON CORPORATION\Project Files\9-7502 Sedro-Woolley\2020\30045299\01-DWG\FIG6-PROPOSED BORING LOC.dwg LAYOUT: 6 SAVED: 11/10/2020 12:06 PM ACADVER: 23.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ARCADIS.CTB PLOTTED: 11/11/2020 4:28 PM BY: HARRIS, JESS

XREFS: IMAGES: PROJECTNAME: ----
GEN-X-BASEMAP



LEGEND

- APPROXIMATE BOUNDARY
- MONITORING WELL LOCATION
- MW-4 DECOMMISSIONED MONITORING WELL
- VP-1 SOIL VAPOR POINT LOCATION
- PROPOSED MONITORING WELL LOCATION
- PROPOSED SOIL BORING LOCATION
- APPROXIMATE GROUNDWATER FLOW DIRECTION
- M.H. MANHOLE
- C.B. CATCH BASIN
- C.O. CLEAN OUT
- D.S. DOWN SPOUT
- L.P. LIGHT OR LIGHT POLE
- PVC PIPE
- ELECTRIC LINE
- GAS LINE
- SANITARY SEWER LINE
- STORM SEWER LINE
- WATER LINE

NOTES:

1. LOCATIONS OF UTILITIES ARE APPROXIMATE AND WILL NOT BE RELIED UPON DURING FIELD ACTIVITIES.
2. SEWER LINES ARE PVC PIPE UNLESS OTHERWISE NOTED.

FORMER CHEVRON STATION 9-7502
640 METCALF STREET
SEDRO-WOOLLEY, WASHINGTON

PROPOSED WELL AND BORING LOCATIONS

ARCADIS Design & Consultancy for natural and built assets

FIGURE 7

APPENDIX A

Property Details

Parcel Map - 634 Metcalf Street

April 13, 2021

1:1,128

0 0.0075 0.015 0.03 mi

0 0.015 0.03 0.06 km

Legend

Tax Parcel Numbers

Land Accounts

Tax Parcels

634 Metcalf Street

Data Accuracy Warning: All GIS data was created from available public records and existing map sources. Map features have been adjusted to achieve a best-fit registration. While great care was taken in this process, maps from different sources rarely agree as to the precise location of geographic features. Map discrepancies can be as great as 300 feet.

Details for Parcel: P77454

Jurisdiction: SEDRO-WOOLLEY

Zoning Designation: Please contact the city of **SEDRO-WOOLLEY** for SEDRO-WOOLLEY zoning information.

Excise Affidavits *Document scans of excise affidavits*

Parcel Number	XrefID	Quarter	Section	Township	Range
P77454	4177-002-013-0000		24	35	04

Owner Information
CITY OF SEDRO WOOLLEY
325 METCALF ST
SEDRO WOOLLEY, WA 98284

Site Address(es)
640 METCALF STREET
Sedro Woolley, WA *(Jurisdiction, State)*
Zip Code Lookup | Site Address Information

Map Links
Open in iMap
Assessor's Parcel Map:
PDF | DWF

Current Legal Description Abbreviation Definitions
N 30 FEET OF LOTS 11 TO 13, BLOCK 2, TOWN OF WOOLLEY

2020 Values for 2021 Taxes* Exemption

Building Market Value	$112,300.00
Land Market Value	+$37,100.00
Total Market Value	$149,400.00
Assessed Value	$149,400.00
Taxable Value	$.00

Sale Information

Deed Type	QUIT CLAIM DEED
Sale Date	1997-06-24
Sale Price	$.00

Sale requires NRL disclosure (more info)

2021 Property Tax Summary
2021 Taxes will be available after 2/15/2021
.
Use the Taxes link above for 2020 taxes

** Effective date of value is January 1 of the assessment year (2020)*

Legal Description at time of Assessment

***Assessment Use Code**	(720) PUBLIC ASSEMBLY		WAC 458-53-030
Neighborhood	(6E1PBLDG) ALL COUNTY EXEMPT PUBLIC BUILDING		
Levy Code	0935	**Fire District**	
School District	SD101	**Exemptions**	City Owned
Utilities		**Acres**	0.06
Improvement 1 Attributes Summary			
Building Style	COMMERCIAL REAL PROPERTY		
Year Built	2002	**Foundation**	
Above Grade Living Area	758 Square Feet	**Exterior Walls**	
Finished Basement		**Roof Covering**	
***Total Living Area**	758 Square Feet	**Heat/Air Conditioning**	
Unfinished Basement		**Fireplace**	
***Total Garage Area**		**Bedrooms**	
Bathrooms			
For additional information on individual segments see Improvements tab			

* Assessment Use Code is for assessment administration purposes and has no relation to zoning or allowable land use.

* Total living area includes above grade living area and finished basement area.

* Garage square footage includes all garage areas; basement garages, attached garages, detached garages, etc.

Assessment data for improvements is based on exterior inspections. Please contact the Assessor's office if the information does not accurately reflect the interior characteristics.

Details for Parcel: P77455

Jurisdiction: SEDRO-WOOLLEY

Zoning Designation: Please contact the city of **SEDRO-WOOLLEY** for SEDRO-WOOLLEY zoning information.

Recorded Documents *Documents scanned and recorded by the Auditor's office*

Excise Affidavits *Document scans of excise affidavits*

Parcel Number	XrefID	Quarter	Section	Township	Range
P77455	4177-002-013-0109		24	35	04

Owner Information
CITY OF SEDRO WOOLLEY
325 METCALF ST
SEDRO WOOLLEY, WA 98284

Site Address(es)
640 METCALF STREET
Sedro Woolley, WA *(Jurisdiction, State)*
Zip Code Lookup | Site Address Information

Map Links
Open in iMap
Assessor's Parcel Map:
PDF | DWF

Current Legal Description Abbreviation Definitions
TOWN OF WOOLLEY S 33FT OF N 63FT LOTS 11 TO 13 BLK 2

2020 Values for 2021 Taxes* Exemption

Building Market Value	$.00
Land Market Value	+$40,800.00
Total Market Value	$40,800.00
Assessed Value	$40,800.00
Taxable Value	$.00

Sale Information

Deed Type	QUIT CLAIM DEED
Sale Date	2000-05-31
Sale Price	$29,052.00

Sale requires NRL disclosure (more info)

2021 Property Tax Summary
2021 Taxes will be available after 2/15/2021
.
Use the Taxes link above for 2020 taxes

** Effective date of value is January 1 of the assessment year (2020)*

Legal Description at time of Assessment

***Assessment Use Code**	(720) PUBLIC ASSEMBLY	WAC 458-53-030
Neighborhood	(6EL3PLND) ALL COUNTY EXEMPT PUBLIC LAND	

Levy Code	0935	**Fire District**	
School District	SD101	**Exemptions**	City Owned
Utilities	*SEW, WTR-P	**Acres**	0.07

Improvement 1 Attributes Summary

Building Style	COMMERCIAL REAL PROPERTY		
Year Built		**Foundation**	
Above Grade Living Area		**Exterior Walls**	
Finished Basement		**Roof Covering**	
***Total Living Area**		**Heat/Air Conditioning**	
Unfinished Basement		**Fireplace**	
***Total Garage Area**		**Bedrooms**	
Bathrooms			

For additional information on individual segments see Improvements tab

* Assessment Use Code is for assessment administration purposes and has no relation to zoning or allowable land use.

* Total living area includes above grade living area and finished basement area.

* Garage square footage includes all garage areas; basement garages, attached garages, detached garages, etc.

Assessment data for improvements is based on exterior inspections. Please contact the Assessor's office if the information does not accurately reflect the interior characteristics.

Details for Parcel: P77456

Jurisdiction: SEDRO-WOOLLEY

Zoning Designation: Please contact the city of **SEDRO-WOOLLEY** for SEDRO-WOOLLEY zoning information.

Excise Affidavits *Document scans of excise affidavits*

Parcel Number	XrefID	Quarter	Section	Township	Range
P77456	4177-002-013-0208		24	35	04

Owner Information
CITY OF SEDRO WOOLLEY
325 METCALF ST
SEDRO WOOLLEY, WA 98284

Site Address(es)
640 METCALF STREET
Sedro Woolley, WA *(Jurisdiction, State)*
Zip Code Lookup | Site Address Information

Map Links
Open in iMap
Assessor's Parcel Map:
PDF | DWF

Current Legal Description Abbreviation Definitions
S 37 FEET OF LOTS 11 TO 13, BLOCK 2, TOWN OF WOOLLEY

2020 Values for 2021 Taxes* Exemption

Building Market Value	$.00
Land Market Value	+$45,800.00
Total Market Value	$45,800.00
Assessed Value	$45,800.00
Taxable Value	$.00

Sale Information

Deed Type	QUIT CLAIM DEED
Sale Date	1997-06-24
Sale Price	$.00

Sale requires NRL disclosure (more info)

2021 Property Tax Summary
2021 Taxes will be available after 2/15/2021
.
Use the Taxes link above for 2020 taxes

** Effective date of value is January 1 of the assessment year (2020)*

Legal Description at time of Assessment

***Assessment Use Code**	(720) PUBLIC ASSEMBLY		WAC 458-53-030
Neighborhood	(6E1PBLDG) ALL COUNTY EXEMPT PUBLIC BUILDING		
Levy Code	0935	**Fire District**	
School District	SD101	**Exemptions**	City Owned
Utilities		**Acres**	0.08
Improvement 1 Attributes Summary			
Building Style	COMMERCIAL REAL PROPERTY		
Year Built		**Foundation**	
Above Grade Living Area		**Exterior Walls**	
Finished Basement		**Roof Covering**	
***Total Living Area**		**Heat/Air Conditioning**	
Unfinished Basement		**Fireplace**	
***Total Garage Area**		**Bedrooms**	
Bathrooms			
For additional information on individual segments see Improvements tab			

* Assessment Use Code is for assessment administration purposes and has no relation to zoning or allowable land use.

* Total living area includes above grade living area and finished basement area.

* Garage square footage includes all garage areas; basement garages, attached garages, detached garages, etc.

Assessment data for improvements is based on exterior inspections. Please contact the Assessor's office if the information does not accurately reflect the interior characteristics.

APPENDIX B

Release History

THORNE ENVIRONMENTAL
A TG Company

August 4, 1989 5E-1047-1

Chevron U.S.A. Inc.
P.O. Box 220
Seattle, Washington 98111

Attention: Mr. Phil Briggs

Subject: Liquid Hydrocarbon Spill Clean-Up Activities
Chevron U.S.A. Inc. Service Station 7502
Sedro Woolley, Washington

Mr. Briggs:

Thorne Environmental, Inc. is pleased to present the following letter report on the above referenced project. This report describes our observations and findings during our site visits and the clean-up of the downgradient stormwater drainage system.

Please contact us should you have any questions about this report.

Sincerely,

THORNE ENVIRONMENTAL, INC.

Carl R. Andersen

Carl R. Andersen
Project Hydrogeologist

William F. Galli by CRA

William F. Galli, P.E.
Principal Engineer

LIQUID HYDROCARBON SPILL
CLEAN-UP ACTIVITIES
SERVICE STATION 7502
SEDRO WOOLLEY, WASHINGTON

THORNE ENVIRONMENTAL
A TG Company

"Treatment by Design"

THORNE ENVIRONMENTAL

SUMMARY

Following the emergency clean-up of spilled liquid hydrocarbons (unleaded gasoline) at Service Station 7502 in Sedro Woolley, Washington, Chevron U.S.A. Inc. retained Thorne Environmental, Inc. to: 1) evaluate and document the existing conditions in the area of the release; and 2) recommend and document any additional clean-up actions. Our work, completed between July 26 and 29, 1989, consisted of: 1) assessing and documenting the surface conditions remaining after the July 25, 1989 release; 2) conducting limited combustible vapor concentration monitoring in the City of Sedro Woolley stormwater drainage system; 3) providing recommendations for reducing the concentrations of any gasoline vapors and/or liquid hydrocarbons remaining in the drainage system; 4) observing and documenting the implemented activities; and 5) preparing this letter report. Our work was authorized under Contract Number M66CNW01669X, Release #18, dated July 26, 1989, and Change #1, dated July 28, 1989.

According to a July 25, 1989 report prepared by Mr. Thomas J. Sheahan of the Skagit County Department of Emergency Management (see Appendix A), the following actions were taken after the gasoline was spilled during routine tank filling operations. First, the area of the spill was secured by the emergency response personnel. Fume-suppressing foam was then placed over the gasoline collected in a nearby manhole and the gasoline remaining in the manhole was recovered with a vacuum truck. This was followed by washing the gasoline from the street and flushing the drainage system with about 8,000 gallons of water.

The following summarizes our observations and the recommended activities:

- Our initial site visit indicated that the gasoline had flowed down the station's eastern driveway to a street gutter before entering a stormwater catch basin located at the southeast corner of the site. It appeared that a limited amount of gasoline leaked into a water meter valve box near the eastern edge of the station driveway. The hydrocarbon-stained soils in the bottom of the valve box were removed.

- Combustible vapor measurements obtained in the manholes and catch basins at the intersection of Ferry and Metcalf Streets indicated that explosive vapors of up to 60% of the Lower Explosive Limit (LEL) were present on July 26, 1989, the day following the release. A concentration of 55% LEL was observed in a catch basin at the southwest corner of this intersection on July 27, 1989; however, measurements in this catch basin about 30 minutes later showed the combustible vapor concentrations to be less than 5% LEL.

- Based on the observations and a meeting with personnel from Chevron U.S.A. Inc., Skagit County Department of Emergency Management, the City of Sedro Woolley and Thorne Environmental, Inc., it was decided to clean the bottoms of the downgradient stormwater manholes and flush water through the stormwater drainage system. This was completed by using a 5,000-gallon capacity vacuum truck to clean out the collected sediment and liquid from the manhole vaults located along Metcalf Street from near the service station site to 3rd Street. In addition, an absorbent boom was placed in a manhole vault at the end of 3rd Street near where the drainage system outfall is located. This boom was installed to collect any residual gasoline that may be flushed during the next rainfall.

This summary is presented solely for introductory purposed; the information contained in this section should be used only in conjunction with the full text of this report. A description of the project, site conditions, a report prepared by the Skagit County Department of Emergency Management and our observations are contained within this report.

1.0 PROJECT DESCRIPTION AND BACKGROUND

1.1 Purpose and Scope of Work

On July 26,1989, Thorne Environmental, Inc. was authorized to evaluate the existing site conditions and provide recommendations for any further clean-up activities following a surface spill of liquid hydrocarbons (unleaded gasoline) at Chevron U.S.A. Inc. Service Station 7502 in Sedro Woolley, Washington. Our work was completed in accordance with Contract Number M66CNW01669X, Release #18, dated July 26, 1989 and Change #1, dated July 28, 1989.

The scope of work completed for this project consisted of:

- Assessing and documenting the surface conditions following the release;
- Conducting limited combustible vapor concentration monitoring in the downgradient stormwater drainage system;
- Providing recommendations for any further clean-up;
- Observing and documenting the implemented activities; and
- Compiling the collected data into this report.

We have prepared this letter report for the use of Chevron U.S.A. Inc., and their agents. This evaluation was completed in accordance with guidance by Chevron U.S.A. Inc., as well as generally accepted hydrogeological and environmental engineering practices in existence in the project area at the time of our work. The statements and conclusions contained in this report are based on the observations and data collected for this project by Thorne Environmental Inc. No other warranties, either express or implied, are provided.

2.0 SITE CONDITIONS AND OBSERVATIONS

Chevron U.S.A. Inc. Service Station 7502 is located at the northwest corner of the intersection of Ferry Street and Metcalf Street in Sedro Woolley, Washington (Figure 1). The site is relatively level with an estimated relief of about two feet across the property. The station building occupies the western central portion of the parcel. Two pump islands exist on the eastern side of the site and three underground gasoline storage tanks exist north of the islands. Asphalt pavement covered most of the site, except at the pump island area and the tank fills. At the time of our activities, the station had resumed normal operations.

Based on the report filed by the Skagit County Department of Emergency Management (Appendix A), the gasoline had moved eastward from the tank fills to the street where it followed the gutter south to a stormwater catch basin. The majority of the gasoline collected in a manhole at the intersection of Ferry and Metcalf Streets, although the report indicates that some gasoline was detected in a manhole at the Woodworth Street and Metcalf Street intersection. The gasoline was then recovered from the Ferry and Metcalf Street manhole and the remainder of the stormwater drainage system was flushed.

On July 26, 1989, we observed staining on the pavement between the tank fills and the sidewalk where the gasoline had migrated. We attributed this to the reaction of the asphaltic pavement to the gasoline. However, the asphaltic pavement adjacent to the street gutter east of the station was eroded for a distance of about 125 feet. We understand that this paving was recent. We also observed some gasoline-stained soils within a water meter valve box in the station driveway.

During the July 26, 1989 visit, we also obtained combustible vapor concentration measurements near the top of the manholes and catch basins located at the intersection of Ferry Street and Metcalf Street (see Figure 1). A maximum Lower Explosive Limit (LEL) concentration of 60% was detected in the catch basin located at the southeast corner of the intersection of Ferry Street and Metcalf Street. The LEL concentrations detected in the other nearby catch basins and manholes were less than 1%. The LEL concentrations were measured with a Model 1314SMPN Gastechtor combustible gas indicator (CGI), calibrated to hexane. The CGI had an operating range of 0 to 100% LEL as well as 0 to 1,990 parts per million (ppm) of organic vapors. The minimum detection levels for the instrument were 1% LEL and 1 ppm. The concentrations of any detected organic vapors were considered semi-quantitative data since the instrument is sensitive to a wide range of chemicals and does not provide compound-specific measurements.

On July 27, 1989, we met at the site with representatives from Chevron U.S.A. Inc., Skagit County Department of Emergency Management and City of Sedro Woolley. During this visit we obtained combustible vapor concentration measurements in the manholes and catch basins we had monitored the previous day, as well as those located south (downgradient) of the site along Metcalf Street to the intersection of State and 3rd Streets (see Figure 1). A maximum combustible vapor reading of 55% LEL was recorded in the catch basin located at the southwest corner of the intersection of Ferry Street and Metcalf Street. However, a measurement in this catch basin about 30 minutes later showed LEL concentrations below 5%. The other manholes and catch basins monitored showed LEL concentrations of 1% or less. Following the meeting, we checked the water meter valve box in the station driveway. It appeared that the gasoline-stained soils had been removed and that only soils with hydrocarbon-like staining, but little to no hydrocarbon-like odors, remained in the bottom of the vault.

3.0 RECOMMENDED ACTIVITIES

Based on the discussions with the Chevron U.S.A. Inc., Skagit County Department of Emergency Management and City of Sedro Woolley representatives, we recommended that the sediment and liquid that had collected in the stormwater system manhole vaults be removed and the system then flushed with water. The sediment and the flush water were to be collected by a vacuum truck. These activities were recommended due to the potential for the gasoline to adhere to the sediments and/or low areas in the drainage system. In addition to the above recommended activities, an absorbent boom was to be placed in the stormwater system near where the system outfall discharges into a slough connected to the Skagit River. The boom was intended to act as a barrier to collect any unrecovered gasoline mobilized by the flushing as well as any gasoline released after the first rainfall that fills the drainage system. The recommended activities were to be completed as soon as possible to take advantage of the dry, summer weather.

4.0 CLEAN-UP ACTIVITIES

Due to time constraints on securing a vacuum truck and the concern that rainfall could occur before the drainage system cleaning could be completed, the absorbent boom was installed by Northwest EnviroServices, Inc. personnel on July 28, 1989. The boom was placed in the manhole vault at the intersection of Fidalgo and 3rd Streets on July 28, 1989 since the actual outfall could not be located.

The removal of the sediment and liquid contained in the manhole vaults and the flushing of the stormwater drainage system were then completed on July 29, 1989 using a 5,000-gallon capacity vacuum truck provided by Northwest EnviroServices,Inc. The location and designations of the manholes vacuumed are shown on the attached Figure 1. As shown on this figure, the stormwater system drains from manhole MH-1 toward MH-4. Combustible vapor concentrations (as percent LEL) were not detected in the manhole vaults which were vacuumed.

The hydrocarbon-like odors described in the following sections should be considered subjective data. This is due to each individual's olfactory sensitivity as well as uncontrolled outside influences such as temperature and wind velocity.

The Metcalf Street manhole vaults between Ferry and State Streets (manhole vaults MH-1 to MH-3) were initially vacuumed. Hydrocarbon-like odors and or sheens were noted only in manhole vault MH-1. After cleaning the majority of the sediment and liquid (and any additional water which was used to rinse the vaults and loosen the sediment) from the vaults along Metcalf Street, the vacuum truck was situated at manhole vault MH-3. Approximately 2,500 gallons of water were flushed into manhole vault MH-1 from a nearby fire hydrant. This water was then recovered into the vacuum truck at manhole vault MH-3. During flushing of the system, hydrocarbon-like odors were noted at manhole vault MH-3 when the rinse water was initially introduced, however, no hydrocarbon-like sheens were observed on the flush water and measurable LEL concentrations were not detected.

Following the above activities, the sediment and liquid in manhole vault MH-4 were recovered by the vacuum truck. No hydrocarbon-like odors were noted and a minimal sheen, which appeared to be related to roadway surface oils, was noted. A visual check of the manholes downgradient of manhole vault MH-4 did not disclose the presence of sheens on the water surface. In addition, hydrocarbon-like odors were not detected near the surface of the vaults. Following the cleaning operations, the absorbent boom in the manhole vault at Fidalgo and 3rd Streets was examined. The boom did not show any visible hydrocarbon sheens and the water flowing through this vault did not have hydrocarbon-like sheens and/or odors. It is planned that the boom will remain in place until the stormwater drainage system is flushed by precipitation.

5.0. CONCLUSIONS AND RECOMMENDATIONS

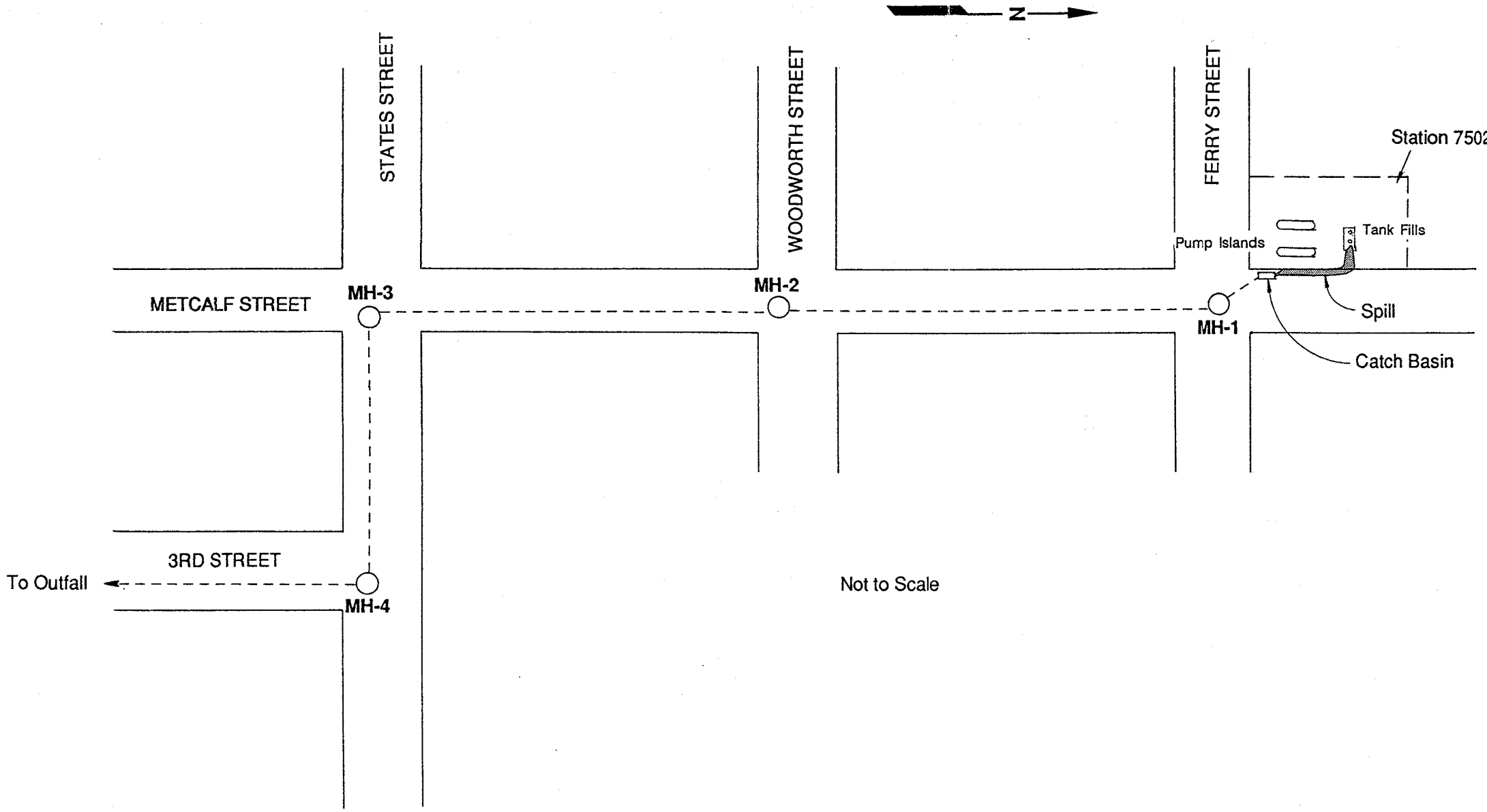
Based on our observations during our initial site visits and the clean-up activities, it appears that the emergency crews which responded to the release either recovered or flushed most, if not all, of the gasoline through the stormwater drainage system.

Following the next heavy rainfall, we recommend: 1) inspecting the absorbent boom located within the manhole vault at the intersection of Fidalgo and 3rd Streets; and 2) monitoring the combustible vapor concentrations in the manholes and catch basins along Metcalf Street. However, we anticipate that any gasoline sheens and/or odors will be masked by hydrocarbons washed into the drainage system by runoff from the paved streets.

THORNE ENVIRONMENTAL, INC.

Carl R. Andersen
Project Hydrogeologist

William F. Galli by SRB
William F. Galli, P.E.
Principal Engineer



EXPLANATION

MH-1 ○ Number and Approximate Location of Manhole Vault

THORNE ENVIRONMENTAL

Date: August 1989
Project Number: 5E-1047-1

Chevron U.S.A. Inc.
Service Sta. 7502/Sedro Woolley, WA

SITE AND VICINITY SKETCH

Figure **1**

APPENDIX A

SKAGIT COUNTY
DEPARTMENT OF EMERGENCY MANAGEMENT

County Administration Bldg, Rm 203, 2nd & Kincaid St Mount Vernon, WA 98273
Phone: (206) 336-9400 or 336-9403

EMERGENCY
Mitigation
Preparedness
Response
Recovery

SERVING
Anacortes
Burlington
Concrete
Hamilton
La Conner
Lyman
Mount Vernon
Sedro-Woolley
Skagit County

Sedro-Woolley Gasoline Spill

July 25, 1989

Report by: Thomas J. Sheahan, Director

At approximately 1459, Sedro-Woolley "911" Dispatch received a call from a truck driver of American Transport, P. O. Box 1735, Auburn, Washington 98071, Telephone: 1-800-447-7780.

The driver's name was Bill Battle. Mr. Battle stated that there was a gas spill of approximately 100 gallons. At approximately 1506 hours, our office received a call from Sedro-Woolley Dispatch telling us of the spill. I arrived at approximately 1521 hours. The Sedro-Woolley Police, Sedro-Woolley Fire Department, and Fire Protection District #8 were on the scene. Just before I arrived, Chief Banta of the Burlington Fire Department arrived. Sedro-Woolley Fire Chief Wayne Moritz gave Ted Banta and me an quick briefing, and we assigned tasks.

Chief Ted Banta immediately checked the lower explosive level with his gas sniffer and found it to be approximately 60%. He did this at approximately 1530 hours. It was decided by Chief Moritz, Chief Banta, and myself that we needed to immediately expand the security of the scene due to the high explosive nature of the scene, and we needed to get some foam to cover the gasoline in the manhole at Woodworth and Metcalf Street intersection. The Burlington Fire Department was called for under mutual aid. The Sedro-Woolley Fire Department assisted the Sedro-Woolley Police in securing the scene.

Chief Wayne Moritz then took me to the Chevron Station at 124 Ferry Street and showed me what apparently had happened. The truck and trailer was off-loading fuel into the underground tanks. He was unloading Unleaded Fuel into a center tank which was located between the Regular and Supreme tanks. The tanks were located in front of the lube room on the north side of the truck and trailer which was jackknifed for unloading. The fill hose was still full which was approximately a four-inch hose, 40 feet long, with the estimated fuel in that line to be 35 gallons. The gasoline that escaped ran in an alluvial fan to the street. At the fill hole it was 15 feet wide, and at the street it was 25 feet wide covering an area of approximately 44 feet long, 1 1/2 to 3 feet wide which pretty well dissolved the asphalt along the curb. It then entered a catch basin and from there went to a manhole located at the intersection of Ferry and Metcalf Streets. It then ran in a southerly direction for approximately 300 feet to the next catch basin located at Woodworth and Metcalf Streets. The majority of the fuel was in the first manhole.

It was then decided to call in a pump truck and have the first manhole pumped out. I told Mr. Battle, the driver, that we needed to do this because we did not want the fuel to run through the storm system. He said they had pumping equipment in Seattle, but that was a couple of hours away. We felt time was critical, and there was a local contractor (Vintage Oil) that could be at the site in less than an hour. The cost was minimal at $205.00 (see attached bill). This was okayed by the Mr. Battle and Chuck Cope at 4:05 p.m.

There was a great deal that still needed to be done after discussing the situation with Chief Moritz and Chief Banta. We needed to drain the fuel from the off-loading hose as it was full. There were two 2 1/2" fire hoses deployed to protect the truck, station, and adjacent buildings. We then pulled my truck and the service station operator's pickup in and pumped 35 gallons out of the unleaded system into those vehicles which relieved the fuel from the fill hose. We then backed the trucks away from the station, and I released the truck and driver at 1640 hours. Vintage Oil arrived at the scene at about 1640 hours and under the supervision of Chief Moritz, started pumping the manhole at 1650 hours. There were approximately 350 gallons pumped off, and we ran an additional 10 to 20 gallons of water into the system to flush the product. Then we pumped that off. Vintage oil was released shortly after 5:00 p.m.

Both Sedro-Woolley and Burlington Fire Departments then put more foam into the system at the two manholes in the intersection of Metcalf and Ferry. Burlington Fire washed the asphalt to remove any gas residue from the pavement. There was obvious damage to the pavement for that first 125 feet to the catch basin. Chief Banta then checked the lower explosive limits and found it to be 10 to 15%. We ran approximately 8,000 gallons of water through the system before fire service left the area. The fire departments left the scene at approximately 1730 hours.

I then spoke to the service station attendant Leonard J. Bauer who said he was in the lube room and noticed gas on the ground under the truck and trailer. He immediately snuffed his cigarette. He stated that he believed the driver was in the cab. However, when I spoke to the second attendant Mike Vermeis, he said the driver was on the north side of the truck sticking the tanks when someone pulled in for gas. He then came back and he saw gas all over the ground. He thought the driver was up on the truck. Mike said he then told the driver of the leak. The driver immediately called "911" for help. All of the attendants removed people from the area until fire and police arrived.

There was a Public Utility District No. 1 (424-7104) water meter close by which was saturated with gasoline. The Public Utility District may have to remove the meter.

One other point is that the outfall for this storm system drops into a slough at the end of 3rd Street. A containment may need to be put up in that area because from there it goes to the Skagit River.

A list of possible costs:

Fire Department Man Hours:

Sedro-Woolley Fire Department -

Burlington Fire Department - No Charge

Fire Protection District No. 8 -

Foam and Pads:

Sedro-Woolley Fire Department -

Burlington Fire Department - No Charge

City of Sedro-Woolley:

Street Dept. (Repair) -

Police Department -

Skagit County Public Utility District No. 1: No Charge

Skagit County Department of Emergency Management - Cost of one Spill Response Kit (See attached bill).

Report by: Thomas J. Sheahan, Director

TJS/skb

Attachments

APPENDIX C

Boring Logs and Terrestrial Ecological Evaluation

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: Chevron 9-7502
PROJECT NUMBER: 060041
CLIENT: Chevron EMC
LOCATION: 124 Ferry Street
Sedro-Woolley, Washington

HOLE DESIGNATION: GB-01
DATE COMPLETED: April 1, 2008
DRILLING METHOD: Air Knife/Direct Push
FIELD PERSONNEL: B. Glusica

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	BOREHOLE	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (ft)	SAMPLE 'N' VALUE	SAMPLE PID [ppm]
0	ASPHALT	0.50	BENTONITE CHIPS					
2	SW-GRAVELLY SAND, with silt, very fine grained sand, fine grained gravel (up to 0.5" diameter), dark grey (10YR 4/1), dry, moderate petroleum odor							21.3
4								
6	- damp below 5 ft BGS			GB01-05				30.3
8	- fine to coarse grained gravel (increasing with depth, up to 1" diameter) wet below 7.5 ft BGS - no odor below 8 ft BGS		▽ 8"Ø BOREHOLE	GB01-08				4.9
10								
12	GP-pea gravel	11.00		GB01-11				
	END OF BOREHOLE @ 12.0ft BGS	12.00						
14	Air Knife was used from 0 to 8 ft BGS							
16								
18								
20								
22								
24								
26								
28								
30								
32								
34								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE
WATER FOUND ▽
CHEMICAL ANALYSIS ⬭

OVERBURDEN LOG 60041.GPJ CRA_CORP.GDT 4/25/08

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: Chevron 9-7502
PROJECT NUMBER: 060041
CLIENT: Chevron EMC
LOCATION: 124 Ferry Street
Sedro-Woolley, Washington

HOLE DESIGNATION: GB-02
DATE COMPLETED: April 1, 2008
DRILLING METHOD: Air Knife/Direct Push
FIELD PERSONNEL: B. Glusica

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	BOREHOLE	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (ft)	SAMPLE 'N' VALUE	SAMPLE PID [ppm]
0	ASPHALT	0.50	BENTONITE CHIPS					
2	SW-GRAVELLY SAND, with silt, very fine grained sand, fine grained, subrounded gravel (up to 0.5" diameter), poorly graded sand and gravel, very dark grey (10YR 3/1), dry, moderate petroleum odor							69.9
4	- damp below 5 ft BGS			GB02-05				44.8
6								
8	GW-gravel	8.00	8"Ø BOREHOLE					
10								
12	SP-SAND, fine grained, poorly graded, grey (10YR 5/1), wet	12.00		GB02-12				
14								
16	END OF BOREHOLE @ 16.0ft BGS	16.00		GB02-15.5				
18	Air Knife was used from 0 to 8 ft BGS							
20								
22								
24								
26								
28								
30								
32								
34								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE
WATER FOUND ▽
CHEMICAL ANALYSIS ⬭

OVERBURDEN LOG 60041.GPJ CRA_CORP.GDT 4/25/08

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: Chevron 9-7502
PROJECT NUMBER: 060041
CLIENT: Chevron EMC
LOCATION: 124 Ferry Street
Sedro-Woolley, Washington

HOLE DESIGNATION: GB-03
DATE COMPLETED: April 1, 2008
DRILLING METHOD: Air Knife/Direct Push
FIELD PERSONNEL: B. Glusica

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	BOREHOLE	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (ft)	SAMPLE 'N' VALUE	SAMPLE PID [ppm]
	NOT SAMPLED							
2	SM-SILTY SAND, with gravel, fine grained sand, fine grained gravel (up to 0.5" diameter), poorly graded sand and gravel, dark grey (10YR 4/1), dry, slight petroleum odor	2.00	BENTONITE CHIPS	GB03-02				82.5
4								
6	- fine to coarse grained gravel (increasing with depth, up to 1" diameter), moist below 5 ft BGS			GB03-05				32.7
8			8"Ø BOREHOLE					
10	GP-pea gravel	9.00						
12	SW-GRAVELLY, SILTY SAND, fine grained sand, fine to coarse grained, subrounded gravel (up to 1" diameter), poorly graded sand and gravel, very dark grey (5YR 3/1), wet, moderate petroleum odor	11.00 12.00		GB03-11				390 6.1
14	END OF BOREHOLE @ 12.0ft BGS							
	Air Knife was used from 0 to 8 ft BGS							
16								
18								
20								
22								
24								
26								
28								
30								
32								
34								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE
WATER FOUND ▽
CHEMICAL ANALYSIS ⬭

OVERBURDEN LOG 60041.GPJ CRA_CORP.GDT 4/25/08

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: Chevron 9-7502
PROJECT NUMBER: 060041
CLIENT: Chevron EMC
LOCATION: 124 Ferry Street
Sedro-Woolley, Washington

HOLE DESIGNATION: GB-04
DATE COMPLETED: April 1, 2008
DRILLING METHOD: Air Knife/Direct Push
FIELD PERSONNEL: B. Glusica

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	BOREHOLE	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (ft)	SAMPLE 'N' VALUE	SAMPLE PID [ppm]
0	ASPHALT	0.50	BENTONITE CHIPS	GB04-02				44.2
2	ML-GRAVELLY, SANDY SILT, very fine grained sand, fine to coarse grained, subangular gravel (up to 1" diameter), poorly graded sand and gravel, non-plastic, dark grey (2.5YR 4/1), dry, moderate petroleum odor							
4								
6	- moist, decreasing odor below 5 ft BGS			GB04-05				4.3
8			8"Ø BOREHOLE					
10	GW-pea gravel, wet, strong petroleum odor	9.00						
12	SP-SAND, fine grained, poorly graded, very dark grey (10YR 3/1), wet, strong petroleum odor	11.00		GB04-11				264 12.4
14	ML-CLAYEY SILT, soft, moderate plasticity, grey (2.5YR 5/1), wet	13.00						1.4
16	END OF BOREHOLE @ 16.0ft BGS	16.00		GB04-15.5				
18	Air Knife was used from 0 to 8 ft BGS							
20								
22								
24								
26								
28								
30								
32								
34								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE
WATER FOUND ▽
CHEMICAL ANALYSIS ⬭

OVERBURDEN LOG 60041.GPJ CRA_CORP.GDT 4/25/08

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: Chevron 9-7502
PROJECT NUMBER: 060041
CLIENT: Chevron EMC
LOCATION: 124 Ferry Street
Sedro-Woolley, Washington

HOLE DESIGNATION: GB-05
DATE COMPLETED: April 2, 2008
DRILLING METHOD: Air Knife/Direct Push
FIELD PERSONNEL: B. Glusica

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	BOREHOLE	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (ft)	SAMPLE 'N' VALUE	SAMPLE PID [ppm]
0	ASPHALT	0.50	BENTONITE CHIPS					
2	ML-SILT, trace sand and clay, soft, fine grained, moderate plasticity, brown (10YR 4/3), damp							0.7
4								
6	- wet below 5 ft BGS			GB04-05				0.4
8	- clayey silt, dark grey (10YR 4/1) below 8 ft BGS		8"Ø BOREHOLE	GB04-08				
10	SP-SAND, very fine grained, poorly graded, very dark grey (10YR 3/1), wet, dark grey/black staining, strong petroleum odor (strongest odor @ 10 ft BGS, decreasing with depth)	9.50						334
12				GB04-11.5				
14	ML-SILT, dense, non-plastic, dark grey (10YR 4/1), wet	14.00						
16	END OF BOREHOLE @ 16.0ft BGS	16.00		GB04-15.5				
18	Air Knife was used from 0 to 8 ft BGS							
20								
22								
24								
26								
28								
30								
32								
34								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE
WATER FOUND ▽
CHEMICAL ANALYSIS ⬭

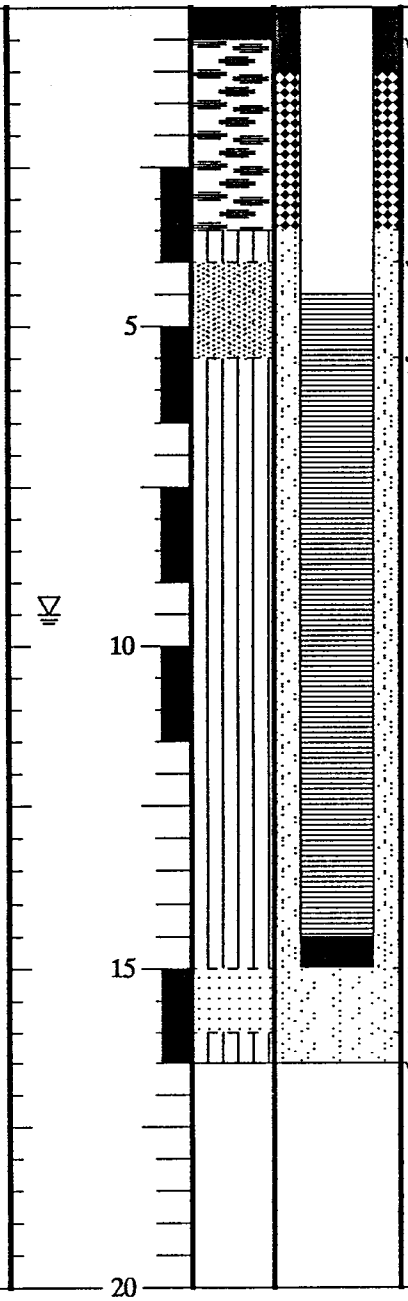
OVERBURDEN LOG 60041.GPJ CRA_CORP.GDT 4/25/08

LOG OF EXPLORATORY BORING

PROJECT NAME	Chevron U.S.A. Inc. 7502	BORING NO.	MW-1
LOCATION	Sedro Woolley, Washington	PAGE	1 OF 2
DRILLED BY	Geoboring & Develop.	REFERENCE ELEV.	97.92' (a)
DRILL METHOD	H.S.Auger	TOTAL DEPTH	16.50'
LOGGED BY	Mike Noll	DATE COMPLETED	2/6/91

SAMPLING METHOD AND NUMBER	PID (ppm)	BLOWS (per foot)
SS/S-1		18
SS/S-2*	116	3
SS/S-3*	108	3
SS/S-4*	115	4
	55	
SS/S-5	4	21

GROUND WATER LEVELS | DEPTH IN FT. | SAMPLES | LITHO-LOGIC COLUMN | WELL DETAILS



LITHOLOGIC DESCRIPTION

0 - 0.5 foot: 3" ASPHALT and SANDY GRAVEL.

0.5 - 3.5 feet: SANDY GRAVEL (GP), loose, moist, olive, fine to coarse, fine to coarse sand, trace fines. (ALLUVIUM)

3.5 - 4.0 feet: SANDY SILT (ML), soft, moist, olive.

4.0 - 5.5 feet: GRAVELLY SAND (SW); loose, moist, olive, fine to coarse, fine gravel, little fines. (ALLUVIUM)

5.5 - 15.0 feet: SANDY SILT (ML), soft to firm, moist to wet, gray to olive-gray, some green and blue-gray, low plasticity to non-plastic, fine sand. Abundant fine laminations, some black laminae and organics at 10 feet. Thin (2 to 3") fine SAND beds at 9 feet and 10 feet. (ALLUVIUM)

15.0 - 16.0 feet: SAND (SP), medium dense, wet, olive gray, trace silt. (ALLUVIUM)

16.0 - 16.5 feet: SANDY SILT (ML), finely laminated.

Boring terminated at 16.5 feet.

REMARKS

1) Drilled with a Mobil B-61, 6-inch-I.D. hollow stem auger, standard penetration test. 2) Flush mount security casing, 4-inch locking plug cap with padlock. 3) SS = Split Spoon Sampler. 4) PID = Photoionization detector, ppm = parts per million. (a) REFERENCE ELEVATION based on an arbitrary site datum.

LOG OF EXPLORATORY BORING

PROJECT NAME	Chevron U.S.A. Inc. 7502	BORING NO.	MW-1
LOCATION	Sedro Woolley, Washington	PAGE	2 OF 2
DRILLED BY	Geoboring & Develop.	REFERENCE ELEV.	97.92' (a)
DRILL METHOD	H.S.Auger	TOTAL DEPTH	16.50'
LOGGED BY	Mike Noll	DATE COMPLETED	2/6/91

SAMPLING METHOD AND NUMBER	PID (ppm)	BLOWS (per foot)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
				25				* Denotes analyzed sample. Well Completion Details- MW-1: 0.3 - 4.5 feet: 4-inch-diameter schedule 40 PVC riser pipe 4.5 - 14.5 feet: 4-inch-diameter schedule 40 PVC screen with 0.010-inch machined slots 14.5 - 15.0 feet: 4-inch-diameter schedule 40 PVC end cap 0 - 1.0 feet: concrete 1.0 - 3.5 feet: bentonite chips (hydrated) 3.5 - 16.5 feet: 10 x 20 Colorado silica sand
				30				
				35				
				40				

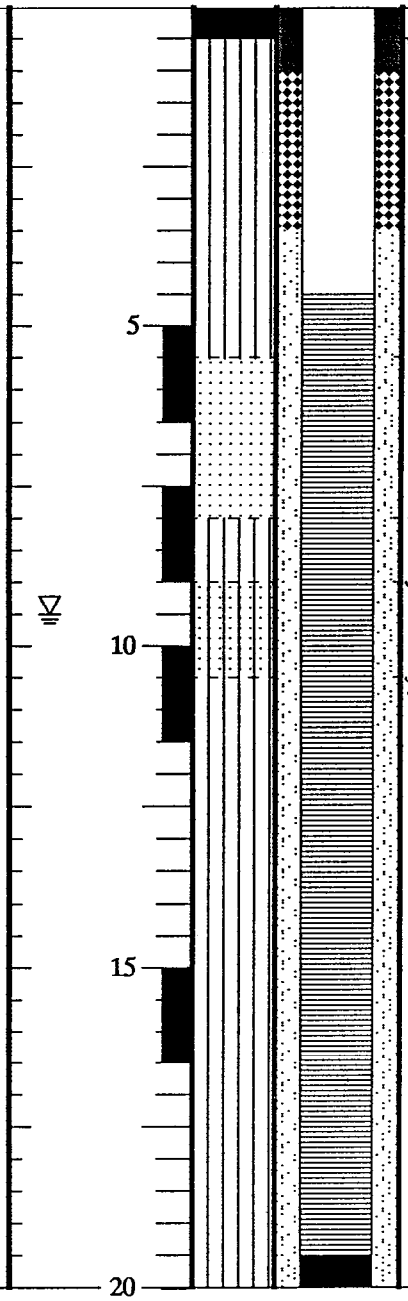
REMARKS

1) Drilled with a Mobil B-61, 6-inch-I.D. hollow stem auger, standard penetration test. 2) Flush mount security casing, 4-inch locking plug cap with padlock. 3) SS = Split Spoon Sampler. 4) PID = Photoionization detector, ppm = parts per million. (a) REFERENCE ELEVATION based on an arbitrary site datum.

LOG OF EXPLORATORY BORING

PROJECT NAME	Chevron U.S.A. Inc. 7502	BORING NO.	MW-2
LOCATION	Sedro Woolley, Washington	PAGE	1 OF 2
DRILLED BY	Geoboring & Develop.	REFERENCE ELEV.	97.79' (a)
DRILL METHOD	H.S.Auger	TOTAL DEPTH	21.50'
LOGGED BY	Mike Noll	DATE COMPLETED	2/6/91

SAMPLING METHOD AND NUMBER	PID (ppm)	BLOWS (per foot)
SS/S-1*	11	20
SS/S-2*	96	4
SS/S-3*	10	4
SS/S-4	< 1	12



LITHOLOGIC DESCRIPTION

0 - 0.5 feet: 3" ASPHALT and SANDY GRAVEL.

0.5 - 5.5 feet: SANDY SILT (ML), soft, moist, olive, low plasticity, some fine sand.

5.5 - 8.0 feet: **SAND (SP),** loose, moist, gray to yellowish-brown, fine, trace silt. Abundant thin laminae and cross-bedding. (ALLUVIUM)

8.0 - 9.0 feet: **SANDY SILT (ML),** soft, moist to wet, gray, low plasticity, fine sand. Some thin laminae.

9.0 - 10.5 feet: **SILTY SAND with GRAVEL (SM),** loose, wet, olive brown, fine, low plasticity fines, fine gravel.

10.5 - 21.5 feet: **SILT (ML),** soft, wet, olive gray, low plasticity, trace fine sand. Some thin laminae, roots, and wood fragments. (ALLUVIUM)

*Denotes analyzed sample.

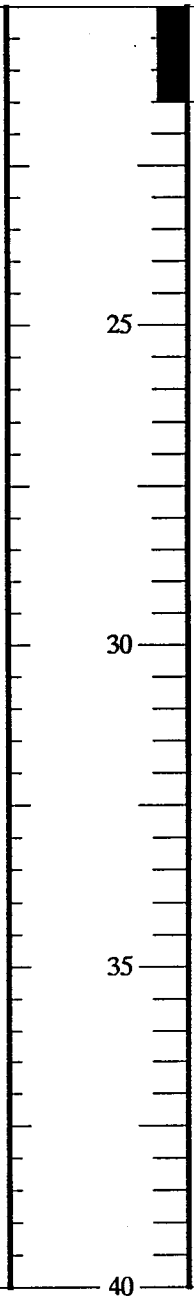
REMARKS

1) Drilled with a Mobil B-61, 6-inch-I.D. hollow stem auger, standard penetration test. 2) Flush mount security casing, 4-inch locking plug cap with padlock. 3) SS = Split Spoon Sampler. 4) PID = Photoionization detector, ppm = parts per million. (a) REFERENCE ELEVATION based on an arbitrary site datum.

LOG OF EXPLORATORY BORING

PROJECT NAME	Chevron U.S.A. Inc. 7502	BORING NO.	MW-2
LOCATION	Sedro Woolley, Washington	PAGE	2 OF 2
DRILLED BY	Geoboring & Develop.	REFERENCE ELEV.	97.79' (a)
DRILL METHOD	H.S.Auger	TOTAL DEPTH	21.50'
LOGGED BY	Mike Noll	DATE COMPLETED	2/6/91

SAMPLING METHOD AND NUMBER	PID (ppm)	BLOWS (per foot)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
SS/S-5		6						Boring terminated at 21.5 feet.



Well Completion Details - MW-2:

0.5 - 4.5 feet: 4-inch-diameter schedule 40 PVC riser pipe

4.5 - 19.5 feet: 4-inch-diameter schedule 40 PVC screen with 0.010-inch machine-cut slots

19.5 - 20.0 feet: 4-inch-diameter schedule 40 PVC end cap

0 - 1.0 feet: concrete

1.0 - 3.5 feet: bentonite chips (hydrated)

3.5 - 21.5 feet: 10 x 20 Colorado silica sand

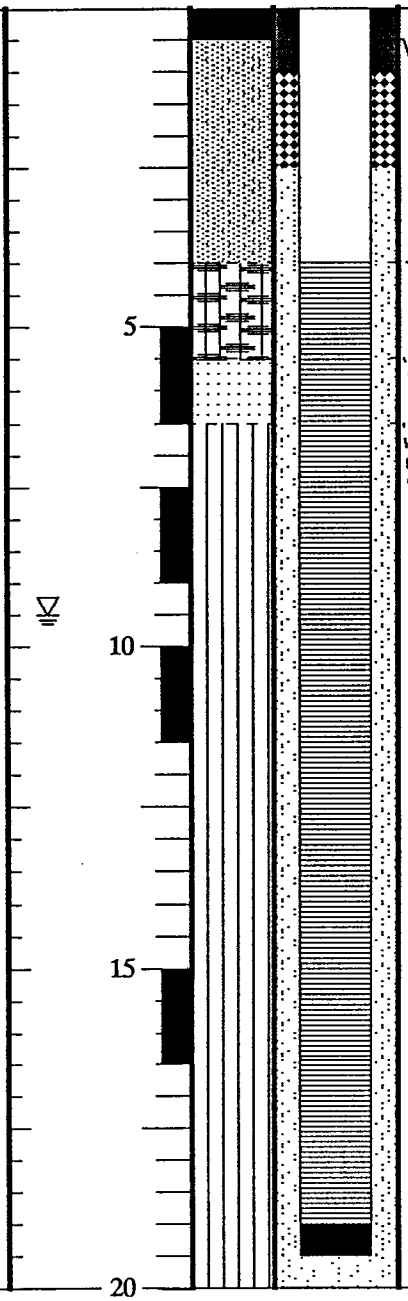
REMARKS

1) Drilled with a Mobil B-61, 6-inch-I.D. hollow stem auger, standard penetration test. 2) Flush mount security casing, 4-inch locking plug cap with padlock. 3) SS = Split Spoon Sampler. 4) PID = Photoionization detector, ppm = parts per million. (a) REFERENCE ELEVATION based on an arbitrary site datum.

LOG OF EXPLORATORY BORING

PROJECT NAME	Chevron U.S.A. Inc. 7502	BORING NO.	MW-3
LOCATION	Sedro Woolley, Washington	PAGE	1 OF 2
DRILLED BY	Geoboring & Develop.	REFERENCE ELEV.	97.66' (a)
DRILL METHOD	H.S.Auger	TOTAL DEPTH	21.50'
LOGGED BY	Mike Noll	DATE COMPLETED	2/7/91

SAMPLING METHOD AND NUMBER	PID (ppm)	BLOWS (per foot)
SS/S-1*	< 1	14
SS/S-2*	11	5
SS/S-3*	1	4
SS/S-4	1	13



0 - 0.5 feet: 3" ASPHALT and SANDY GRAVEL.

0.5 - 4.0 feet: SAND (SW), loose, moist, dark grayish-brown, fine to coarse, trace fines. (FILL)

4.0 - 5.5 feet: SILTY GRAVEL (GM), medium dense, moist, olive brown, fine to coarse, low plasticity fines, little fine to coarse sand.

5.5 - 6.5 feet: SAND (SP), medium dense, moist, gray with yellowish-brown horizons, fine, trace fines. Abundant fine cross-bedding. (ALLUVIUM)

6.5 - 20.5 feet: SILT (ML), soft to firm, moist to 9 feet, wet below 9 feet, olive to olive-gray with some yellowish-brown streaks, becoming dark-gray to dark grayish-brown below 10 feet, low plasticity, trace to little fine sand. Thin lamination at 8 to 8.5 feet, 10 to 10.5 feet, 16 to 16.5 feet, and 20 to 20.5 feet. Some wood and charcoal fragments at 11 to 11.5 feet. Organic-rich horizons at 20 to 20.5 feet. (ALLUVIUM)

*Denotes analyzed sample

REMARKS

1) Drilled with a Mobil B-61, 6-inch-I.D. hollow stem auger, standard penetration test. 2) Flush mount security casing, 4-inch locking plug cap with padlock. 3) SS = Split Spoon Sampler. 4) PID = Photoionization detector, ppm = parts per million. (a) REFERENCE ELEVATION based on an arbitrary site datum.

LOG OF EXPLORATORY BORING

PROJECT NAME	Chevron U.S.A. Inc. 7502	BORING NO.	MW-3
LOCATION	Sedro Woolley, Washington	PAGE	2 OF 2
DRILLED BY	Geoboring & Develop.	REFERENCE ELEV.	97.66' (a)
DRILL METHOD	H.S.Auger	TOTAL DEPTH	21.50'
LOGGED BY	Mike Noll	DATE COMPLETED	2/7/91

SAMPLING METHOD AND NUMBER	PID (ppm)	BLOWS (per foot)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
SS/S-5		2						20.5 - 21.5 feet: SAND (SP), dark gray, fine to medium, trace fines, loose, wet. (ALLUVIUM)
								Boring terminated at 21.5 feet.
				25				Well Completion Details - MW-3: 0.5 - 4.0 feet: 4-inch-diameter schedule 40 PVC riser pipe 4.0 - 19.0 feet: 4-inch-diameter schedule 40 PVC screen with 0.010-inch machine-cut slots 19.0 - 19.5 feet: 4-inch-diameter schedule 40 PVC end cap 0 - 1.0 feet: concrete 1.0 - 2.5 feet: bentonite chips (hydrated) 2.5 - 20.5 feet: 10 x 20 Colorado silica sand 20.5 - 21.5 feet: bentonite chips
				30				
				35				
				40				

REMARKS

1) Drilled with a Mobil B-61, 6-inch-I.D. hollow stem auger, standard penetration test. 2) Flush mount security casing, 4-inch locking plug cap with padlock. 3) SS = Split Spoon Sampler. 4) PID = Photoionization detector, ppm = parts per million. (a) REFERENCE ELEVATION based on an arbitrary site datum.

LOG OF EXPLORATORY BORING

PROJECT NAME	Chevron U.S.A. Inc. 7502	BORING NO.	MW- 4
LOCATION	Sedro Woolley, Washington	PAGE	1 OF 2
DRILLED BY	Geoboring & Develop.	REFERENCE ELEV.	98.18' (a)
DRILL METHOD	H.S.Auger	TOTAL DEPTH	21.50'
LOGGED BY	Mike Noll	DATE COMPLETED	2/7/91

SAMPLING METHOD AND NUMBER	PID (ppm)	BLOWS (per foot)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
								0 - 1.0 feet: 3" ASPHALT, overlying 8" concrete slab.
								1.0 - 5.0 feet: SANDY GRAVEL (GW), loose, moist, gray, fine to coarse, fine to coarse sand, little fines. (FILL)
SS/S-1	< 1	10						
SS/S-2	< 1	15		5				5.0 - 5.5 feet: SILT (ML), firm, moist, dark gray, low plasticity, trace fine sand. Some charcoal and brick fragments; some thin laminae.
SS/S-3*	10	12						5.5. - 7.0 feet: SAND (SP), loose, moist, light gray to olive gray with yellowish-brown horizons, fine, trace fines. Abundant fine laminae and cross-bedding. (ALLUVIUM)
SS/S-4*	16	7	▽	10				7.0 - 8.5 feet: SILT AND SANDY SILT interbeds (ML), firm, moist, olive-gray with yellowish-brown streaks, low plasticity, some fine sand. Some thin laminae; some charcoal fragments.
	148							
								8.5 - 10.0 feet: SAND (SP), loose, moist to wet, gray with yellowish-brown streaks, fine, trace fines. Abundant fine laminae. (ALLUVIUM)
SS/S-5	51	19		15				10.0 - 21.0 feet: SILT and SANDY SILT (ML), firm, wet, dark gray to olive-gray with some brown and yellowish-brown streaks, low plasticity, trace to some fine sand. Abundant organic-rich laminae at 11 to 11.5 feet, 15 to 15.5 feet, and 20 to 20.5 feet. Oil sheen and strong petroleum-like odor on soil cuttings at 12 feet. (ALLUVIUM)
				20				

REMARKS

1) Drilled with a Mobil B-61, 6-inch-I.D. hollow stem auger, standard penetration test. 2) Flush mount security casing, 4-inch locking plug cap with padlock. 3) SS = Split Spoon Sampler. 4) PID = Photoionization detector, ppm = parts per million. (a) REFERENCE ELEVATION based on an arbitrary site datum.

LOG OF EXPLORATORY BORING

PROJECT NAME	Chevron U.S.A. Inc. 7502	BORING NO.	MW- 4
LOCATION	Sedro Woolley, Washington	PAGE	2 OF 2
DRILLED BY	Geoboring & Develop.	REFERENCE ELEV.	98.18' (a)
DRILL METHOD	H.S.Auger	TOTAL DEPTH	21.50'
LOGGED BY	Mike Noll	DATE COMPLETED	2/7/91

SAMPLING METHOD AND NUMBER	PID (ppm)	BLOWS (per foot)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
SS/S-6	10	4						21.0 - 21.5 feet: SAND (SP), loose, wet, dark gray, fine, little fines. Some mica flakes and thin laminae.
								Boring terminated at 21.5 feet.
				25				Well Completion Details - MW-4: 0.5 - 4.0 feet: 4-inch-diameter schedule 40 PVC riser pipe 4.0 - 19.0 feet: 4-inch-diameter schedule 40 PVC screen with 0.010-inch machine-cut slots 19.0 - 19.5 feet: 4-inch-diameter schedule 40 PVC end cap 0 - 1.0 feet: concrete 1.0 - 2.5 feet: bentonite chips (hydrated) 2.5 - 20.5 feet: 10 x 20 Colorado silica sand 20.5 - 21.5 feet: bentonite chips (hydrated)
				30				
				35				*Denotes analyzed sample.
				40				

REMARKS

1) Drilled with a Mobil B-61, 6-inch-I.D. hollow stem auger, standard penetration test. 2) Flush mount security casing, 4-inch locking plug cap with padlock. 3) SS = Split Spoon Sampler. 4) PID = Photoionization detector, ppm = parts per million. (a) REFERENCE ELEVATION based on an arbitrary site datum.

LOG OF EXPLORATORY BORING

PROJECT NAME	Chevron U.S.A. Inc. 7502	BORING NO.	MW-5
LOCATION	Sedro Woolley, Washington	PAGE	1 OF 2
DRILLED BY	Geoboring & Develop.	REFERENCE ELEV.	97.79' (a)
DRILL METHOD	H.S.Auger	TOTAL DEPTH	21.50'
LOGGED BY	Mike Noll	DATE COMPLETED	2/7/91

SAMPLING METHOD AND NUMBER	PID (ppm)	BLOWS (per foot)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
								0 - 0.5 feet: 3" ASPHALT with gravel.
								0.5 - 4.0 feet: SANDY GRAVEL (GW), loose, moist, brown, fine to coarse, fine to coarse sand, trace fines. (FILL)
SS/S-1		11		5				4.0 - 7.0 feet: SILTY SANDY GRAVEL (GW), medium dense, moist, brown, fine to coarse, some fine to coarse sand, few fines. (FILL)
SS/S-2*	13	21						7.0 - 9.5 feet: SAND (SW), medium dense, moist to wet, brown, fine to coarse, trace fines. Some concrete, tile, and metal fragments. (FILL)
SS/S-3*	5	3	▽	10				9.5 - 12.5 feet: SILT and SANDY SILT interbeds (ML), firm, wet, dark gray and olive-brown with yellowish-brown streaks, low plasticity. Some thin laminae, organic layers, and abundant roots at 11 to 11.5 feet and 13 to 13.5 feet.
SS/S-4	15	11						12.5 - 15.5 feet: SAND and SILTY SAND interbeds (SM), medium dense, wet, gray with yellowish-brown horizons, fine, little to some low plasticity fines. Some fine cross-bedding; some petroleum-like odor at 14 feet. (ALLUVIUM)
SS/S-5	43	26		15				15.5 - 21.0 feet: SILT (ML), stiff to soft, wet, olive to olive-brown, some yellowish-brown, low plasticity, trace fine sand. Some thin laminae, wood fragments, and roots at 15.5 to 16.5 feet; some large wood fragments at 20 to 21 feet.
				20				*Denotes analyzed sample.

REMARKS

1) Drilled with a Mobil B-61, 6-inch-I.D. hollow stem auger, standard penetration test. 2) Flush mount security casing, 4-inch locking plug cap with padlock. 3) SS = Split Spoon Sampler. 4) PID = Photoionization detector, ppm = parts per million. (a) REFERENCE ELEVATION based on an arbitrary site datum.

LOG OF EXPLORATORY BORING

PROJECT NAME	Chevron U.S.A. Inc. 7502	BORING NO.	MW- 5
LOCATION	Sedro Woolley, Washington	PAGE	2 OF 2
DRILLED BY	Geoboring & Develop.	REFERENCE ELEV.	97.79' (a)
DRILL METHOD	H.S.Auger	TOTAL DEPTH	21.50'
LOGGED BY	Mike Noll	DATE COMPLETED	2/7/91

SAMPLING METHOD AND NUMBER	PID (ppm)	BLOWS (per foot)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
SS/S-6	8	4						21.0 - 21.5 feet: SAND (SP), loose, wet, dark gray, fine to medium, trace fines.
								Boring terminated at 21.5 feet.
				25				Well Completion Details - MW-5: 0.5 - 4.5 feet: 4-inch-diameter schedule 40 PVC riser pipe 4.5 - 19.5 feet: 4-inch-diameter schedule 40 PVC screen with 0.010-inch machine-cut slots 19.5 - 20.0 feet: 4-inch-diameter schedule 40 PVC end cap 0 - 1.0 feet: concrete 1.0 - 3.0 feet: bentonite chips (hydrated) 3.0 - 20.5 feet: 10 x 20 Colorado silica sand 20.5 - 21.5 feet: bentonite chips (hydrated)
				30				
				35				
				40				

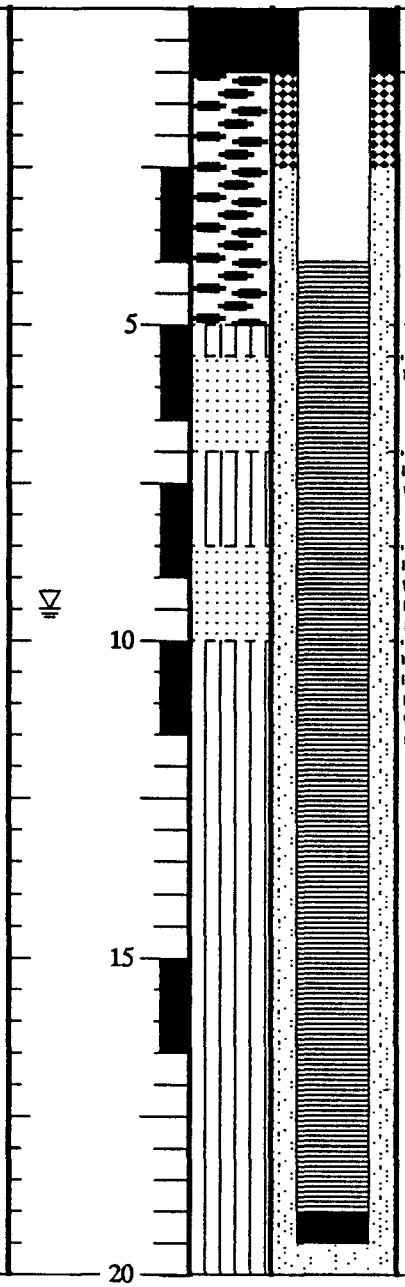
REMARKS

1) Drilled with a Mobil B-61, 6-inch-I.D. hollow stem auger, standard penetration test. 2) Flush mount security casing, 4-inch locking plug cap with padlock. 3) SS = Split Spoon Sampler. 4) PID = Photoionization detector, ppm = parts per million. (a) REFERENCE ELEVATION based on an arbitrary site datum.

LOG OF EXPLORATORY BORING

PROJECT NAME	Chevron U.S.A. Inc. 7502	BORING NO.	MW- 4
LOCATION	Sedro Woolley, Washington	PAGE	1 OF 2
DRILLED BY	Geoboring & Develop.	REFERENCE ELEV.	98.18' (a)
DRILL METHOD	H.S.Auger	TOTAL DEPTH	21.50'
LOGGED BY	Mike Noll	DATE COMPLETED	2/7/91

SAMPLING METHOD AND NUMBER	PID (ppm)	BLOWS (per foot)	LITHOLOGIC DESCRIPTION
			0 - 1.0 feet: 3" ASPHALT, overlying 8" concrete slab.
SS/S-1	< 1	10	1.0 - 5.0 feet: SANDY GRAVEL (GW), loose, moist, gray, fine to coarse, fine to coarse sand, little fines. (FILL)
SS/S-2	< 1	15	5.0 - 5.5 feet: SILT (ML), firm, moist, dark gray, low plasticity, trace fine sand. Some charcoal and brick fragments; some thin laminae.
SS/S-3*	10	12	5.5. - 7.0 feet: SAND (SP), loose, moist, light gray to olive gray with yellowish-brown horizons, fine, trace fines. Abundant fine laminae and cross-bedding. (ALLUVIUM)
SS/S-4*	16	7	7.0 - 8.5 feet: SILT AND SANDY SILT interbeds (ML), firm, moist, olive-gray with yellowish-brown streaks, low plasticity, some fine sand. Some thin laminae; some charcoal fragments.
	148		8.5 - 10.0 feet: SAND (SP), loose, moist to wet, gray with yellowish-brown streaks, fine, trace fines. Abundant fine laminae. (ALLUVIUM)
SS/S-5	51	19	10.0 - 21.0 feet: SILT and SANDY SILT (ML), firm, wet, dark gray to olive-gray with some brown and yellowish-brown streaks, low plasticity, trace to some fine sand. Abundant organic-rich laminae at 11 to 11.5 feet, 15 to 15.5 feet, and 20 to 20.5 feet. Oil sheen and strong petroleum-like odor on soil cuttings at 12 feet. (ALLUVIUM)



REMARKS

1) Drilled with a Mobil B-61, 6-inch-I.D. hollow stem auger, standard penetration test. 2) Flush mount security casing, 4-inch locking plug cap with padlock. 3) SS = Split Spoon Sampler. 4) PID = Photoionization detector, ppm = parts per million. (a) REFERENCE ELEVATION based on an arbitrary site datum.

LOG OF EXPLORATORY BORING

PROJECT NAME	Chevron U.S.A. Inc. 7502	BORING NO.	MW- 4
LOCATION	Sedro Woolley, Washington	PAGE	2 OF 2
DRILLED BY	Geoboring & Develop.	REFERENCE ELEV.	98.18' (a)
DRILL METHOD	H.S.Auger	TOTAL DEPTH	21.50'
LOGGED BY	Mike Noll	DATE COMPLETED	2/7/91

SAMPLING METHOD AND NUMBER	PID (ppm)	BLOWS (per foot)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
SS/S-6	10	4						21.0 - 21.5 feet: SAND (SP), loose, wet, dark gray, fine, little fines. Some mica flakes and thin laminae.
								Boring terminated at 21.5 feet.
				25				Well Completion Details - MW-4: 0.5 - 4.0 feet: 4-inch-diameter schedule 40 PVC riser pipe 4.0 - 19.0 feet: 4-inch-diameter schedule 40 PVC screen with 0.010-inch machine-cut slots 19.0 - 19.5 feet: 4-inch-diameter schedule 40 PVC end cap 0 - 1.0 feet: concrete 1.0 - 2.5 feet: bentonite chips (hydrated) 2.5 - 20.5 feet: 10 x 20 Colorado silica sand 20.5 - 21.5 feet: bentonite chips (hydrated)
				30				
				35				*Denotes analyzed sample.
				40				

REMARKS

1) Drilled with a Mobil B-61, 6-inch-I.D. hollow stem auger, standard penetration test. 2) Flush mount security casing, 4-inch locking plug cap with padlock. 3) SS = Split Spoon Sampler. 4) PID = Photoionization detector, ppm = parts per million. (a) REFERENCE ELEVATION based on an arbitrary site datum.

LOG OF EXPLORATORY BORING

PROJECT NAME	Chevron U.S.A. Inc.	BORING NO.	MW- 6
LOCATION	Facility 60097502	PAGE	1 OF 2
DRILLED BY	Geoboring & Devel.	REFERENCE ELEV.	97.40' (a)
DRILL METHOD	H.S. Auger (4.25 ID)	TOTAL DEPTH	21.50'
LOGGED BY	Angela Cote	DATE COMPLETED	10/07/91

SAMPLING METHOD AND NUMBER	PID (in ppm)	BLOWS PER 6-INCHES	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
								0 to 3.0 feet: 6-inches ASPHALT and SANDY GRAVEL (GP). (FILL)
SS-1	<1	9-8-9						3.0 to 8.5 feet: SILTY SAND (SM), loose, moist, brown, fine to medium, some fines. (ALLUVIUM)
SS-2	103	2-4-12		5				8.5 to 18.5 feet: SAND (SP), loose, moist, gray, fine to medium, slight hydrocarbon odor, trace fines. (ALLUVIUM)
SS-3*	4	2-3-2		10				12.0 to 20.0 feet: SILTY SAND (SM), loose, wet, gray-brown, fine to medium, grained, some silt. (ALLUVIUM)
			▽ ATD	15				@ 16.0 feet: ground water observed
SS-4*	2	8-11-5						
				20				

REMARKS

(1) Drilled with Mobile B-61, 4.25-inch I.D. hollow stem augers, standard penetration test. (2) Flush mount security casing, 2-inch locking cap with padlock. (3) SS=Split Spoon Sampler. (4) PID=Photoionization detector, ppm = parts per million. (a) = REFERENCE ELEVATION based on arbitrary site datum. (*) = analyzed sample. (+) = sieve analysis sample.

LOG OF EXPLORATORY BORING

PROJECT NAME	Chevron U.S.A. Inc.	BORING NO.	MW- 6
LOCATION	Facility 60097502	PAGE	2 OF 2
DRILLED BY	Geoboring & Devel.	REFERENCE ELEV.	97.40' (a)
DRILL METHOD	H.S. Auger (4.25 ID)	TOTAL DEPTH	21.50'
LOGGED BY	Angela Cote	DATE COMPLETED	10/07/91

SAMPLING METHOD AND NUMBER	PID (in ppm)	BLOWS PER 6-INCHES	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
SS-5+	<1	1-1-1		25 30 35 40				**20.0 to 21.5 feet: SILTY CLAY/CLAYEY SILT (ML), soft, wet, gray-brown, low-plasticity, trace fine sand.**

Total depth sampled = 21.5 feet.
Total depth drilled = 20.0 feet.

WELL COMPLETION DETAILS

0 to 5 feet: schedule 40 PVC 2-inch riser pipe
5 to 20 feet: schedule 40 PVC 2-inch screen with PVC end cap (0.010-inch slot)
0 to 1 foot: concrete with monument cover
1 to 4 feet: bentonite seal
4 to 21.5 feet: Colorado silica sand 8/12

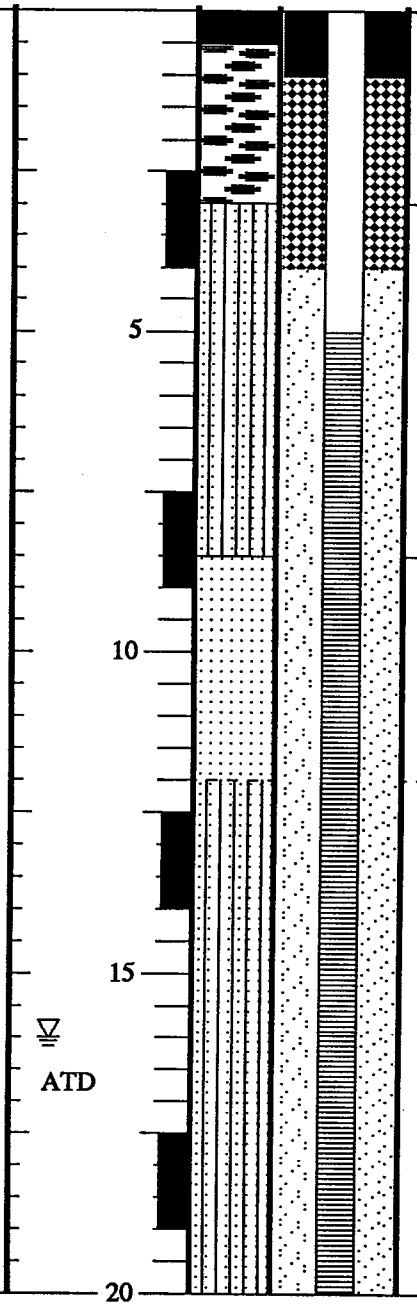
REMARKS
(1) Drilled with Mobile B-61, 4.25-inch I.D. hollow stem augers, standard penetration test. (2) Flush mount security casing, 2-inch locking cap with padlock. (3) SS=Split Spoon Sampler. (4) PID=Photoionization detector, ppm = parts per million. (a) = REFERENCE ELEVATION based on arbitrary site datum. (*) = analyzed sample. (+) = sieve analysis sample.

LOG OF EXPLORATORY BORING

PROJECT NAME	Chevron U.S.A. Inc.	BORING NO.	MW- 6
LOCATION	Facility 60097502	PAGE	1 OF 2
DRILLED BY	Geoboring & Devel.	REFERENCE ELEV.	97.40' (a)
DRILL METHOD	H.S. Auger (4.25 ID)	TOTAL DEPTH	21.50'
LOGGED BY	Angela Cote	DATE COMPLETED	10/07/91

SAMPLING METHOD AND NUMBER	PID (in ppm)	BLOWS PER 6-INCHES	LITHOLOGIC DESCRIPTION
			0 to 3.0 feet: 6-inches ASPHALT and SANDY GRAVEL (GP). (FILL)
SS-1	<1	9-8-9	**3.0 to 8.5 feet: SILTY SAND (SM),** loose, moist, brown, fine to medium, some fines. (ALLUVIUM)
SS-2	103	2-4-12	**8.5 to 18.5 feet: SAND (SP),** loose, moist, gray, fine to medium, slight hydrocarbon odor, trace fines. (ALLUVIUM)
SS-3*	4	2-3-2	**12.0 to 20.0 feet: SILTY SAND (SM),** loose, wet, gray-brown, fine to medium, grained, some silt. (ALLUVIUM)
SS-4*	2	8-11-5	@ 16.0 feet: ground water observed

GROUND WATER LEVELS — DEPTH IN FT. — SAMPLES — LITHOLOGIC COLUMN — WELL DETAILS



REMARKS

(1) Drilled with Mobile B-61, 4.25-inch I.D. hollow stem augers, standard penetration test. (2) Flush mount security casing, 2-inch locking cap with padlock. (3) SS=Split Spoon Sampler. (4) PID=Photoionization detector, ppm = parts per million. (a) = REFERENCE ELEVATION based on arbitrary site datum. (*) = analyzed sample. (+) = sieve analysis sample.

LOG OF EXPLORATORY BORING

PROJECT NAME	Chevron U.S.A. Inc.	BORING NO.	MW- 6
LOCATION	Facility 60097502	PAGE	2 OF 2
DRILLED BY	Geoboring & Devel.	REFERENCE ELEV.	97.40' (a)
DRILL METHOD	H.S. Auger (4.25 ID)	TOTAL DEPTH	21.50'
LOGGED BY	Angela Cote	DATE COMPLETED	10/07/91

SAMPLING METHOD AND NUMBER	PID (in ppm)	BLOWS PER 6-INCHES	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
SS-5+	<1	1-1-1		25 30 35 40				**20.0 to 21.5 feet: SILTY CLAY/CLAYEY SILT (ML), soft, wet, gray-brown, low-plasticity, trace fine sand.** Total depth sampled = 21.5 feet. Total depth drilled = 20.0 feet. **WELL COMPLETION DETAILS** 0 to 5 feet: schedule 40 PVC 2-inch riser pipe 5 to 20 feet: schedule 40 PVC 2-inch screen with PVC end cap (0.010-inch slot) 0 to 1 foot: concrete with monument cover 1 to 4 feet: bentonite seal 4 to 21.5 feet: Colorado silica sand 8/12

REMARKS

(1) Drilled with Mobile B-61, 4.25-inch I.D. hollow stem augers, standard penetration test. (2) Flush mount security casing, 2-inch locking cap with padlock. (3) SS=Split Spoon Sampler. (4) PID=Photoionization detector, ppm = parts per million. (a) = REFERENCE ELEVATION based on arbitrary site datum. (*) = analyzed sample. (+) = sieve analysis sample.

LOG OF EXPLORATORY BORING

PROJECT NAME	Chevron U.S.A. Inc.	BORING NO.	MW-7
LOCATION	Facility 60097502	PAGE	1 OF 2
DRILLED BY	Geoboring & Devel.	REFERENCE ELEV.	97.61' (a)
DRILL METHOD	H.S. Auger (4.25 ID)	TOTAL DEPTH	21.50'
LOGGED BY	Angela Cote	DATE COMPLETED	10/07/91

SAMPLING METHOD AND NUMBER	PID (in ppm)	BLOWS PER 6-INCHES	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
SS-1	1	5-7-9		5				**0 to 9.0 feet: 6-inches ASPHALT and SANDY GRAVEL (GM), medium, moist, brown, fine to medium, some fine to medium sand. (FILL)**
SS-2	NA	4-3-5		10				@ 5 feet: concrete and brick debris encountered.
SS-3*	13	4-7-9	ATD	15				@ 7.5 feet: only 5-inches of sample recovery, could be native material
SS-4*+	12	5-10-14		20				**9.0 to 21.5 feet: SILTY SAND (SM), medium, moist to wet, brown, fine to medium grained, some silt, hydrocarbon-like odor detected. (ALLUVIUM)**
								@ 12.0 feet: ground water observed

REMARKS

(1) Drilled with Mobile B-61, 4.25-inch I.D. hollow stem augers, standard penetration test. (2) Flush mount security casing, 2-inch locking cap with padlock. (3) SS=Split Spoon Sampler. (4) PID=Photoionization detector; ppp = parts per million. (a) = REFERENCE ELEVATION based on arbitrary site datum. (*) = analyzed sample. (+) = sieve analysis sample.

LOG OF EXPLORATORY BORING

PROJECT NAME	Chevron U.S.A. Inc.	BORING NO.	MW- 7
LOCATION	Facility 60097502	PAGE	2 OF 2
DRILLED BY	Geoboring & Devel.	REFERENCE ELEV.	97.61' (a)
DRILL METHOD	H.S. Auger (4.25 ID)	TOTAL DEPTH	21.50'
LOGGED BY	Angela Cote	DATE COMPLETED	10/07/91

SAMPLING METHOD AND NUMBER	PID (in ppm)	BLOWS PER 6-INCHES	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
SS-5	3	8-14-10						

Total depth sampled = 21.5
Total depth drilled = 20.0

WELL COMPLETION DETAILS
0 to 5 feet: schedule 40 PVC 2-inch riser pipe
5 to 20 feet: schedule 40 PVC 2-inch screen with PVC end cap (0.010-inch slot)
0 to 1 foot: concrete with monument cover
1 to 4 feet: bentonite seal
4 to 21.5 feet: Colorado silica sand 8 - 12

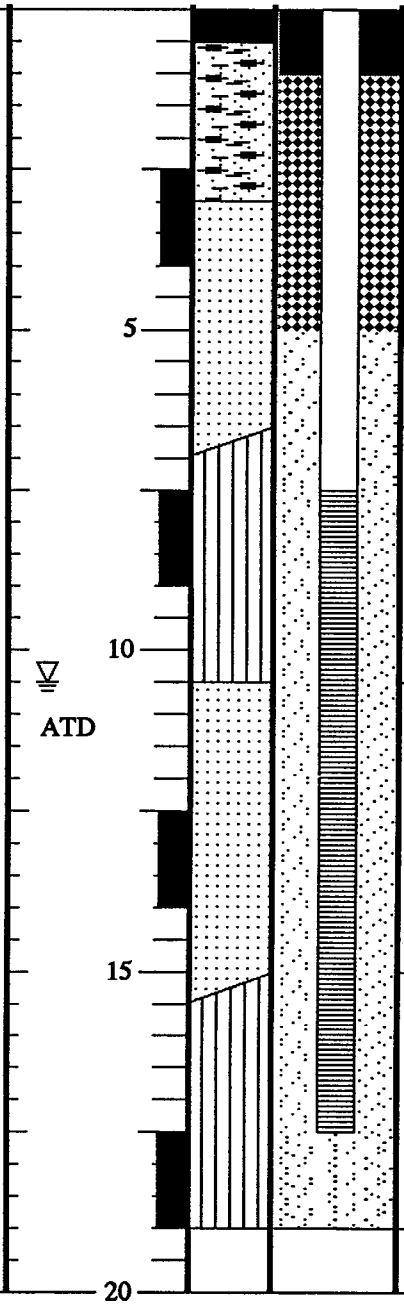
25
30
35
40

REMARKS
(1) Drilled with Mobile B-61, 4.25-inch I.D. hollow stem augers, standard penetration test. (2) Flush mount security casing, 2-inch locking cap with padlock. (3) SS=Split Spoon Sampler. (4) PID=Photoionization detector; ppp = parts per million. (a) = REFERENCE ELEVATION based on arbitrary site datum. (*) = analyzed sample. (+) = sieve analysis sample.

LOG OF EXPLORATORY BORING

PROJECT NAME	Chevron U.S.A. Inc.	BORING NO.	MW- 8
LOCATION	Facility 60097502	PAGE	1 OF 2
DRILLED BY	McGarret Drilling	REFERENCE ELEV.	97.52' (a)
DRILL METHOD	H.S. Auger (4.25 ID)	TOTAL DEPTH	19.00'
LOGGED BY	Jim Jakubiak	DATE COMPLETED	10/14/91

SAMPLING METHOD AND NUMBER	PID (in ppm)	BLOWS PER 6-INCHES	LITHOLOGIC DESCRIPTION
SS-1	<1	3-2-2	**0 to 3 feet: 6-inches ASPHALT and SANDY GRAVEL (GW),** loose, dry-moist, brown, fine to coarse, fine to coarse sand, little fines. (FILL)
			3 to 6.5 feet: SAND (SP), loose, moist, light gray with yellowish brown horizons, fine, trace fines. (ALLUVIUM)
SS-2*	<1	1-1-2	**6.5 to 10.5 feet: SILT AND SANDY SILT INTERBEDDED (ML),** firm, moist to wet, gray, low-plasticity, some fine sand. (ALLUVIUM)
SS-3*	5	5-5-4	**10.5 to 15 feet: SAND (SP),** firm, wet, gray, fine, trace fines, strong hydrocarbon odor. (ALLUVIUM) @ 10.5 to 11 feet: brown silt sand stained hydrocarbon odor (cuttings). Ground water observed at 10.5 feet.
SS-4	3	1-2-1	**15 to 19 feet: SILT (ML),** soft, wet, gray, low-plasticity, some fine sand, slight hydrocarbon odor. (ALLUVIUM).
			Total depth drilled = 17.5 feet. Total depth sampled = 19.0 feet.



REMARKS

(1) Drilled with ML-500 rig, 4.25-inch hollow stem augers, standard penetration test. (2) Flush mount security casing, 2-inch locking cap with padlock. (3) SS=Split Spoon Sampler. (4) PID=Photoionization detector, ppm = parts per million. (a) = REFERENCE ELEVATION based on arbitrary site datum. (*) = analyzed sample.

LOG OF EXPLORATORY BORING

PROJECT NAME	Chevron U.S.A. Inc.	BORING NO.	MW- 8
LOCATION	Facility 60097502	PAGE	2 OF 2
DRILLED BY	McGarret Drilling	REFERENCE ELEV.	97.52' (a)
DRILL METHOD	H.S. Auger (4.25 ID)	TOTAL DEPTH	19.00'
LOGGED BY	Jim Jakubiak	DATE COMPLETED	10/14/91

SAMPLING METHOD AND NUMBER	PID (in ppm)	BLOWS PER 6-INCHES	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
				25				**WELL COMPLETION DETAILS** 0 to 7.5 feet: schedule 40 PVC 2-inch riser pipe 7.5 to 17.5 feet: schedule 40 PVC 2-inch screen with PVC end cap (0.010-inch slot) 0 to 1 foot: concrete with monument cover 1 to 5 feet: bentonite seal 5 to 19 feet: Colorado silica sand 8 - 12
				30				
				35				
				40				

REMARKS

(1) Drilled with ML-500 rig, 4.25-inch hollow stem augers, standard penetration test. (2) Flush mount security casing, 2-inch locking cap with padlock. (3) SS=Split Spoon Sampler. (4) PID=Photoionization detector, ppm = parts per million. (a) = REFERENCE ELEVATION based on arbitrary site datum. (*) = analyzed sample.

LOG OF EXPLORATORY BORING

PROJECT NAME	Chevron U.S.A. Inc.	BORING NO.	MW- 9
LOCATION	Facility 60097502	PAGE	1 OF 2
DRILLED BY	McGarret Drilling	REFERENCE ELEV.	98.15' (a)
DRILL METHOD	H.S. Auger (4.25 ID)	TOTAL DEPTH	19.00'
LOGGED BY	Jim Jakubiak	DATE COMPLETED	10/14/91

SAMPLING METHOD AND NUMBER	PID (in ppm)	BLOWS PER 6-INCHES	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
SS-1	<1	1-2-3		5				**0 to 2 feet: 6-inch ASPHALT and SANDY GRAVEL (GW),** loose, moist, dark grayish brown, fine to coarse, trace fines. (FILL) **2 to 2.5 feet: SILTY GRAVEL (GM),** loose, moist, olive brown, fine to coarse, little fine to coarse sand. (FILL) **2.5 to 5 feet: SAND (SW),** loose, moist, dark grayish-black, fine to coarse, trace fines, possibly stained, no odor. (FILL) **5 to 6 feet: SAND (SP),** soft to medium dense, moist, gray with yellowish brown horizons, fine to very fine, trace silt. (ALLUVIUM) **6 to 19 feet: SILT (ML),** soft, moist to 10 1/2 feet, wet below 10 feet, gray with black streaking beginning at about 10 feet, low-plasticity, little fine sand, hydrocarbon-like odor.
SS-2*	<1	2-2-1						
SS-3*	40	1-1-3	▽ ATD	10				
SS-4	2	1-2-2		15				No hydrocarbon odor @ 17.5 feet.
				20				Total depth sampled 19 feet. Total depth drilled 17.5 feet.

REMARKS

(1) Drilled with ML-500 rig, 4.25-inch I.D. hollow stem augers, standard penetration test. (2) flush mount security casing, 2-inch locking cap with padlock. (3)=Split Spoon Sample. (4) PID=Photoionization detector, ppm = parts per million. (a) = REFERENCE ELEVATION based on arbitrary site datum. (*) = analyzed sample.

LOG OF EXPLORATORY BORING

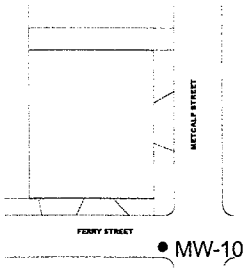
PROJECT NAME	Chevron U.S.A. Inc.	BORING NO.	MW- 9
LOCATION	Facility 60097502	PAGE	2 OF 2
DRILLED BY	McGarret Drilling	REFERENCE ELEV.	98.15' (a)
DRILL METHOD	H.S. Auger (4.25 ID)	TOTAL DEPTH	19.00'
LOGGED BY	Jim Jakubiak	DATE COMPLETED	10/14/91

SAMPLING METHOD AND NUMBER	PID (in ppm)	BLOWS PER 6-INCHES	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
				25				**WELL COMPLETION DETAILS** 0 to 6 feet: schedule 40 PVC 2-inch riser pipe 6 to 16 feet: schedule 40 PVC 2-inch screen with PVC end cap (0.010-inch slot) 0 to 1 foot: concrete with monument 1 to 5 feet: bentonite seal 5 to 19 feet: Colorado silica sand 8 - 12
				30				
				35				
				40				

REMARKS

(1) Drilled with ML-500 rig, 4.25-inch I.D. hollow stem augers, standard penetration test. (2) flush mount security casing, 2-inch locking cap with padlock. (3)=Split Spoon Sample. (4) PID=Photoionization detector, ppm = parts per million. (a) = REFERENCE ELEVATION based on arbitrary site datum. (*) = analyzed sample.

WELL/BORING LOCATION MAP



Delta Environmental Consultants, Inc.

Well/Boring: MW-10

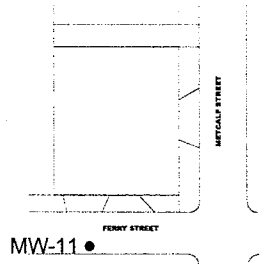
INSTALLATION DATE: 7/1/02	DRILLING METHOD: Hollow Stem Auger
PROJECT: CW97502	SAMPLING METHOD: DM Split Spoon
CLIENT: Chevron 98502	BORING DIAMETER: 8"
LOCATION: 124 Ferry Street	BORING DEPTH: 21.5'
CITY: Sedro Woolley	WELL CASING: SCH 40 PVC 2"
STATE: WA	WELL SCREEN: 7-20' (0.020")
DRILLER: Cascade	SAND PACK: 5-21.5' (2x12)

CASING ELEVATION	
SURVEY DATE:	
DTW:	

DESCRIPTION/LOGGED BY: SHAWN MADISON

WELL/BORING COMPLETION	FIRST ▽	STABILIZED ▼	MOISTURE	PID (ppm)	DENSITY BLOWS / 6"	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	USCS SYMBOL	GRAPHIC	
Concrete / Bentonite / Sand			DP	0	6 7 7	5			SP		SAND: gray; 3% fines; fine to medium sand; medium dense; no odor.
	▽		DP WT	162	9 14 15	10			SP		SAND: gray; 3% fines; fine to medium sand; dense; odor.
						15			SP		
				5.5	3 4 4	16			SM		SILTY SAND: gray; 45% fines; 55% very fine to fine sand; medium dense; no odor.
				0	4 6 6	20 21 22			SM		Save as above.

WELL/BORING LOCATION MAP



Delta Environmental Consultants, Inc.

Well/Boring: MW-11

INSTALLATION DATE: 7/1/02	DRILLING METHOD: Hollow Stem Auger
PROJECT: CW97502	SAMPLING METHOD: DM Split Spoon
CLIENT: Chevron 98502	BORING DIAMETER: 8"
LOCATION: 124 Ferry Street	BORING DEPTH: 21.5'
CITY: Sedro Woolley	WELL CASING: SCH 40 PVC 2"
STATE: WA	WELL SCREEN: 7-20' (0.020")
DRILLER: Cascade	SAND PACK: 5-21.5' (2x12)

CASING ELEVATION	
SURVEY DATE:	
DTW:	

DESCRIPTION/LOGGED BY: SHAWN MADISON

WELL/BORING COMPLETION	FIRST ▽	STABILIZED ▼	MOISTURE	PID (ppm)	DENSITY BLOWS / 6"	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	USCS SYMBOL	GRAPHIC	DESCRIPTION
Concrete / Bentonite / Sand			DP	0	14 14 14	5–6			SM		SILTY SAND: brownish gray; 15% fines; fine to medium sand; 10% gravel; dense; no odor.
			DP	67	4 5 7	10–11			SP		SAND: gray; 3% fines; fine sand; medium dense; odor.
	▽					12–13					
						14–15			SP		
			WT	7.4	4 2 3	15–16			SM		SILTY SAND: gray; 45% fines; 55% very fine to fine sand; loose; no odor.
						17–18					
						19–20					
			WT	211	5 6 4	20–21			SM		Save as above.
						22					

Cambria Environmental Technology Inc.
8620 Holly Drive, Suite 210
Everett, WA 98208
Telephone: (425) 353-6670
Fax: (425) 353-6443

BORING/WELL LOG

CLIENT NAME	Chevron Environmental Management Company	**BORING/WELL NAME**	MW-12
JOB/SITE NAME	Chevron #9-7502	**DRILLING STARTED**	02-May-06
LOCATION	124 Ferry Street	**DRILLING COMPLETED**	02-May-06
PROJECT NUMBER	61H-2095	**WELL DEVELOPMENT DATE (YIELD)**	NA
DRILLER	Cascade Drilling, Inc.	**GROUND SURFACE ELEVATION**	Not Surveyed
DRILLING METHOD	Hollow-stem auger	**TOP OF CASING ELEVATION**	Not Surveyed
BORING DIAMETER	8"	**SCREENED INTERVAL**	5 to 20 fbg
LOGGED BY	Jessica Spahr	**DEPTH TO WATER (First Encountered)**	NA
REVIEWED BY	T. Crotwell, WA LG #2331	**DEPTH TO WATER (Static)**	NA
REMARKS	Air knife to 8' bgs		

PID (ppm)	BLOW COUNTS	SAMPLE ID	EXTENT	DEPTH (fbg)	U.S.C.S.	GRAPHIC LOG	DESCRIPTION	CONTACT DEPTH (fbg)
							Concrete	0.5
							Cleared with air knife	
				5				
					SM		Silty SAND with clay: grey, medium dense, wet, 50% fine grained sand, 30% silt, 20% clay, medium plasticity, low estimated permeability	5.0
4.9	15 19 22	B-12@ 10'		10				10.0
					ML		SILT with fine sand and clay: brown, medium dense, wet, 60% silt, 20 % fine grained sand, 20% clay, medium plasticity, low estimated permeability	
0.3	15 16 19	B-12@ 15'		15				15.0
					ML		SILT with fine sand and clay: dark brown, loose, wet, 60% silt, 20 % fine grained sand, 20% clay, medium plasticity, low estimated permeability	
0.4	7 6 6			20				21.5

WELL DIAGRAM

- Portland Type I/II
- Bentonite Seal
- Pea Gravel
- 4-diam., 0.060 Slotted Schedule 40 PVC
- Bottom of Boring @ 20 fbg

WELL LOG PID EVERETT C:\DOCUMENTS AND SETTINGS\SMCGOWAN\DESKTOP\9-7.GPJ DEFAULT.GDT 5/31/06

Cambria Environmental Technology Inc.
8620 Holly Drive, Suite 210
Everett, WA 98208
Telephone: (425) 353-6670
Fax: (425) 353-6443

BORING/WELL LOG

CLIENT NAME	Chevron Environmental Management Company	**BORING/WELL NAME**	MW-13
JOB/SITE NAME	Chevron #9-7502	**DRILLING STARTED**	02-May-06
LOCATION	124 Ferry Street	**DRILLING COMPLETED**	02-May-06
PROJECT NUMBER	61H-2095	**WELL DEVELOPMENT DATE (YIELD)**	NA
DRILLER	Cascade Drilling, Inc.	**GROUND SURFACE ELEVATION**	Not Surveyed
DRILLING METHOD	Hollow-stem auger	**TOP OF CASING ELEVATION**	Not Surveyed
BORING DIAMETER	8"	**SCREENED INTERVAL**	5 to 20 fbg
LOGGED BY	Jessica Spahr	**DEPTH TO WATER (First Encountered)**	NA
REVIEWED BY	T. Crotwell, WA LG #2331	**DEPTH TO WATER (Static)**	NA
REMARKS	Air knife to 8' bgs		

PID (ppm)	BLOW COUNTS	SAMPLE ID	EXTENT	DEPTH (fbg)	U.S.C.S.	GRAPHIC LOG	DESCRIPTION	CONTACT DEPTH (fbg)	WELL DIAGRAM
							Concrete	0.5	Portland Type I/II
							Cleared with air knife		Bentonite Seal
				5				8.0	
310	19 19 22	B-13@ 10'		10	SM		Silty SAND: dark brown, dense, moist, 60% fine grained sand, 40% silt, medium plasticity, low estimated permeability	10.0	Pea Gravel 4-diam., 0.060 Slotted Schedule 40 PVC
7.7	8 8 7	B-13@ 15'		15	ML		Sandy SILT: Brown, medium stiff, wet, 70% silt, 30% very fine grain sand; low plasticity, low estimated permeability	15.0	
1.9	6 6 6			20	SM		Silty SAND : Dark brown; loose, moist, 80% medium grain sand, 20% silt, low plasticity; high estimated permeability	20.0 21.5	Bottom of Boring @ 20 fbg

WELL LOG PID EVERETT C:\DOCUMENTS AND SETTINGS\SMCGOWAN\DESKTOP\9-7.GPJ DEFAULT.GDT 5/31/06

Cambria Environmental Technology Inc.
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BORING/WELL LOG

CLIENT NAME	Chevron Environmental Management Company	**BORING/WELL NAME**	MW-14
JOB/SITE NAME	Chevron #9-7502	**DRILLING STARTED**	02-May-06
LOCATION	124 Ferry Street	**DRILLING COMPLETED**	02-May-06
PROJECT NUMBER	61H-2095	**WELL DEVELOPMENT DATE (YIELD)**	NA
DRILLER	Cascade Drilling, Inc.	**GROUND SURFACE ELEVATION**	Not Surveyed
DRILLING METHOD	Hollow-stem auger	**TOP OF CASING ELEVATION**	Not Surveyed
BORING DIAMETER	8	**SCREENED INTERVAL**	5 to 20 fbg
LOGGED BY	Jessica Spahr	**DEPTH TO WATER (First Encountered)**	NA
REVIEWED BY	T. Crotwell, WA LG #2331	**DEPTH TO WATER (Static)**	NA
REMARKS	Air knife to 8' bgs		

PID (ppm)	BLOW COUNTS	SAMPLE ID	EXTENT	DEPTH (fbg)	U.S.C.S.	GRAPHIC LOG	DESCRIPTION	CONTACT DEPTH (fbg)
							Asphalt	0.5
							Cleared with air knife	
				5				
								8.0
				10				10.0
0	9 11 14	B-14@ 10'			SM		Silty SAND: Dark brown, medium dense, moist, 70% fine grained sand, 30% silt, non-plastic, medium estimated permeability	
				15				15.0
0	15 16 10	B-14@ 15'			SM		Same as above	
				20				20.0
0	5 5 6				SP		Poorly graded SAND with silt: grey, loose, moist, 85% medium grained sand, 15% silt, low plasticity, high estimated permeability	21.5

WELL DIAGRAM

- Portland Type I/II
- Bentonite Seal
- Pea Gravel
- 4-diam., 0.060 Slotted Schedule 40 PVC
- Bottom of Boring @ 20 fbg

WELL LOG PID EVERETT C:\DOCUMENTS AND SETTINGS\SMCGOWAN\DESKTOP\9-7.GPJ DEFAULT.GDT 5/31/06

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: Chevron 9-7502
PROJECT NUMBER: 060041
CLIENT: Chevron
LOCATION: 124 Ferry Street, Sedro-Woolley, WA

HOLE DESIGNATION: VP-1
DATE COMPLETED: October 1, 2007
DRILLING METHOD: Air Knife/Vacuum Truck
FIELD PERSONNEL: L. Genin

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (ft)	SAMPLE 'N' VALUE	SAMPLE PID [ppm]
	ASPHALT		2"Ø NYLON TUBES WITH GAS-TIGHT CAPS					
	Not Sampled	0.50	CONCRETE					
1								
2			1' HYDRATED BENTONITE					
3			1' DRY BENTONITE					
4			6" SOIL VAPOR SCREEN					
			1' #2 MONTERY SAND					
5	SP-SAND, with silt, very fine grained, poorly graded, beige-grey, dry, no odor	5.00	1' HYDRATED BENTONITE	HA1	X			0
	Not Sampled	5.50						
6			1' DRY BENTONITE					
7			6" SOIL VAPOR SCREEN					
			1' #2 MONTERY SAND					
8	END OF BOREHOLE @ 8.0ft BGS	8.00						
9								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

OVERBURDEN LOG 60041.GPJ CRA_CORP.GDT 10/29/07

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: Chevron 9-7502
PROJECT NUMBER: 060041
CLIENT: Chevron
LOCATION: 124 Ferry Street, Sedro-Woolley, WA

HOLE DESIGNATION: VP-2
DATE COMPLETED: October 1, 2007
DRILLING METHOD: Air Knife/Vacuum Truck
FIELD PERSONNEL: L. Genin

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (ft)	SAMPLE 'N' VALUE	SAMPLE PID [ppm]
	ASPHALT		2"Ø NYLON TUBES WITH GAS-TIGHT CAPS					
	Not Sampled	0.50	CONCRETE					
1								
2			1' HYDRATED BENTONITE					
3			1' DRY BENTONITE					
4			6" SOIL VAPOR SCREEN					
			1' #2 MONTERY SAND					
5	SP-SAND, with silt, very fine grained, medium to low plasticity, poorly graded, beige-grey-brown, dry, no odor	5.00	1' HYDRATED BENTONITE	HA1	X			0
	Not Sampled	5.50						
6			1' DRY BENTONITE					
7	CL-SILTY CLAY, with sand, medium to high plasticity, grey-rust, moist. Clay layers are approximately 0.5" thick consisting of very fine sand and silt between the clay.	7.00	6" SOIL VAPOR SCREEN	HA2	X			0
			1' #2 MONTERY SAND					
8	END OF BOREHOLE @ 8.0ft BGS	8.00						
9								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

OVERBURDEN LOG 60041.GPJ CRA_CORP.GDT 10/29/07

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: Chevron 9-7502
PROJECT NUMBER: 060041
CLIENT: Chevron
LOCATION: 124 Ferry Street, Sedro-Woolley, WA

HOLE DESIGNATION: VP-3
DATE COMPLETED: October 1, 2007
DRILLING METHOD: Air Knife/Vacuum Truck
FIELD PERSONNEL: L. Genin

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH ft BGS	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (ft)	SAMPLE 'N' VALUE	SAMPLE PID [ppm]
	ASPHALT		2"Ø NYLON TUBES WITH GAS-TIGHT CAPS; CONCRETE; 1' HYDRATED BENTONITE; 1' DRY BENTONITE; 6" SOIL VAPOR SCREEN; 1' #2 MONTERY SAND; 1' HYDRATED BENTONITE; 1' DRY BENTONITE; 6" SOIL VAPOR SCREEN; 1' #2 MONTERY SAND					
	Not Sampled	0.50						
1								
2								
3								
4								
5	SP-SAND, with silt, very fine grained, low plasticity, poorly graded, beige-grey-brown, dry, no odor	5.00		HA1	X			0
	Not Sampled	5.50						
6								
7	CL-SILTY CLAY, with sand, medium to high plasticity, grey-rust, moist, no odor. Clay layers are approximately 1" thick consisting of very fine sand and silt between the clay.	7.00		HA2	X			0
8	END OF BOREHOLE @ 8.0ft BGS	8.00						
9								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

Voluntary Cleanup Program

Washington State Department of Ecology
Toxics Cleanup Program

TERRESTRIAL ECOLOGICAL EVALUATION FORM

Under the Model Toxics Control Act (MTCA), a terrestrial ecological evaluation is necessary if hazardous substances are released into the soils at a Site. In the event of such a release, you must take one of the following three actions as part of your investigation and cleanup of the Site:

1. Document an exclusion from further evaluation using the criteria in WAC 173-340-7491.
2. Conduct a simplified evaluation as set forth in WAC 173-340-7492.
3. Conduct a site-specific evaluation as set forth in WAC 173-340-7493.

When requesting a written opinion under the Voluntary Cleanup Program (VCP), you must complete this form and submit it to the Department of Ecology (Ecology). The form documents the type and results of your evaluation.

Completion of this form is not sufficient to document your evaluation. You still need to document your analysis and the basis for your conclusion in your cleanup plan or report.

If you have questions about how to conduct a terrestrial ecological evaluation, please contact the Ecology site manager assigned to your Site. For additional guidance, please refer to https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Terrestrial-ecological-evaluation.

Step 1: IDENTIFY HAZARDOUS WASTE SITE	
Please identify below the hazardous waste site for which you are documenting an evaluation.	
Facility/Site Name:	
Facility/Site Address:	
Facility/Site No:	VCP Project No.:

Step 2: IDENTIFY EVALUATOR			
Please identify below the person who conducted the evaluation and their contact information.			
Name:			Title:
Organization:			
Mailing address:			
City:		State:	Zip code:
Phone:	Fax:	E-mail:	

Step 3: DOCUMENT EVALUATION TYPE AND RESULTS

A. Exclusion from further evaluation.

1. Does the Site qualify for an exclusion from further evaluation?

☐ Yes *If you answered **"YES,"** then answer **Question 2**.*

☐ No or Unknown *If you answered **"NO" or "UNKNOWN,"** then skip to **Step 3B** of this form.*

2. What is the basis for the exclusion? *Check all that apply. Then skip to **Step 4** of this form.*

Point of Compliance: WAC 173-340-7491(1)(a)

☐ All soil contamination is, or will be,* at least 15 feet below the surface.

☐ All soil contamination is, or will be,* at least 6 feet below the surface (or alternative depth if approved by Ecology), and institutional controls are used to manage remaining contamination.

Barriers to Exposure: WAC 173-340-7491(1)(b)

☐ All contaminated soil, is or will be,* covered by physical barriers (such as buildings or paved roads) that prevent exposure to plants and wildlife, and institutional controls are used to manage remaining contamination.

Undeveloped Land: WAC 173-340-7491(1)(c)

☐ There is less than 0.25 acres of contiguous[#] undeveloped[±] land on or within 500 feet of any area of the Site and any of the following chemicals is present: chlorinated dioxins or furans, PCB mixtures, DDT, DDE, DDD, aldrin, chlordane, dieldrin, endosulfan, endrin, heptachlor, heptachlor epoxide, benzene hexachloride, toxaphene, hexachlorobenzene, pentachlorophenol, or pentachlorobenzene.

☐ For sites not containing any of the chemicals mentioned above, there is less than 1.5 acres of contiguous[#] undeveloped[±] land on or within 500 feet of any area of the Site.

Background Concentrations: WAC 173-340-7491(1)(d)

☐ Concentrations of hazardous substances in soil do not exceed natural background levels as described in WAC 173-340-200 and 173-340-709.

* An exclusion based on future land use must have a completion date for future development that is acceptable to Ecology.

[±] "Undeveloped land" is land that is not covered by building, roads, paved areas, or other barriers that would prevent wildlife from feeding on plants, earthworms, insects, or other food in or on the soil.

[#] "Contiguous" undeveloped land is an area of undeveloped land that is not divided into smaller areas of highways, extensive paving, or similar structures that are likely to reduce the potential use of the overall area by wildlife.

B. Simplified evaluation.

1. Does the Site qualify for a simplified evaluation?

☐ Yes *If you answered **"YES,"** then answer **Question 2** below.*

☐ No or Unknown *If you answered **"NO"** or **"UNKNOWN,"** then skip to **Step 3C** of this form.*

2. Did you conduct a simplified evaluation?

☐ Yes *If you answered **"YES,"** then answer **Question 3** below.*

☐ No *If you answered **"NO,"** then skip to **Step 3C** of this form.*

3. Was further evaluation necessary?

☐ Yes *If you answered **"YES,"** then answer **Question 4** below.*

☐ No *If you answered **"NO,"** then answer **Question 5** below.*

4. If further evaluation was necessary, what did you do?

☐ Used the concentrations listed in Table 749-2 as cleanup levels. *If so, then skip to **Step 4** of this form.*

☐ Conducted a site-specific evaluation. *If so, then skip to **Step 3C** of this form.*

5. If no further evaluation was necessary, what was the reason? *Check all that apply. Then skip to **Step 4** of this form.*

Exposure Analysis: WAC 173-340-7492(2)(a)

☐ Area of soil contamination at the Site is not more than 350 square feet.

☐ Current or planned land use makes wildlife exposure unlikely. Used Table 749-1.

Pathway Analysis: WAC 173-340-7492(2)(b)

☐ No potential exposure pathways from soil contamination to ecological receptors.

Contaminant Analysis: WAC 173-340-7492(2)(c)

☐ No contaminant listed in Table 749-2 is, or will be, present in the upper 15 feet at concentrations that exceed the values listed in Table 749-2.

☐ No contaminant listed in Table 749-2 is, or will be, present in the upper 6 feet (or alternative depth if approved by Ecology) at concentrations that exceed the values listed in Table 749-2, and institutional controls are used to manage remaining contamination.

☐ No contaminant listed in Table 749-2 is, or will be, present in the upper 15 feet at concentrations likely to be toxic or have the potential to bioaccumulate as determined using Ecology-approved bioassays.

☐ No contaminant listed in Table 749-2 is, or will be, present in the upper 6 feet (or alternative depth if approved by Ecology) at concentrations likely to be toxic or have the potential to bioaccumulate as determined using Ecology-approved bioassays, and institutional controls are used to manage remaining contamination.

C. Site-specific evaluation. A site-specific evaluation process consists of two parts: (1) formulating the problem, and (2) selecting the methods for addressing the identified problem. Both steps require consultation with and approval by Ecology. *See* WAC 173-340-7493(1)(c).

1. Was there a problem? *See* WAC 173-340-7493(2).

☐ Yes *If you answered **"YES,"** then answer **Question 2** below.*

☐ No *If you answered **"NO,"** then identify the reason here and then skip to **Question 5** below:*

- ☐ No issues were identified during the problem formulation step.
- ☐ While issues were identified, those issues were addressed by the cleanup actions for protecting human health.

2. What did you do to resolve the problem? *See* WAC 173-340-7493(3).

- ☐ Used the concentrations listed in Table 749-3 as cleanup levels. *If so, then skip to **Question 5** below.*
- ☐ Used one or more of the methods listed in WAC 173-340-7493(3) to evaluate and address the identified problem. *If so, then answer **Questions 3 and 4** below.*

3. If you conducted further site-specific evaluations, what methods did you use?
Check all that apply. See WAC 173-340-7493(3).

- ☐ Literature surveys.
- ☐ Soil bioassays.
- ☐ Wildlife exposure model.
- ☐ Biomarkers.
- ☐ Site-specific field studies.
- ☐ Weight of evidence.
- ☐ Other methods approved by Ecology. If so, please specify:

4. What was the result of those evaluations?

- ☐ Confirmed there was no problem.
- ☐ Confirmed there was a problem and established site-specific cleanup levels.

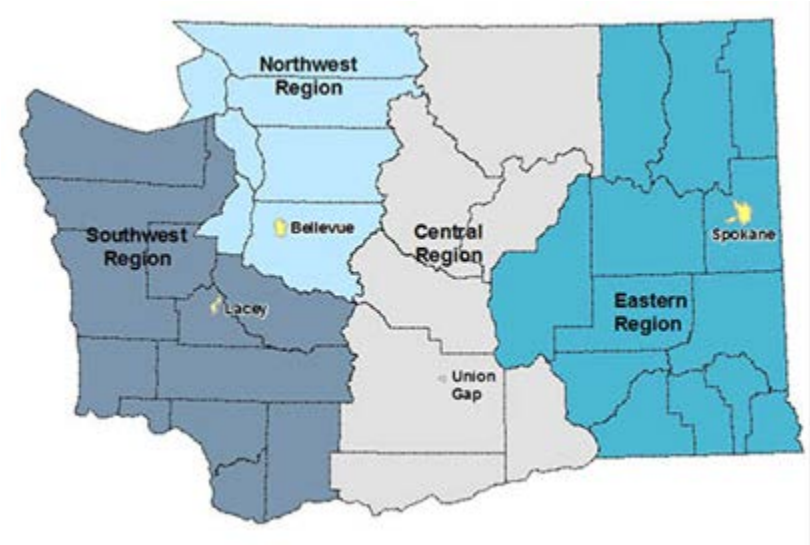
5. Have you already obtained Ecology's approval of both your problem formulation and problem resolution steps?

☐ Yes If so, please identify the Ecology staff who approved those steps:

☐ No

Step 4: SUBMITTAL

Please mail your completed form to the Ecology site manager assigned to your Site. If a site manager has not yet been assigned, please mail your completed form to the Ecology regional office for the County in which your Site is located.

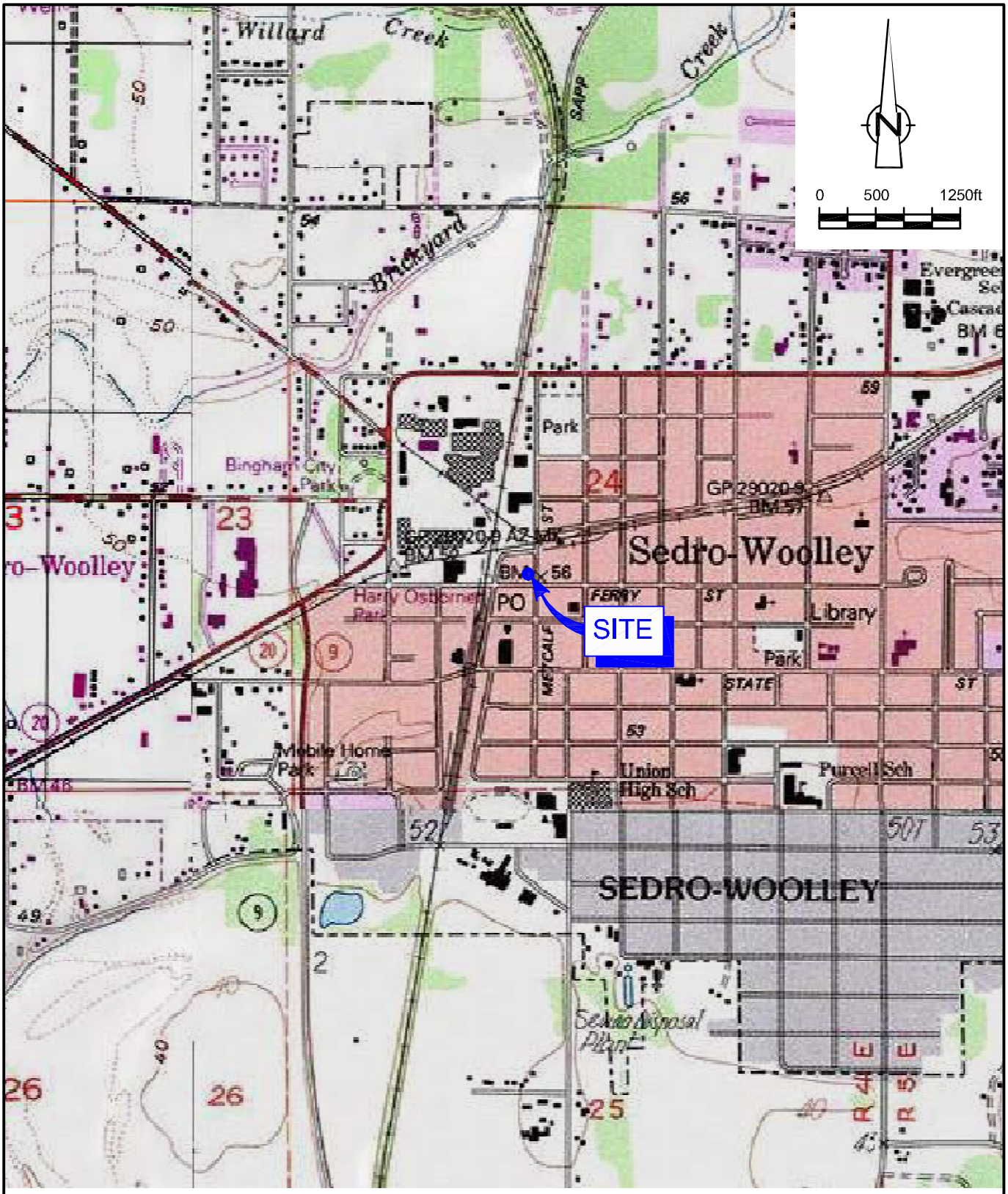


Northwest Region: Attn: VCP Coordinator 3190 160th Ave. SE Bellevue, WA 98008-5452	**Central Region:** Attn: VCP Coordinator 1250 West Alder St. Union Gap, WA 98903-0009
Southwest Region: Attn: VCP Coordinator P.O. Box 47775 Olympia, WA 98504-7775	**Eastern Region:** Attn: VCP Coordinator N. 4601 Monroe Spokane WA 99205-1295

If you need this publication in an alternate format, please call the Toxics Cleanup Program at 360-407-7170. People with hearing loss can call 711 for Washington Relay Service. People with a speech disability can call 877-833-6341.

APPENDIX D

Historical Maps

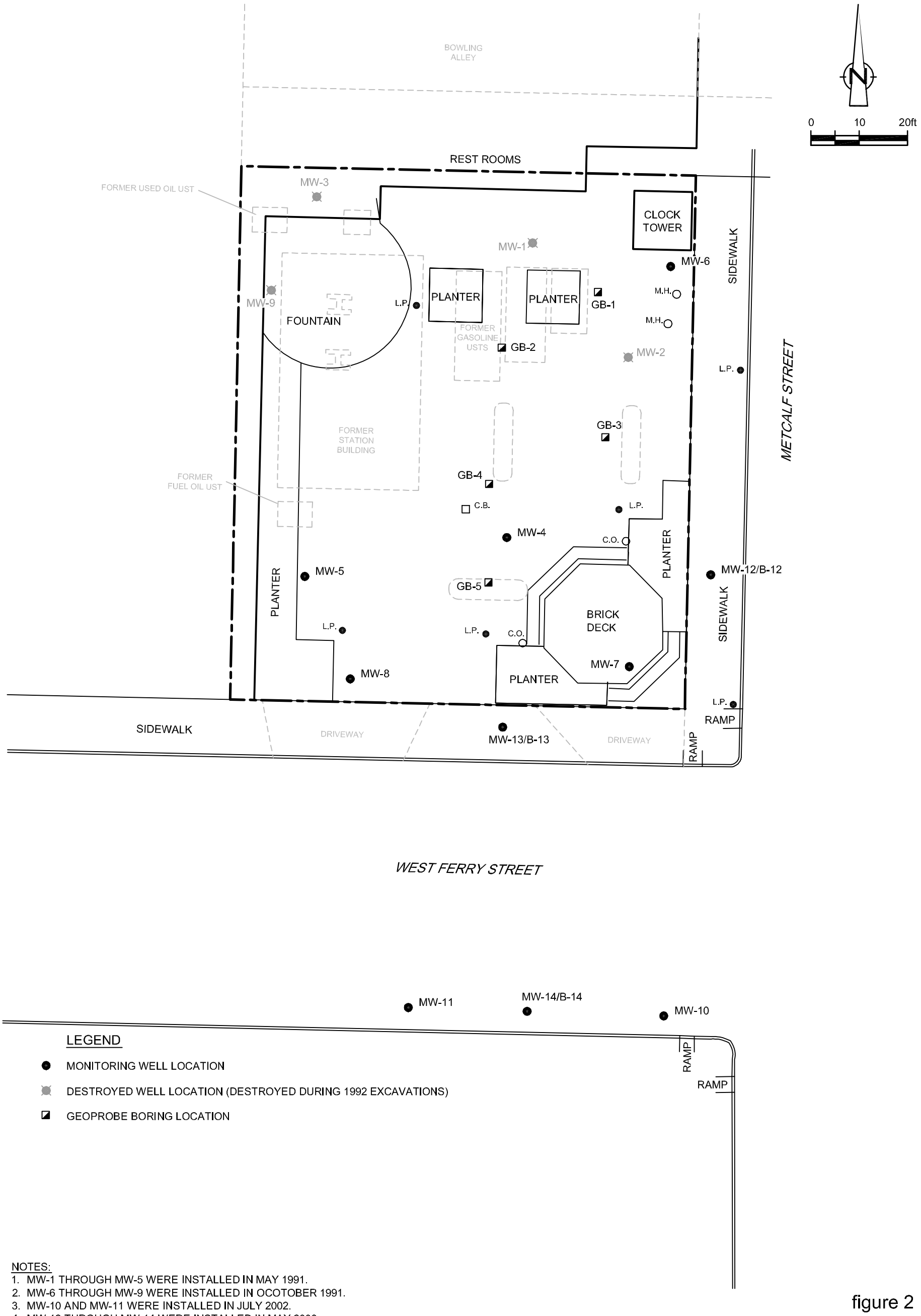


SOURCE: TOPO! MAPS.

figure 1

VICINITY MAP
FORMER CHEVRON STATION 9-7502
124 FERRY STREET
Sedro-Woolley, Washington

60041-2007(PRES001)GN-WA001 NOV 07/2008



LEGEND

- MONITORING WELL LOCATION
- DESTROYED WELL LOCATION (DESTROYED DURING 1992 EXCAVATIONS)
- GEOPROBE BORING LOCATION

NOTES:

1. MW-1 THROUGH MW-5 WERE INSTALLED IN MAY 1991.
2. MW-6 THROUGH MW-9 WERE INSTALLED IN OCOTOBER 1991.
3. MW-10 AND MW-11 WERE INSTALLED IN JULY 2002.
4. MW-12 THROUGH MW-14 WERE INSTALLED IN MAY 2006.

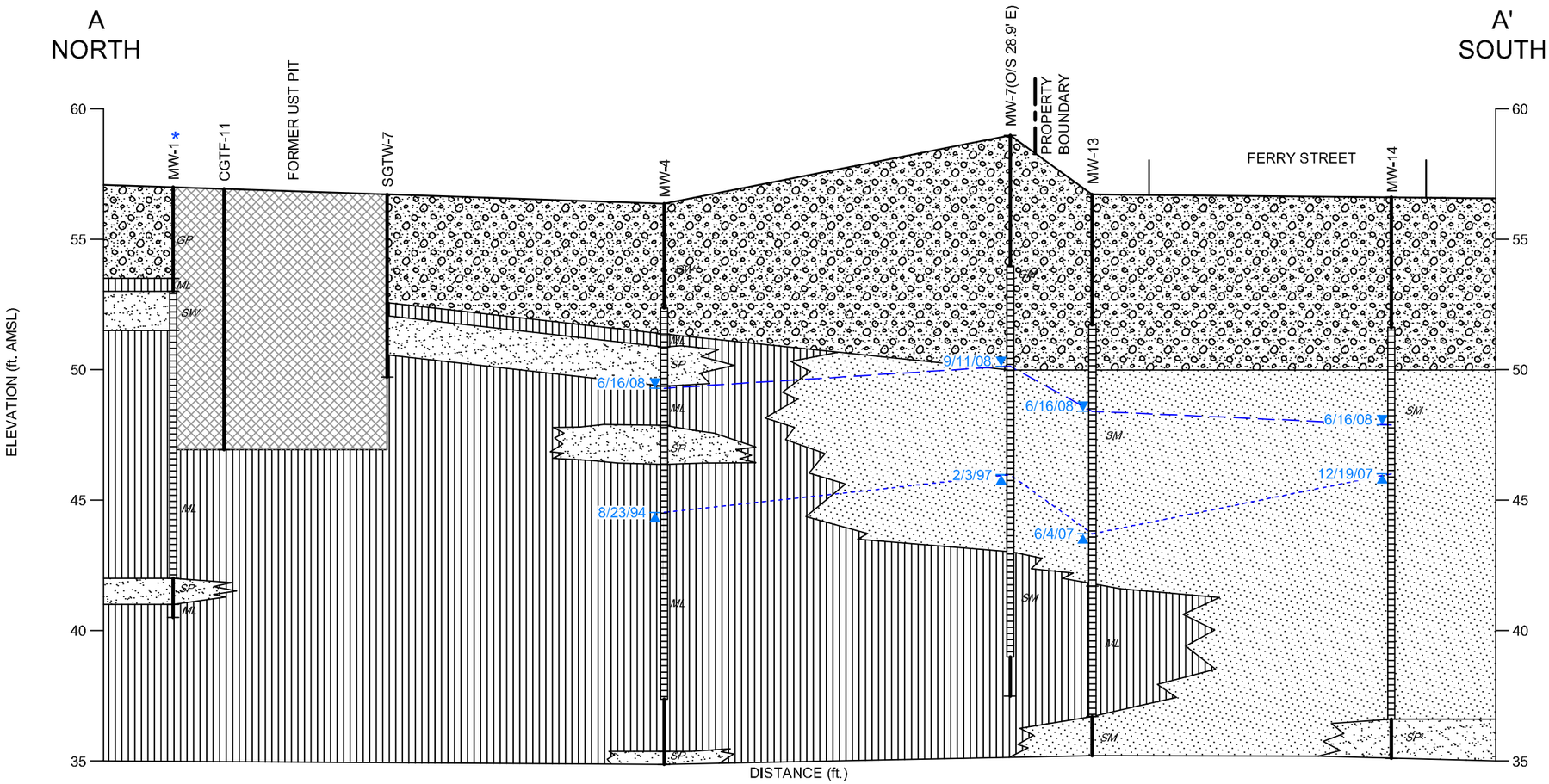
figure 2

SITE ASSESSMENT SITE PLAN
FORMER CHEVRON STATION 9-7502
124 FERRY STREET
Sedro-Woolley, Washington

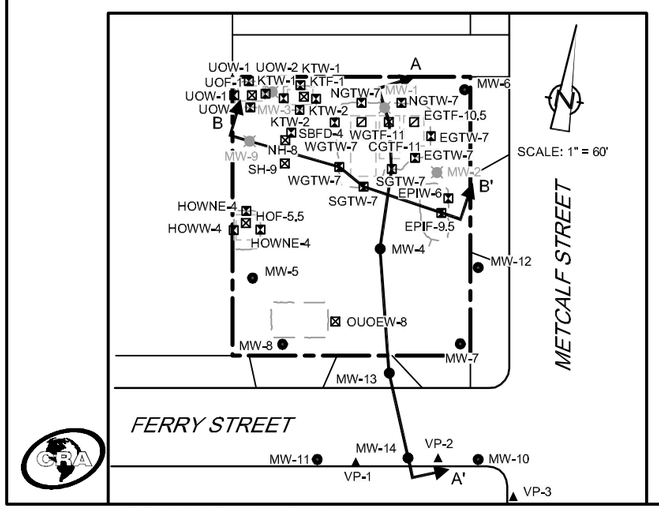
60041-2007(PRES002)GN-WA012 NOV 14/2008

A
NORTH

A'
SOUTH



SCALE: HORZ. 1"=15'
VERT. 1"=5'



LEGEND

- MW-2 — WELL DESIGNATION
- GROUND SURFACE
- OBSERVATION WELL INSTALLATION
- STRATIGRAPHIC BOUNDARY
- CL — TYPICAL SOIL CLASSIFICATION
- SCREENED INTERVAL
- BOTTOM OF BORING

- DATE ▼ MAXIMUM GROUNDWATER DEPTH
- DATE ▲ MINIMUM GROUNDWATER DEPTH
- * ABANDONED MONITORING WELL LOCATION

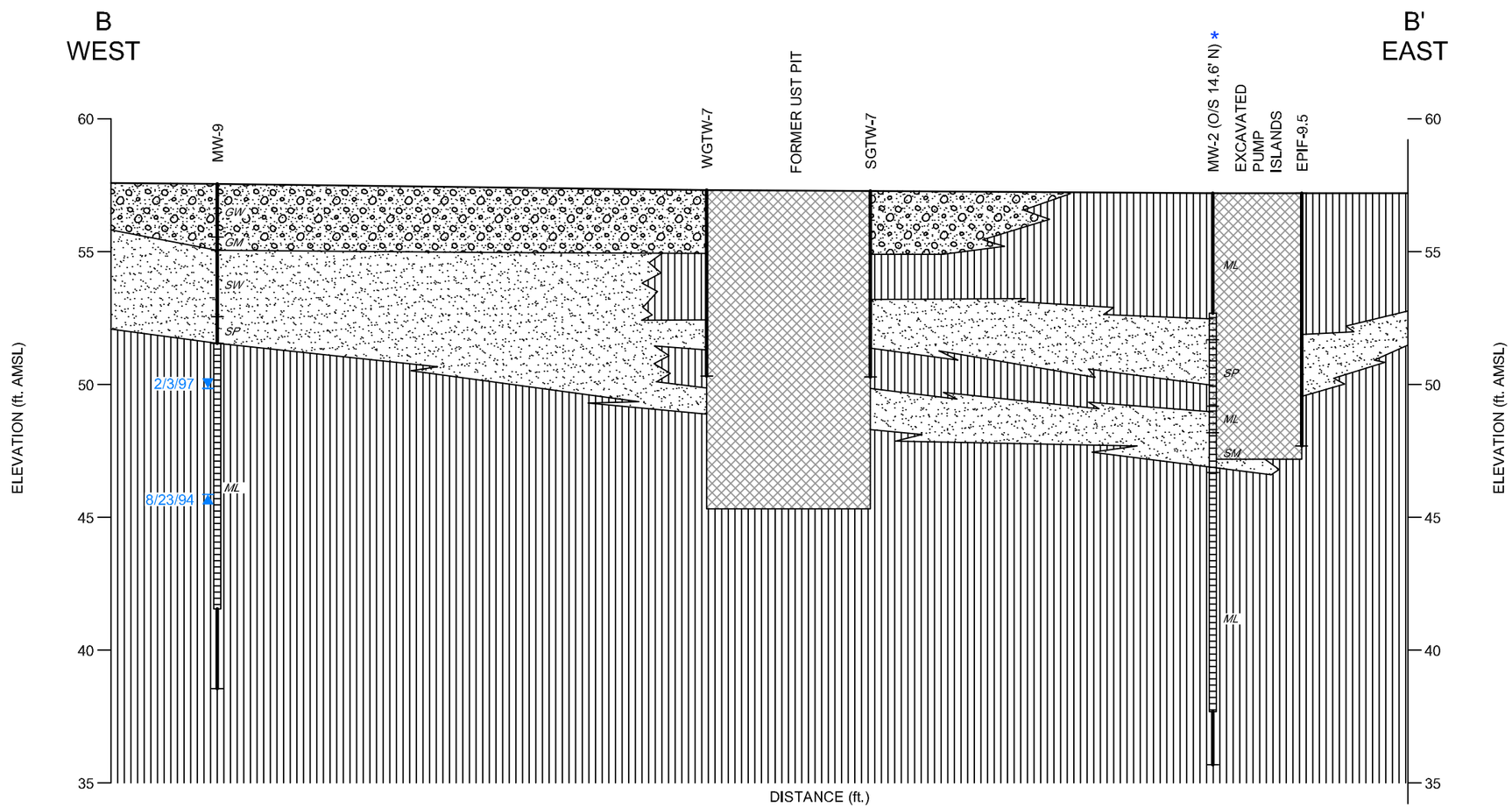
- BACKFILL
- ML
- SP
- GM
- SM

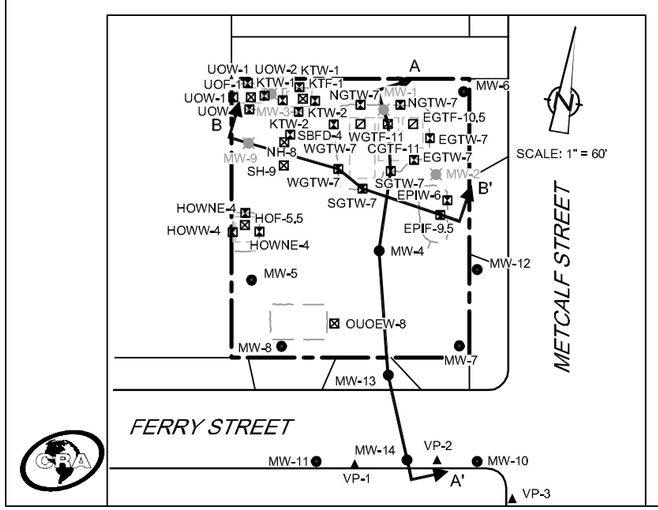
- HISTORIC LOW GROUNDWATER ELEVATION (AMSL)
- HISTORIC HIGH GROUNDWATER ELEVATION (AMSL)

figure 3

CROSS-SECTION A-A' WITH HISTORIC HIGH AND LOW GROUNDWATER ELEVATIONS
FORMER CHEVRON STATION NO. 9-7502
124 FERRY STREET
Sedro Woolley, Washington

60041-2008(PRES003)GN-WA003 NOV 20/2008





LEGEND

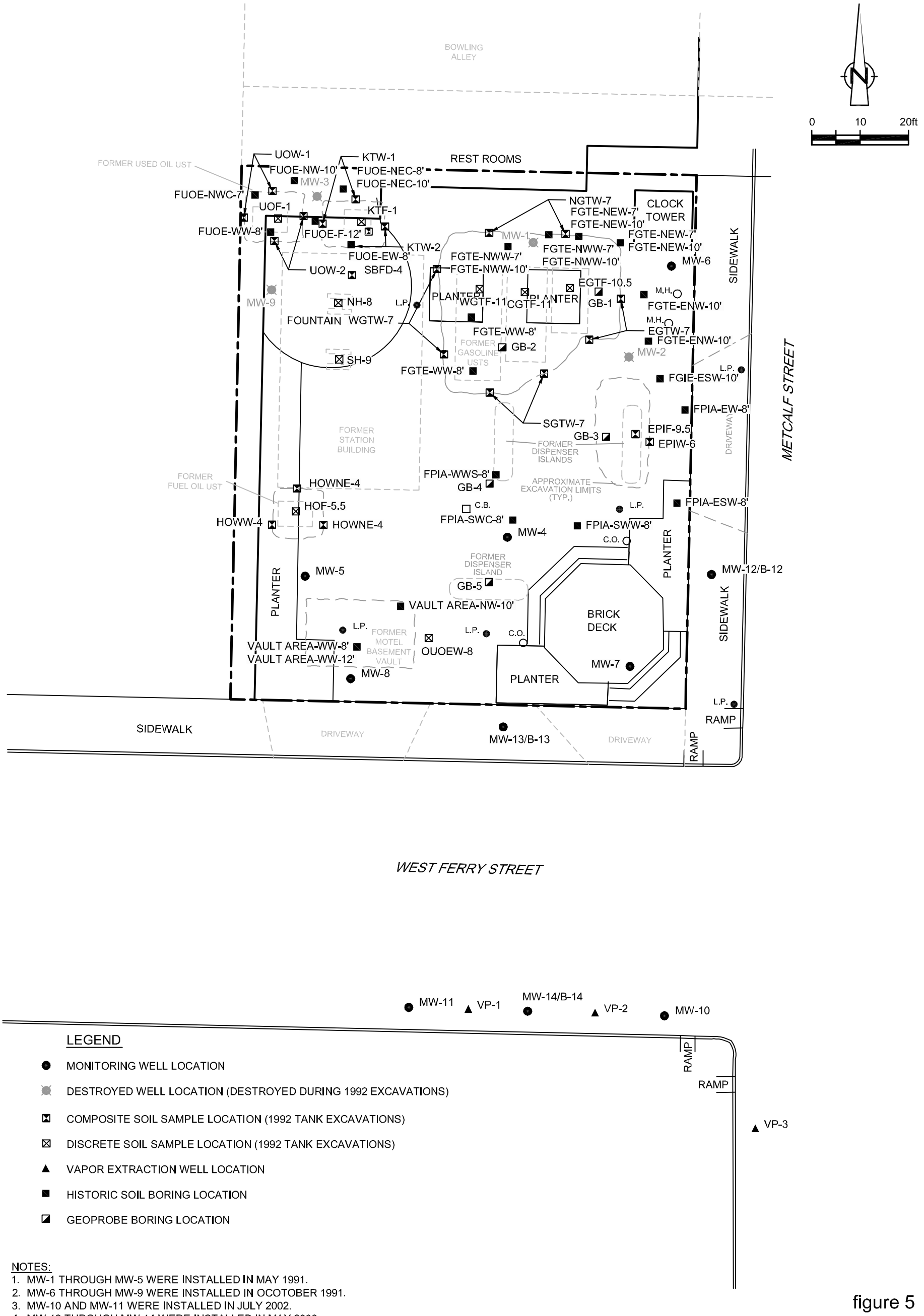
MW-2 — WELL DESIGNATION
GROUND SURFACE — OBSERVATION WELL INSTALLATION
STRATIGRAPHIC BOUNDARY
CL — TYPICAL SOIL CLASSIFICATION
SCREENED INTERVAL
BOTTOM OF BORING

DATE ▼ MAXIMUM GROUNDWATER DEPTH
DATE ▲ MINIMUM GROUNDWATER DEPTH
* ABANDONED MONITORING WELL LOCATION

BACKFILL
ML
SP
GM

figure 4

CROSS-SECTION B-B' WITH HISTORIC HIGH AND LOW GROUNDWATER ELEVATIONS
FORMER CHEVRON STATION NO. 9-7502
124 FERRY STREET
Sedro Woolley, Washington



LEGEND

- MONITORING WELL LOCATION
- DESTROYED WELL LOCATION (DESTROYED DURING 1992 EXCAVATIONS)
- COMPOSITE SOIL SAMPLE LOCATION (1992 TANK EXCAVATIONS)
- DISCRETE SOIL SAMPLE LOCATION (1992 TANK EXCAVATIONS)
- VAPOR EXTRACTION WELL LOCATION
- HISTORIC SOIL BORING LOCATION
- GEOPROBE BORING LOCATION

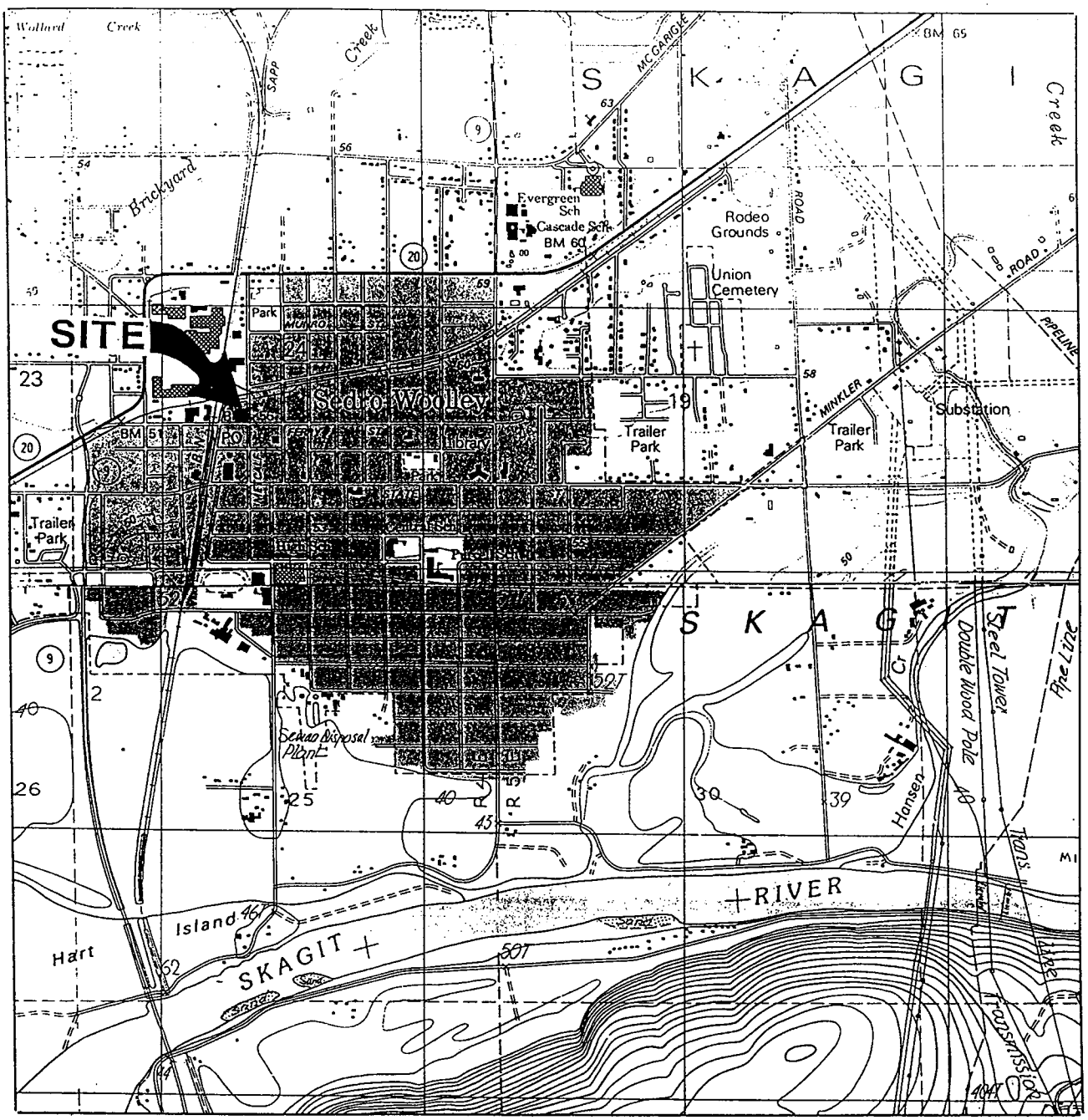
NOTES:
1. MW-1 THROUGH MW-5 WERE INSTALLED IN MAY 1991.
2. MW-6 THROUGH MW-9 WERE INSTALLED IN OCOTOBER 1991.
3. MW-10 AND MW-11 WERE INSTALLED IN JULY 2002.
4. MW-12 THROUGH MW-14 WERE INSTALLED IN MAY 2006.

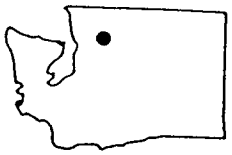
figure 5

SITE PLAN
FORMER CHEVRON STATION 9-7502
124 FERRY STREET
Sedro-Woolley, Washington

60041-2007(PRES002)GN-WA010 NOV 12/2008

142322





WASHINGTON

N

0 2000 4000

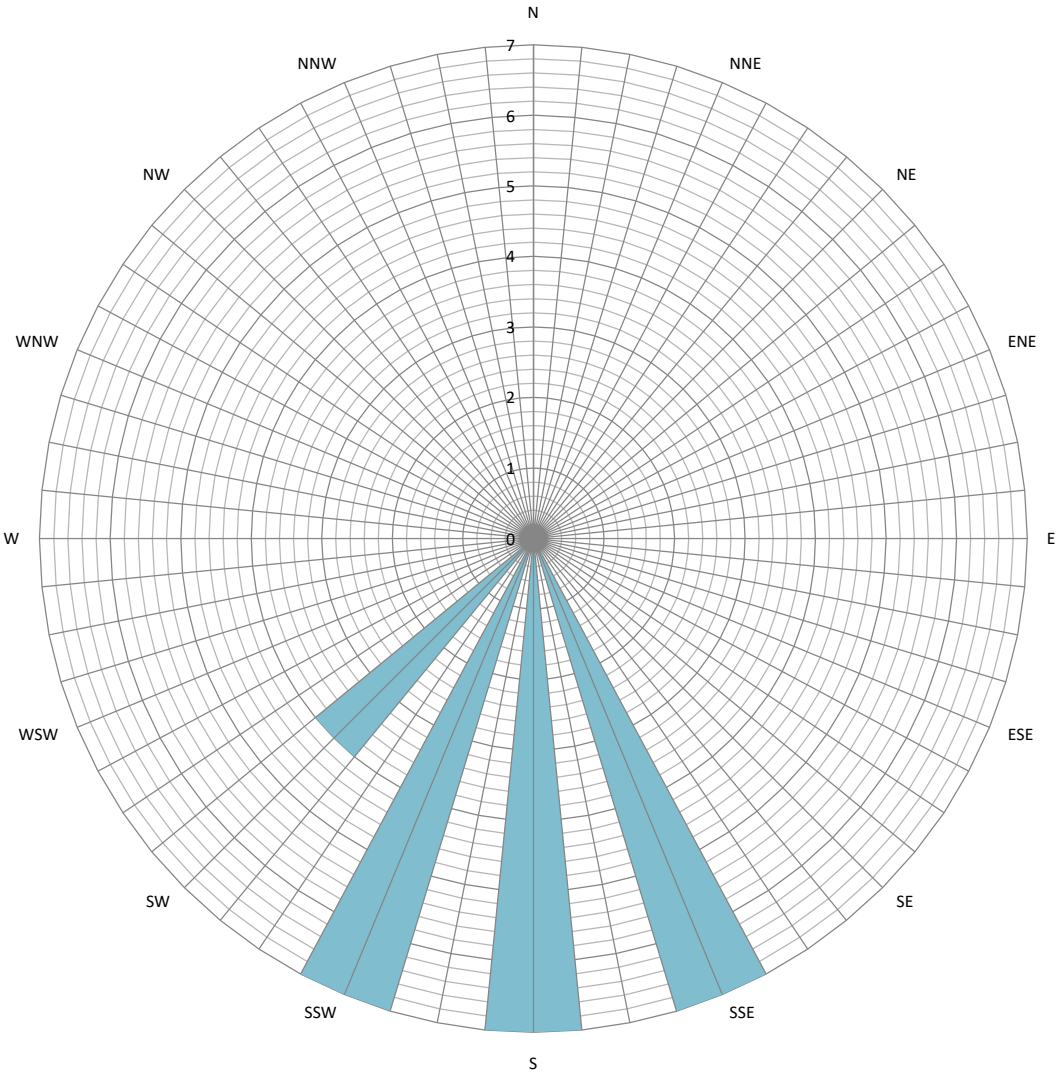
SCALE(ft)

Source: U.S.G.S. 7.5 Min. Quadrangle Map. Sedro-Woolley South (1985), Sedro-Woolley North (1981).

emcon Northwest, Inc.

DATE 1-91
DWN. JA
APPR. DG
REVIS.
PROJECT NO. 0311-025.01

Figure 1
CHEVRON U.S.A. PRODUCTS COMPANY
FACILITY #60097502
SEDRO WOOLLEY, WASHINGTON
SITE LOCATION MAP



Legend

N=North
NNE= North Northeast
NE= Northeast
ENE= East Northeast
E= East
ESE= East Southeast
SE=Southeast
SSE= South Southeast
S= South
SW= Southwest
SSW= South Southwest
WSW= West South West
W= West
WNW= West Northwest
NW=Northwest
NNW= North Northwest

Note

Rose diagram based on gradient calculations from 25 groundwater monitoring events conducted by Statewide Land Survey, Inc. since top of casing survey in 2007.

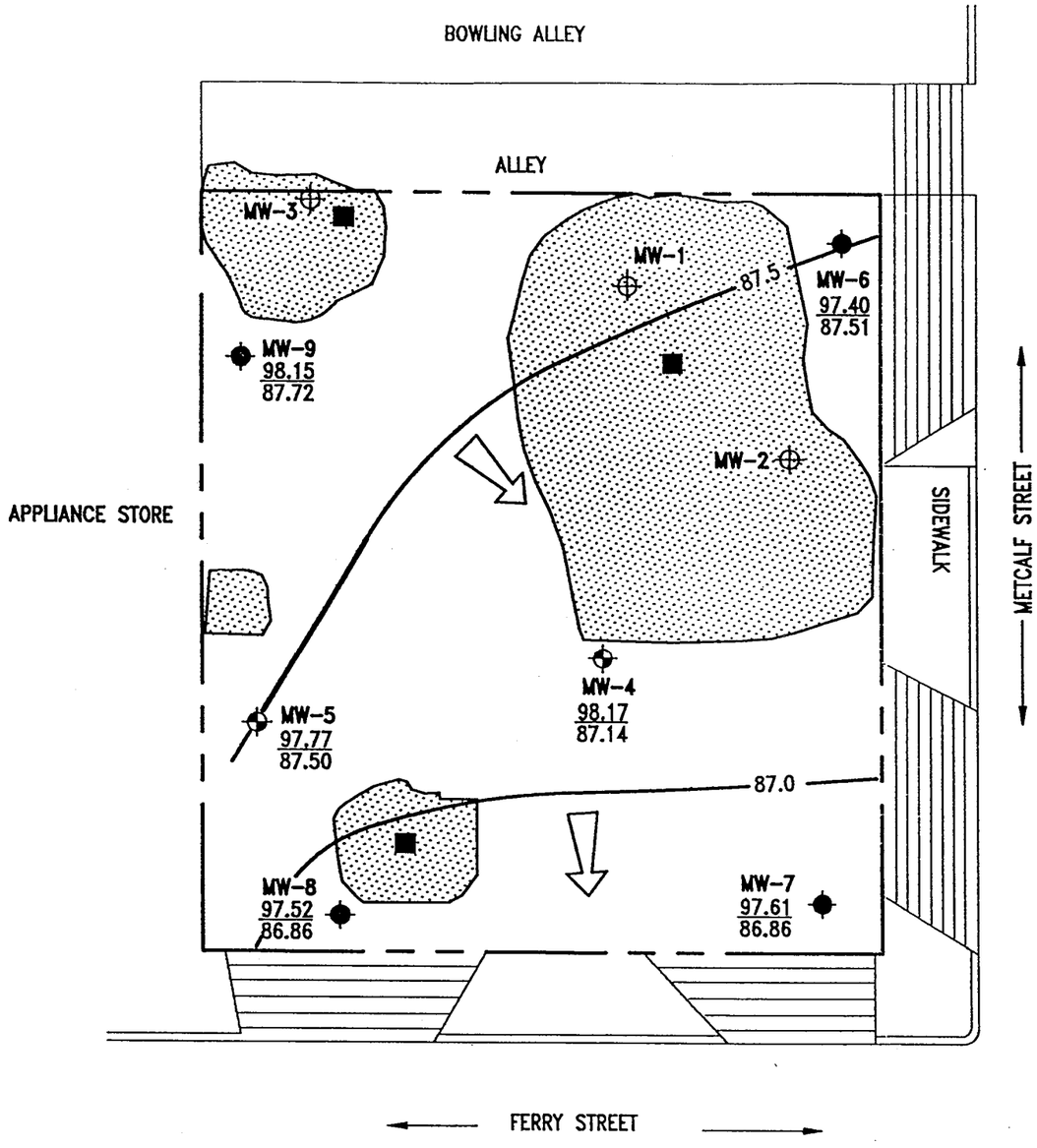
Number of Events Observed = 25

FORMER CHEVRON STATION 9-7502
640 METCALF STREET
SEDRO-WOOLLEY, WASHINGTON

HISTORICAL GROUNDWATER GRADIENT DIRECTION ROSE DIAGRAM

ARCADIS Design & Consultancy for natural and built assets

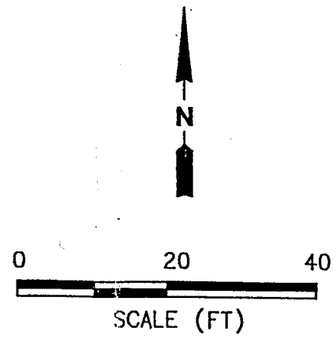
FIGURE D1



EXPLANATION:

- MW-6 — Approximate Location of 2" Diameter Monitoring Well
- MW-4 — Approximate Location of 4" Diameter Monitoring Well
- MW-1 — Approximate Location of Abandoned Monitoring Well
- ■ — Approximate Location of 10" Diameter PVC Casing
- Inferred Ground Water Elevation
- 87.0 — Contour (0.5 Ft. Contour Interval)
- 98.17 / 86.86 — Measuring Point Elevation * / Ground Water Elevation *
- Approximate Limits of Excavation
- Inferred Direction of Ground Water Migration

* Based on Arbitrary Datum of 100.00 Feet



NOTE:

Monitoring Wells MW-1, MW-2 and MW-3 removed during excavation activities

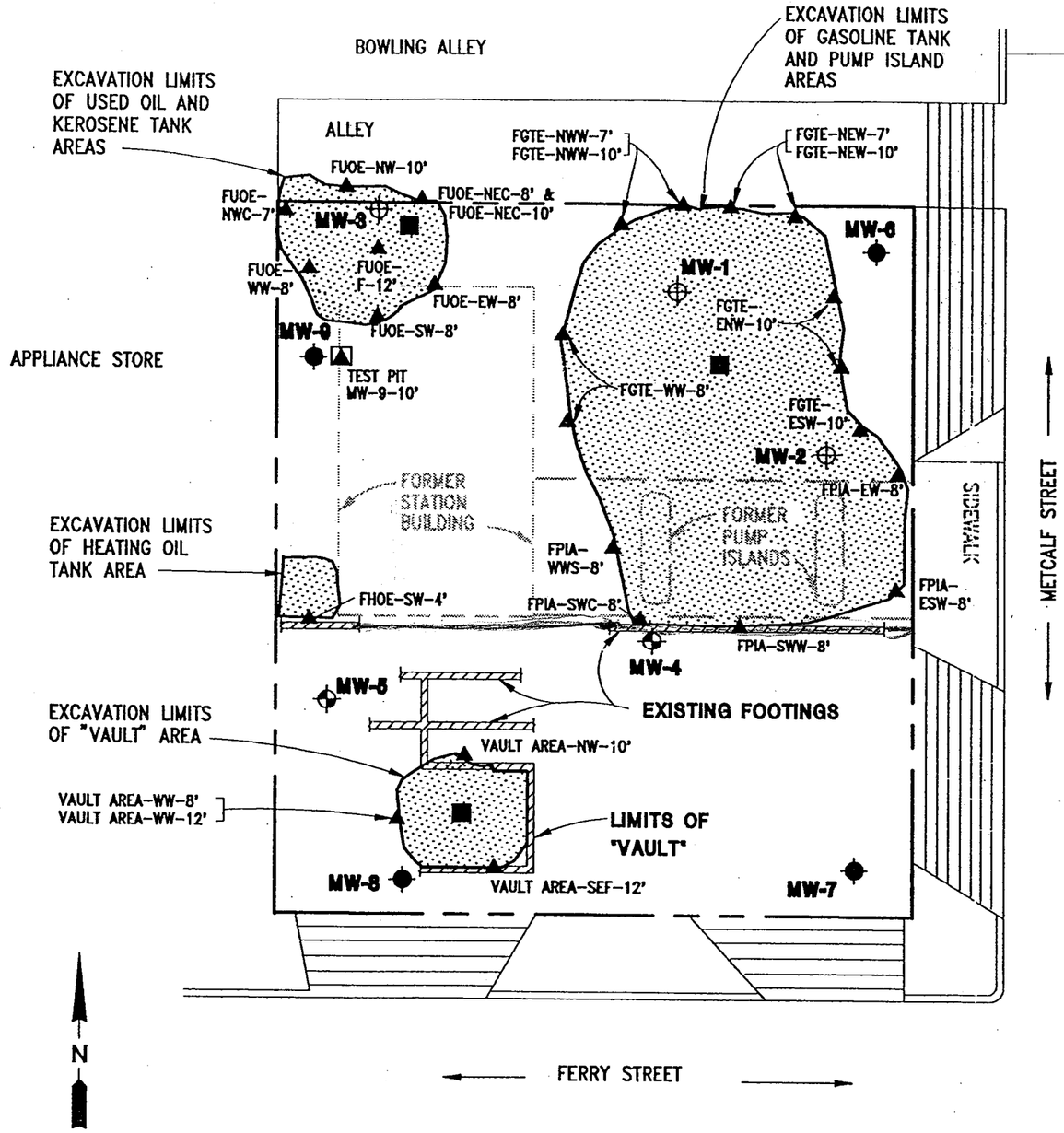
Source: Standard Oil Company of California Western Operations, Inc. Ground Plan, December 28, 1965.

EMCON Northwest, Inc.

DATE	11-92
DWN.	MLP
REV.	
APPR.	JLJ
PROJECT NO.	0311-025.01

Figure 4
CHEVRON U.S.A. PRODUCTS COMPANY
FACILITY #60097502
SEDRO WOOLLEY, WASHINGTON
MONITORING WELL LOCATIONS AND GROUND WATER ELEVATION CONTOUR MAP (SEPT. 24, 1992)

I=20 D:\0311\025\01C02 1-20-93



EXPLANATION:

- MW-6 ⊕ Approximate Location of 2" Diameter Monitoring Well
- MW-4 ⊕ Approximate Location of 4" Diameter Monitoring Well
- MW-1 ⊕ Approximate Location of Abandoned Monitoring Well
- ■ Approximate Location of 10" Diameter PVC Casing
- □ Test Pit
- Approximate Location of Exposed Concrete Footing
- Approximate Location of Former Station Building and Pump Island
- Approximate Limits of Excavation
- ▲ Approximate Location of Soil Sample

SOIL SAMPLE LIST

Sample	Sample Location
GASOLINE TANK AREA EXCAVATION	
FGTE-NWW-10'	North Wall, Western Section
FGTE-NEW-10'*	North Wall, Eastern Section
FGTE-ENW-10'*	East Wall, Northern Section
FGTE-ESW-10'	East Wall, Southern Section
FGTE-NWW-7'*	North Wall, Western Section
FGTE-NEW-7'*	North Wall, Eastern Section
FGTE-WW-8'*	West Wall
USED OIL AND KEROSENE TANK AREA EXCAVATION	
FUOE-SW-8'	South Wall
FUOE-F-12'	Floor
FUOE-NEC-8'	Northeast Corner
FUOE-EW-8'	East Wall
FUOE-NW-10'	North Wall
FUOE-NEC-10'	Northeast Corner
FUOE-WW-8'	West Wall
FUOE-NWC-7'	Northwest Corner
TEST PIT	
TEST PIT MW-9-10'	TEST PIT EAST OF MW-9

Sample	Sample Location
PUMP ISLAND AREA EXCAVATION	
FPIA-EW-8'	East Wall
FPIA-ESW-8'	East Wall, Southern Section
FPIA-WWS-8'	West Wall, Southern Section
FPIA-SWC-8'	Southwest Corner
FPIA-SWW-8'	Southwest Wall
FORMER HEATING OIL TANK AREA EXCAVATION	
FHOE-SW-4'	South Wall
VAULT AREA EXCAVATION	
VAULT AREA-WW-8'	West Wall
VAULT AREA-NW-10'	North Wall
VAULT AREA-SEF-12'	South East Floor
VAULT AREA-WW-12'	West Wall

* Consists of 2 discrete samples which were composited by the analytical laboratory.

NOTE:

Monitoring Wells MW-1, MW-2 and MW-3 removed during excavation activities

Source: Standard Oil Company of California Western Operations, Inc. Ground Plan, December 28, 1965.

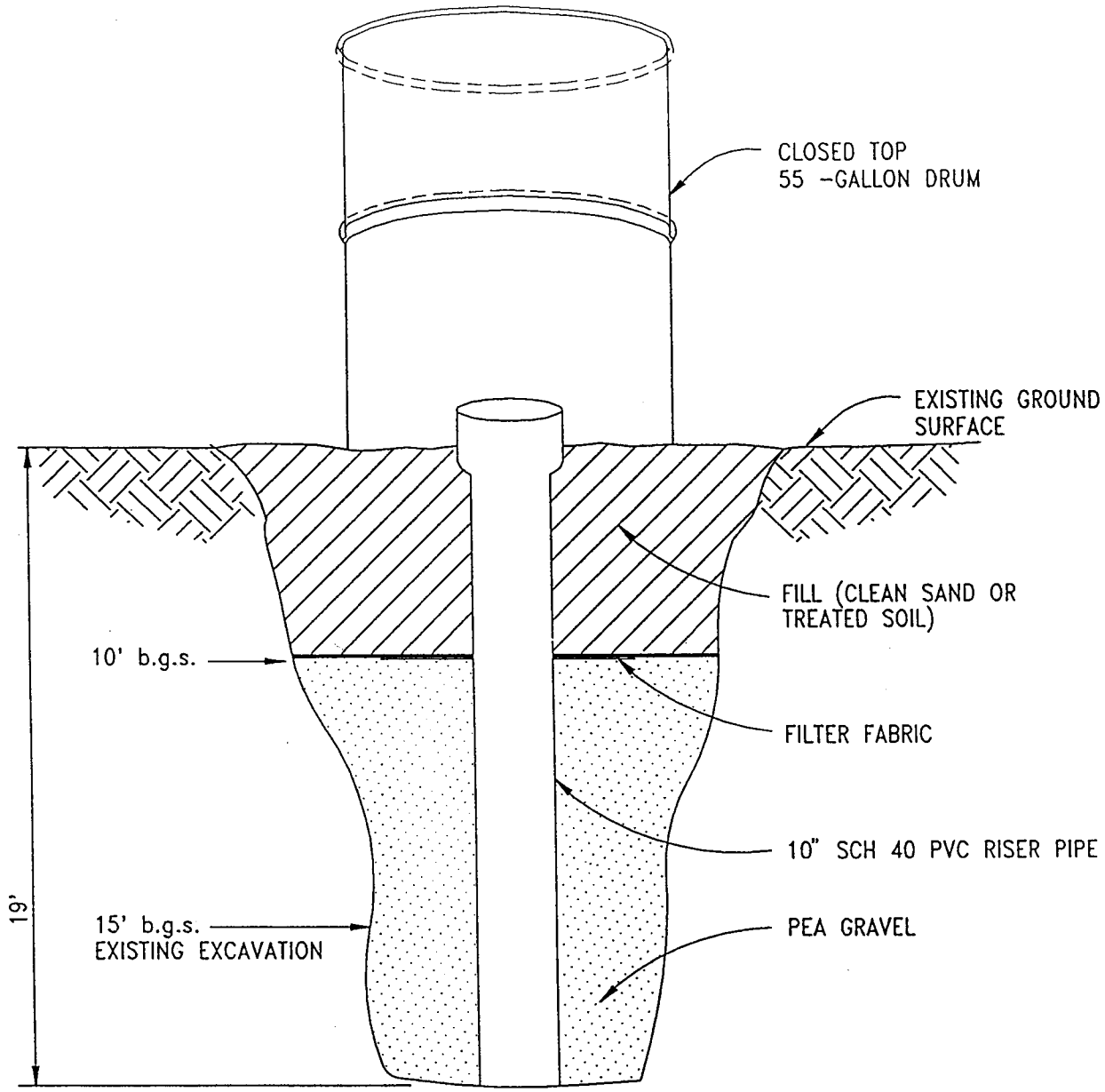
0 20 40
SCALE (FT)

EMCON Northwest, Inc.

DATE 1-93
DWN. JG
REV.
APPR. JLJ
PROJECT NO.
0311-025.01

Figure 2
CHEVRON U.S.A. PRODUCTS COMPANY
FACILITY #60097502
SEDRO WOOLLEY, WASHINGTON
SITE PLAN AND SOIL SAMPLE LOCATIONS

I=20 D:\0311\025\01C01 1-20-93



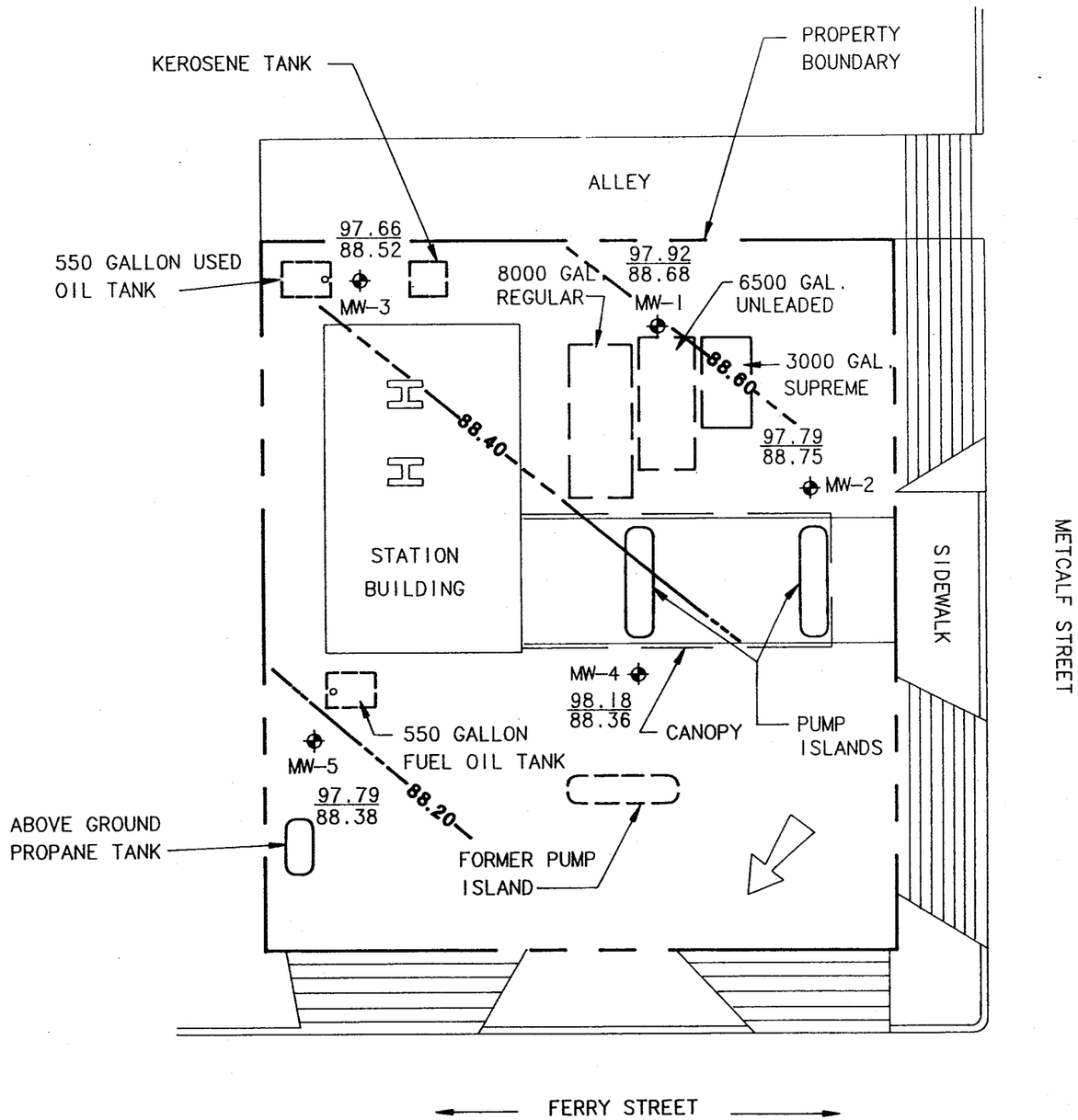
Not To Scale

Emcon Northwest, Inc.

DATE 1/93
DWN. JG
REV.
APPR. JLJ
PROJECT NO.
0311025.01

Figure 3
CHEVRON U.S.A PRODUCTS COMPANY
FACILITY #60097502
SEDRO WOOLLEY, WASHINGTON
10" DIA. PVC CASING CONSTRUCTION DETAILS

1= 1 01-21-93 J:\DATA\DWG\0311\025\01C03



EXPLANATION:

- APPROXIMATE LOCATION OF 4" DIAMETER MONITORING WELL
- 97.92 — MEASURING POINT ELEVATION *
- 88.68 — GROUND WATER ELEVATION *
- INFERRED DIRECTION OF GROUND WATER MIGRATION
- * BASED ON ARBITRARY DATUM
- 88.20 — INFERRED GROUND WATER ELEVATION CONTOUR

N

0 20 40

SCALE (FT)

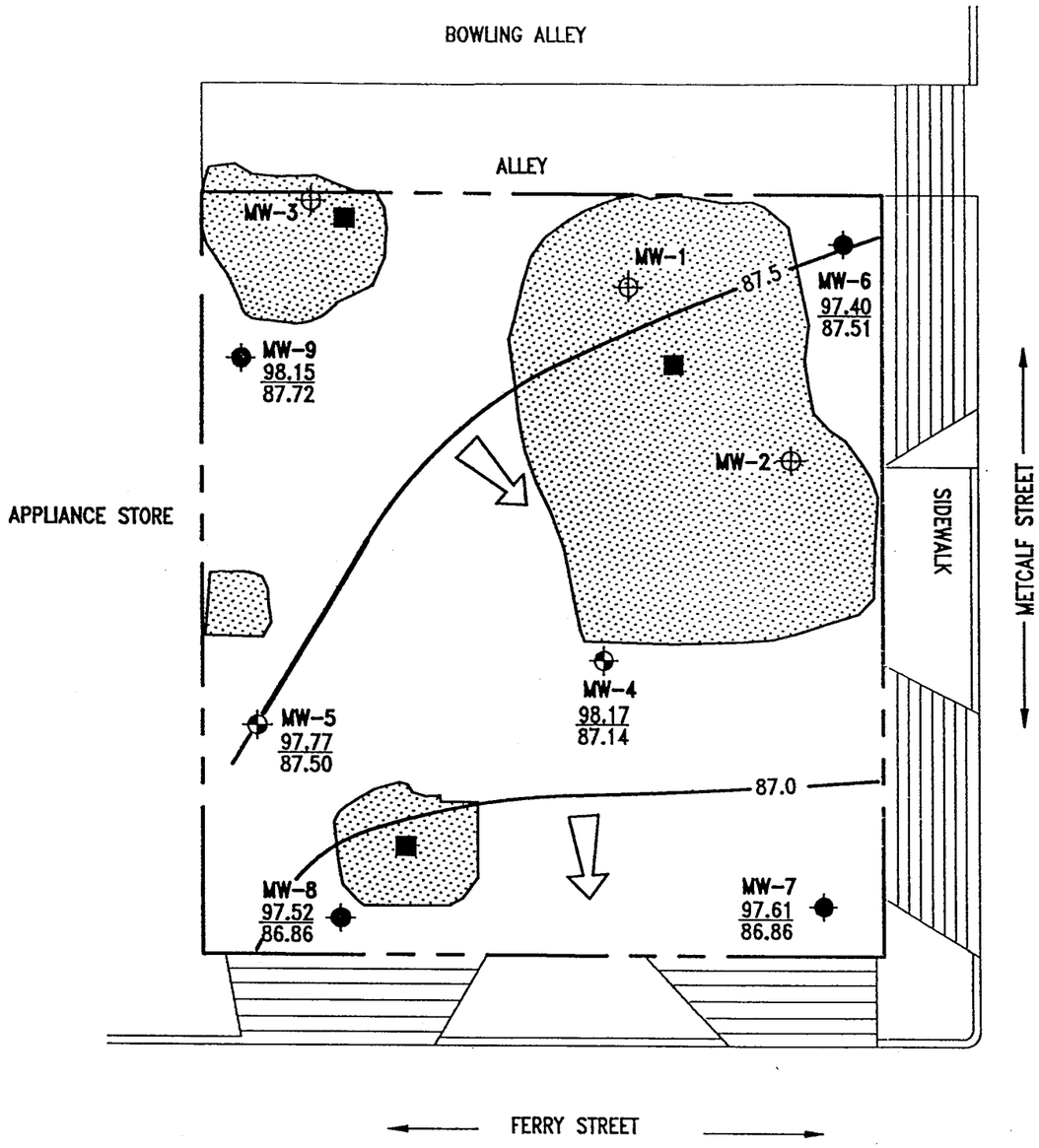
Sweet-Edwards
EMCON

Source: Standard Oil Company of California Western Operations, Inc. Ground Plan, December 28, 1965.

DATE 1-91
DWN. MLP
APPR. JJ
REVIS.
PROJECT NO. U1125.01

Figure 2
FACILITY 60097502/124 FERRY STREET
SEDRO WOOLLEY, WASHINGTON
SITE PLAN AND GROUND WATER SURFACE ELEVATION CONTOUR MAP FOR FEB. 12, 1991

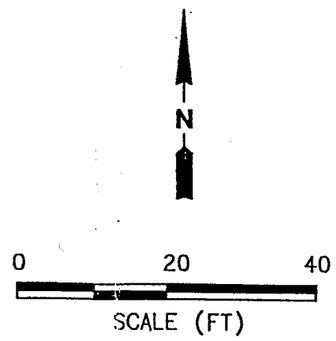
CADD FILE: CHEVRON\U1125-EP\2-28-91



EXPLANATION:

- MW-6 — Approximate Location of 2" Diameter Monitoring Well
- MW-4 — Approximate Location of 4" Diameter Monitoring Well
- MW-1 — Approximate Location of Abandoned Monitoring Well
- Approximate Location of 10" Diameter PVC Casing Inferred Ground Water Elevation
- 87.0 — Contour (0.5 Ft. Contour Interval)
- 98.17 — Measuring Point Elevation *
  86.86 — Ground Water Elevation *
- Approximate Limits of Excavation
- Inferred Direction of Ground Water Migration

* Based on Arbitrary Datum of 100.00 Feet



NOTE:

Monitoring Wells MW-1, MW-2 and MW-3 removed during excavation activities

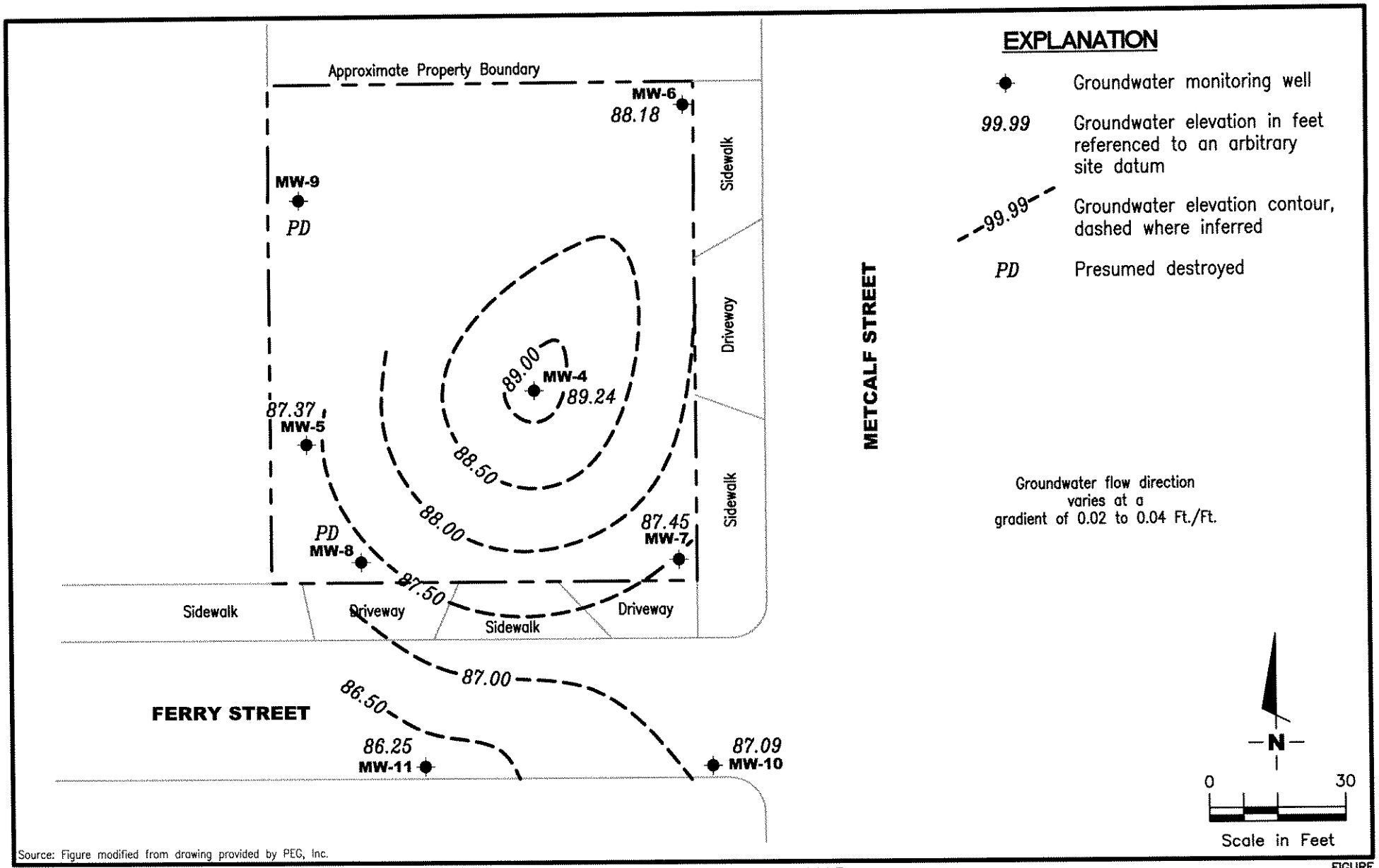
Source: Standard Oil Company of California Western Operations, Inc. Ground Plan, December 28, 1965.

EMCON Northwest, Inc.

DATE	11-92
DWN.	MLP
REV.	
APPR.	JLJ
PROJECT NO.	0311-025.01

Figure 4
CHEVRON U.S.A. PRODUCTS COMPANY
FACILITY #60097502
SEDRO WOOLLEY, WASHINGTON
MONITORING WELL LOCATIONS AND GROUND WATER ELEVATION CONTOUR MAP (SEPT. 24, 1992)

I=20 D:\0311\025\01C02 1-20-93



Source: Figure modified from drawing provided by PEG, Inc.

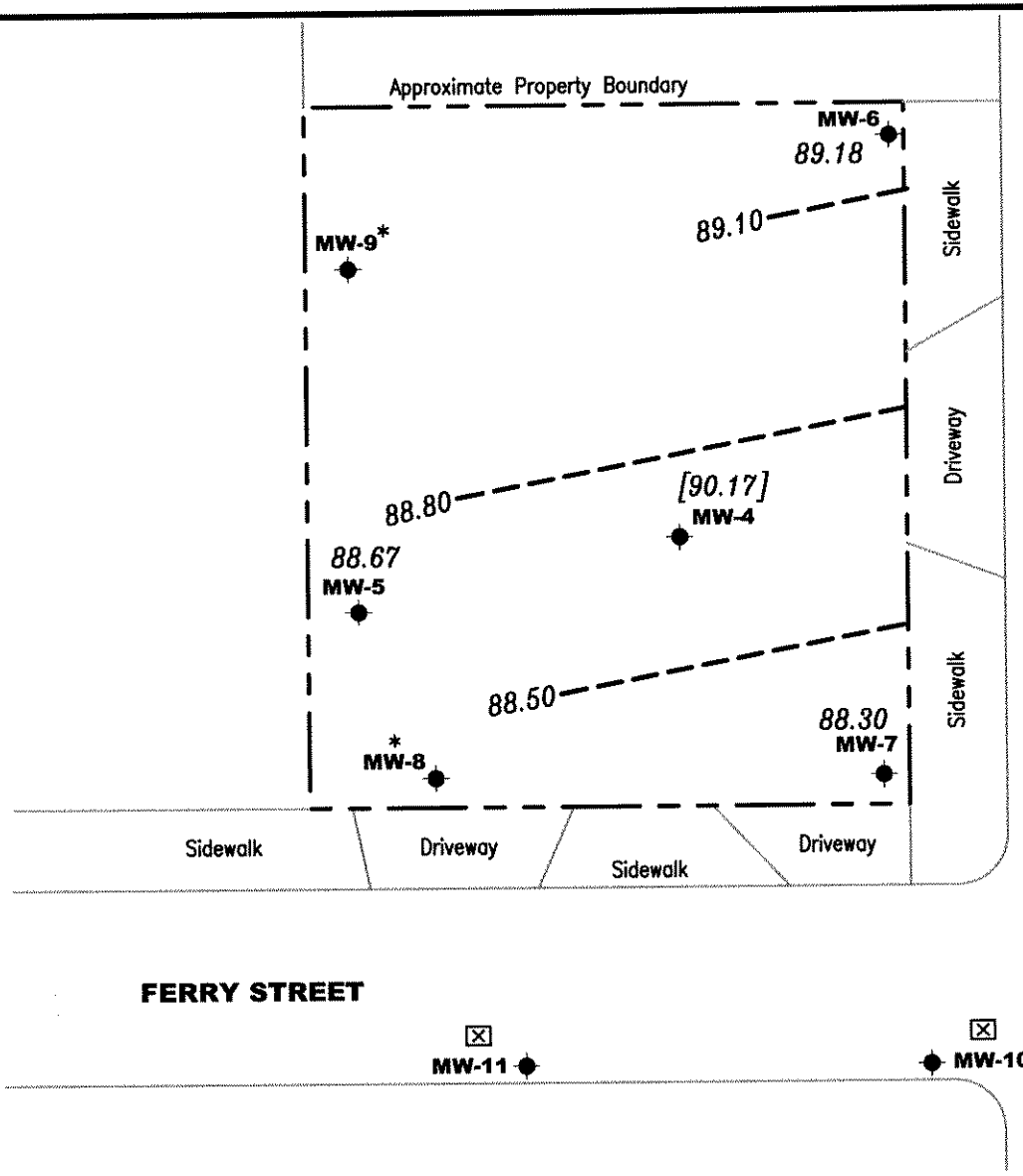
GETTLER - RYAN INC.
6747 Sierra Court, Suite J
Dublin, CA 94568 (925) 551-7555

POTENTIOMETRIC MAP
Former Chevron Service Station #9-7502
124 Ferry Street
Sedro Woolley, Washington

FIGURE
2

PROJECT NUMBER	REVIEWED BY	DATE	REVISED DATE
386657		September 15, 2005	

FILE NAME: P:\Enviro\Chevron\9-7502\Q05-9-7502.DWG | Layout Tab: Pot3



METCALF STREET

EXPLANATION

- ● Groundwater monitoring well
- *99.99* Groundwater elevation in feet referenced to an arbitrary site datum
- --99.99-- Groundwater elevation contour, dashed where inferred
- *[99.99]* Not used in contouring
- ☒ Inaccessible
- * Discontinued from monitoring/ sampling program

Approximate groundwater flow direction at a gradient of 0.009 Ft./Ft.

N

0 30

Scale in Feet

Source: Figure modified from drawing provided by PEG, Inc.

FIGURE 2

GETTLER - RYAN INC.
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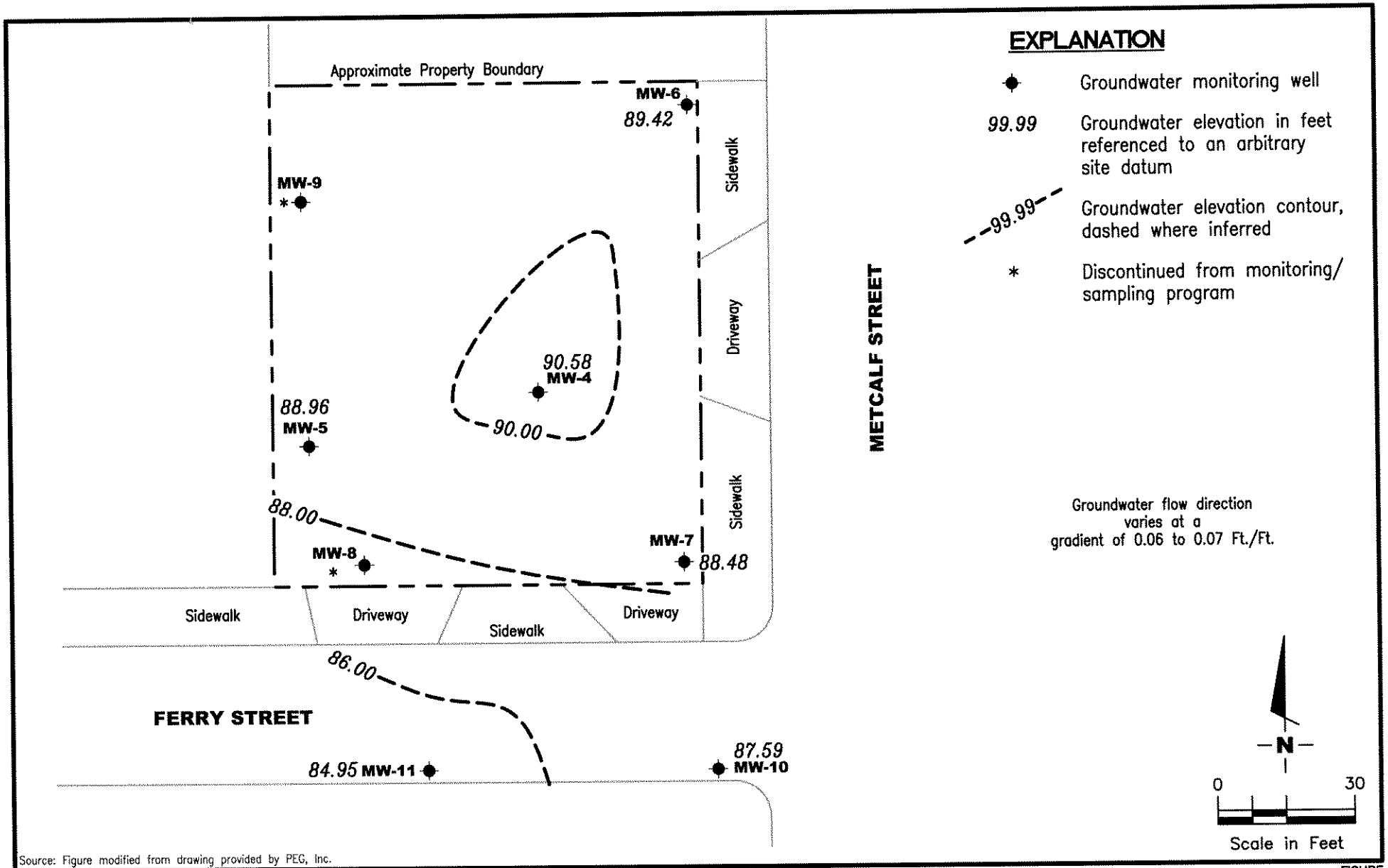
Dublin, CA 94568 (925) 551-7555

POTENTIOMETRIC MAP
Former Chevron Service Station #9-7502
124 Ferry Street
Sedro Woolley, Washington

PROJECT NUMBER	REVIEWED BY	DATE	REVISED DATE
386657		March 11, 2006	

FILE NAME: P:\Enviro\Chevron\9-7502\Q06-9-7502.DWG | Layout Tab: Pot1



Source: Figure modified from drawing provided by PEG, Inc.

GETTLER - RYAN INC.
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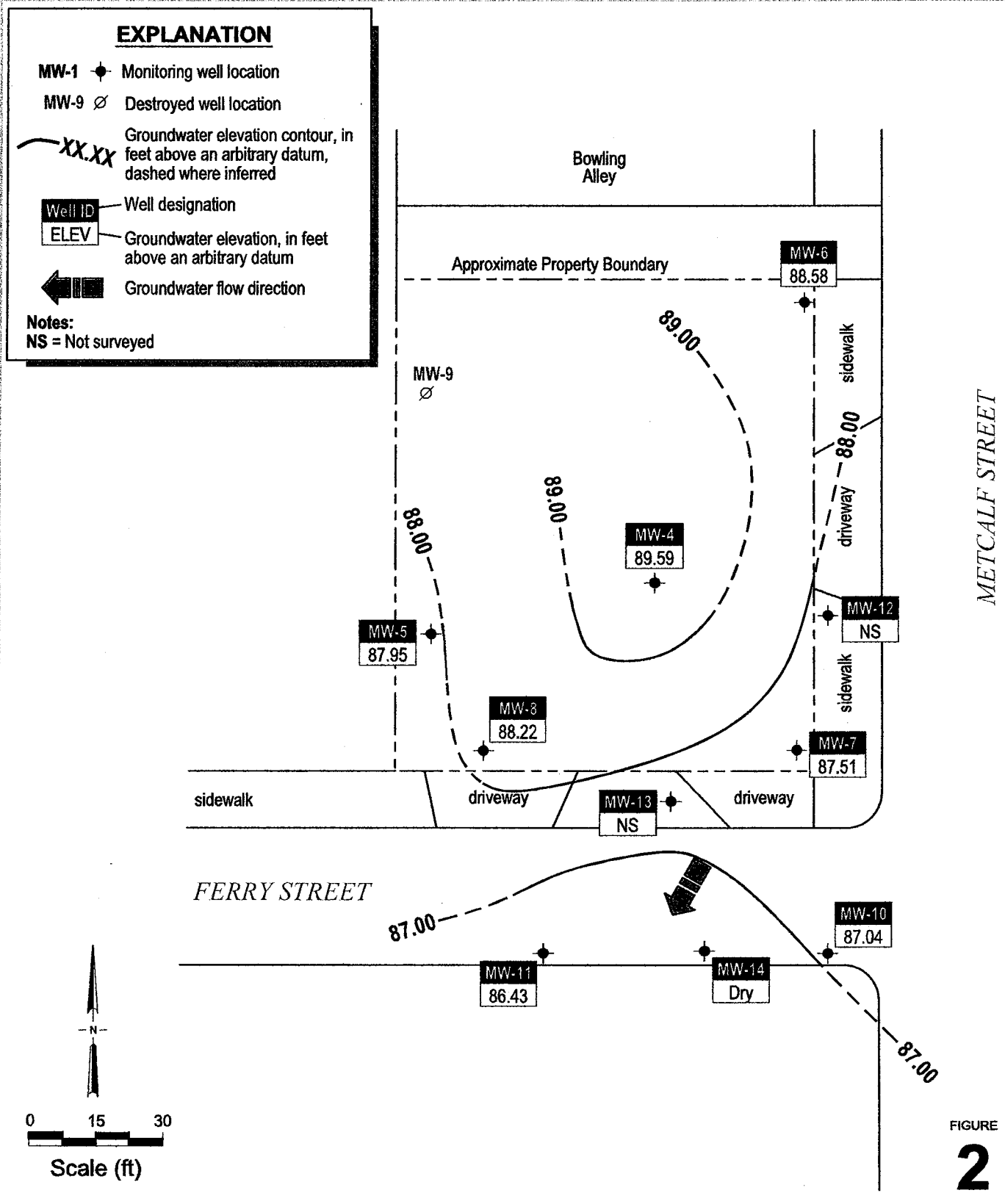
Dublin, CA 94568 (925) 551-7555

POTENTIOMETRIC MAP
Former Chevron Service Station #9-7502
124 Ferry Street
Sedro Woolley, Washington

FIGURE
2

PROJECT NUMBER	REVIEWED BY	DATE	REVISED DATE
386657		June 13, 2006	

FILE NAME: P:\Enviro\Chevron\9-7502\Q06-9-7502.DWG | Layout Tab: Pot2



FIGURE

2

M:\MT2-1\WA SITES\9-7502 SEDRO WOOLEY\FIGURES\9-7502_3Q06-GW.DWG

Chevron Service Station 9-7502

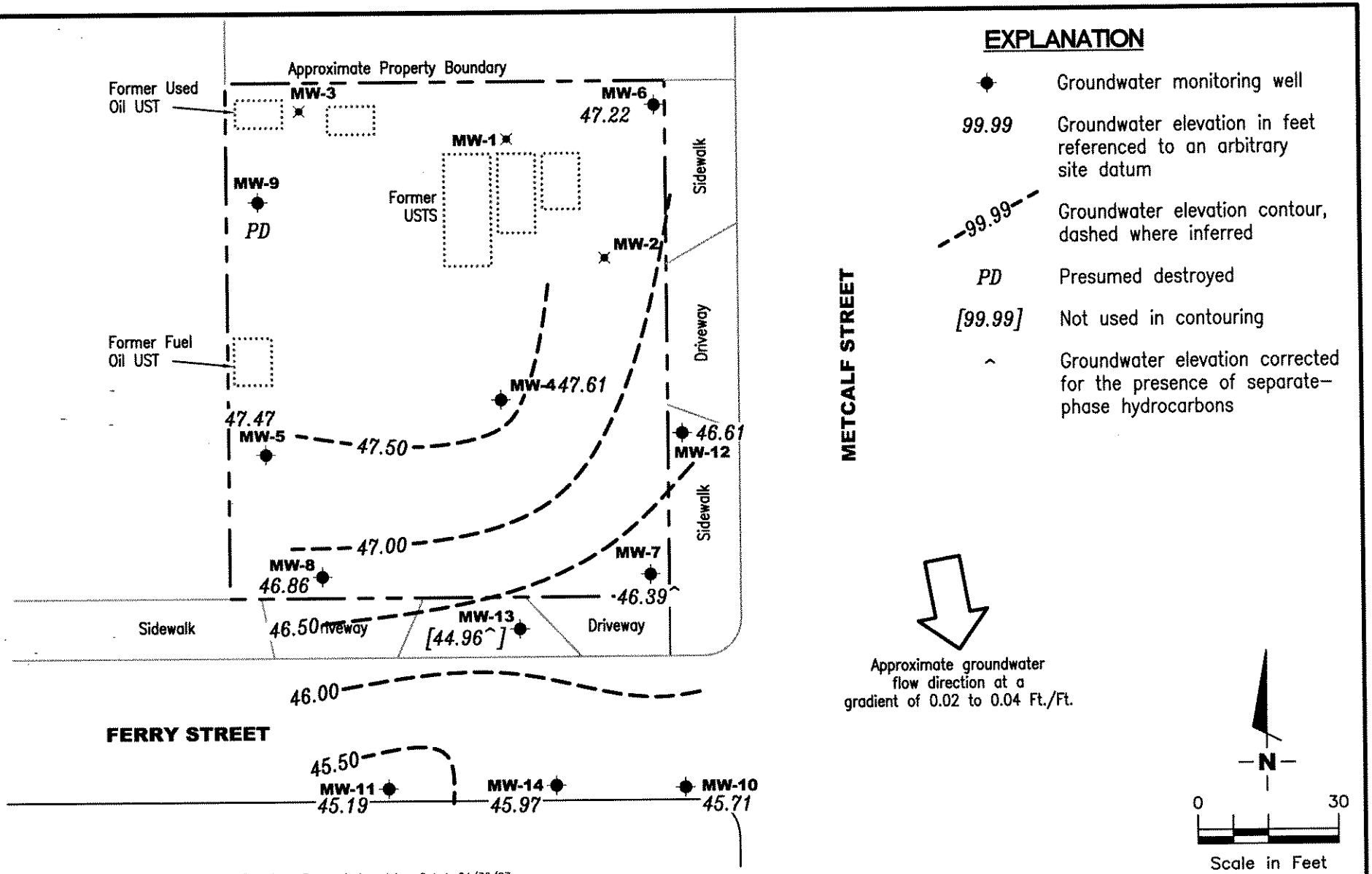
124 Ferry Street

Sedro Wooley, Washington

CAMBRIA

Groundwater Elevation Contour Map

August 10, 2006



Source: Figure modified from drawing provided by Conestoga-Rovers & Associates, Dated: 04/30/07

FIGURE

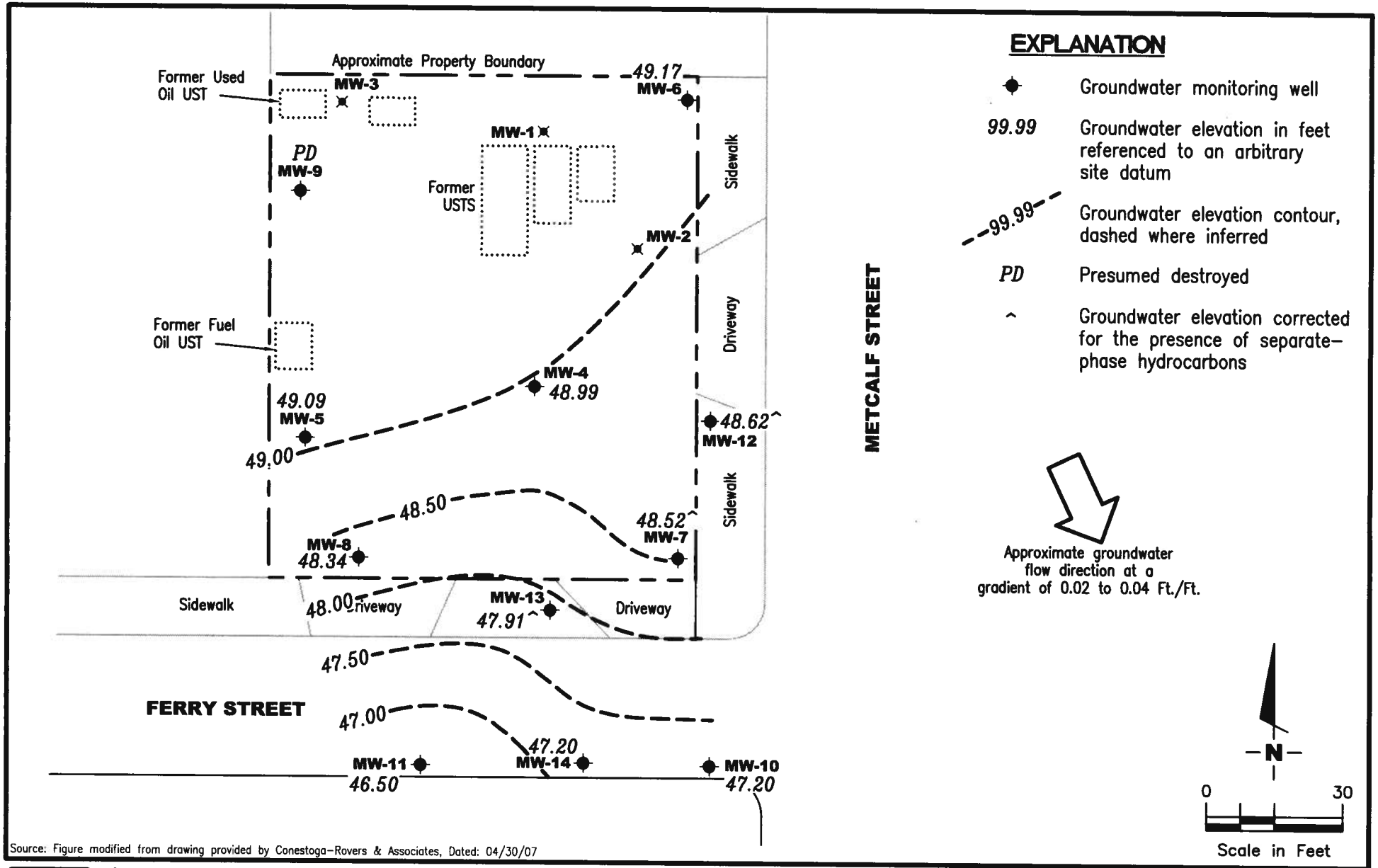
2

POTENTIOMETRIC MAP
Former Chevron Service Station #9-7502
124 Ferry Street
Sedro Woolley, Washington

GETTLER - RYAN INC.
6747 Sierra Court, Suite J
Dublin, CA 94568 (925) 551-7555

PROJECT NUMBER	REVIEWED BY	DATE	REVISED DATE
386657		September 5, 2007	

FILE NAME: P:\Enviro\Chevron\9-7502\Q07-9-7502.DWG | Layout Tab: Pot3



Source: Figure modified from drawing provided by Conestoga-Rovers & Associates, Dated: 04/30/07

GETTLER - RYAN INC.
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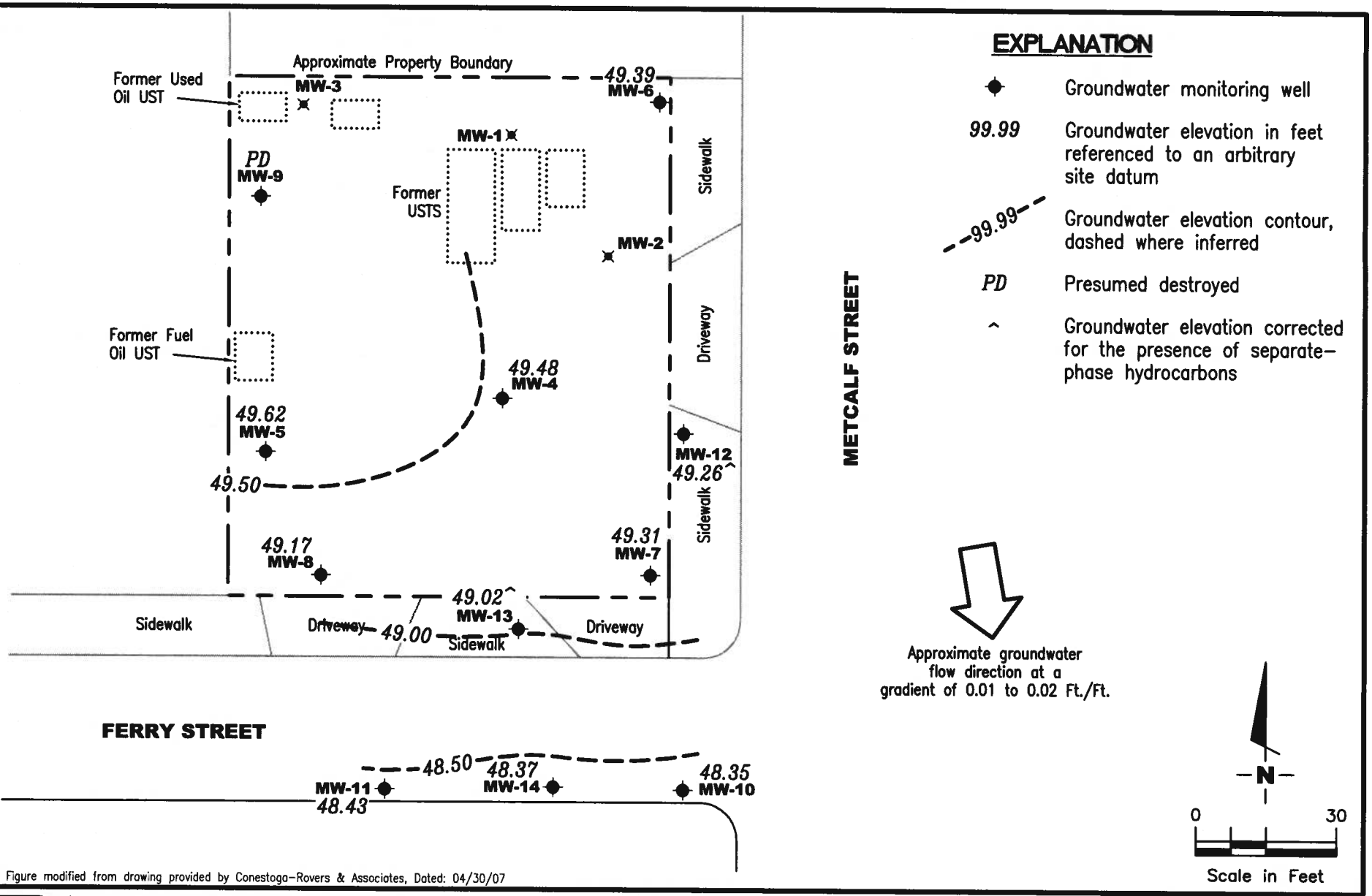
Dublin, CA 94568 (925) 551-7555

POTENTIOMETRIC MAP
Former Chevron Service Station #9-7502
124 Ferry Street
Sedro Woolley, Washington

FIGURE
2

PROJECT NUMBER	REVIEWED BY	DATE	REVISED DATE
386657		November 20, 2008	

FILE NAME: P:\Enviro\Chevron\9-7502\Q08-9-7502.DWG | Layout Tab: Pot4



Source: Figure modified from drawing provided by Conestoga-Rovers & Associates, Dated: 04/30/07

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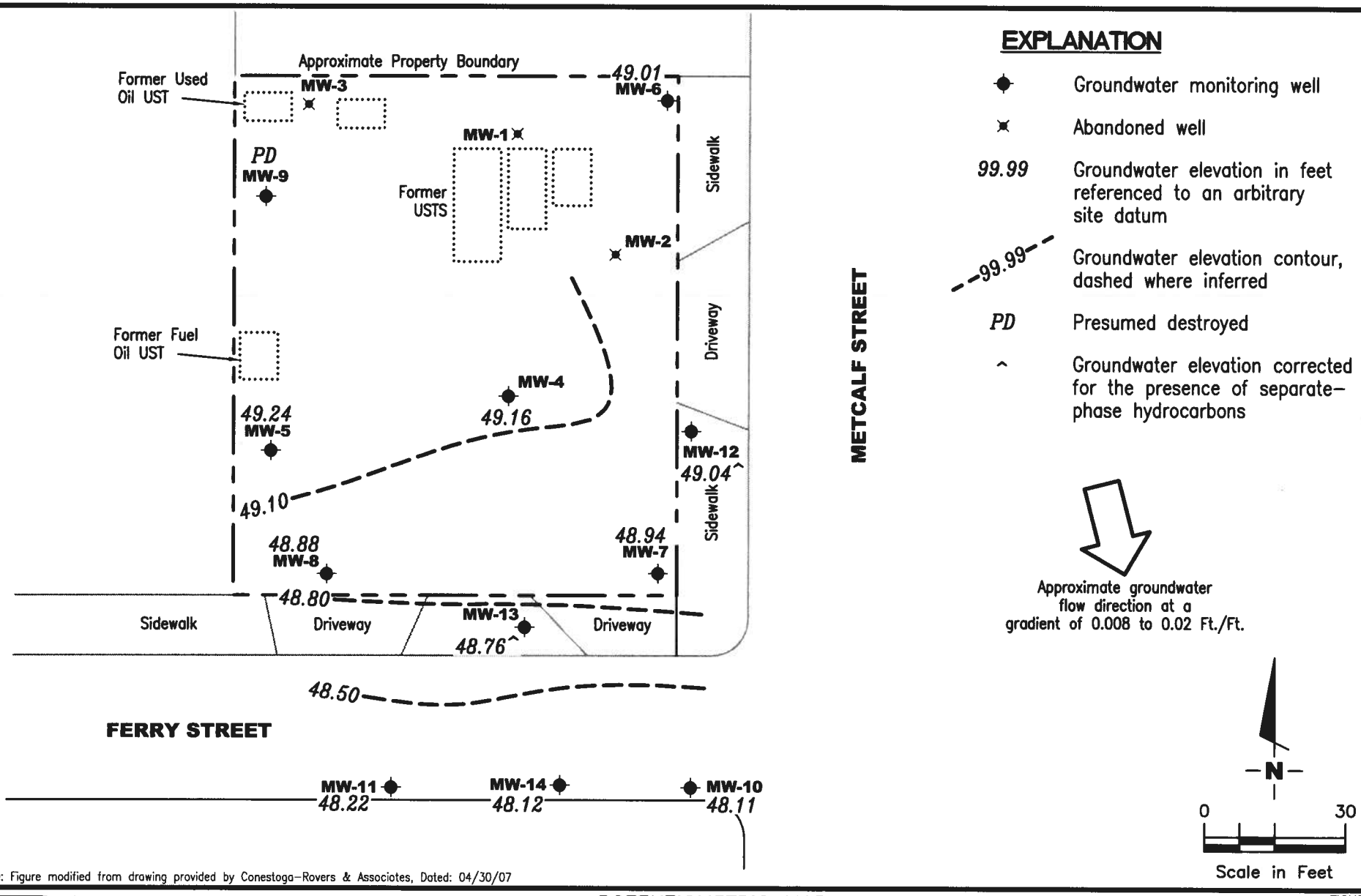
6747 Sierra Court, Suite J
Dublin, CA 94568 (925) 551-7555

POTENTIOMETRIC MAP
Former Chevron Service Station #9-7502
124 Ferry Street
Sedro Woolley, Washington

FIGURE
2

PROJECT NUMBER	REVIEWED BY	DATE	REVISED DATE
386657		March 4, 2009	

FILE NAME: P:\Enviro\Chevron\9-7502\Q09-9-7502.DWG | Layout Tab: Pot1



Source: Figure modified from drawing provided by Conestoga-Rovers & Associates, Dated: 04/30/07

GETTLER - RYAN INC.
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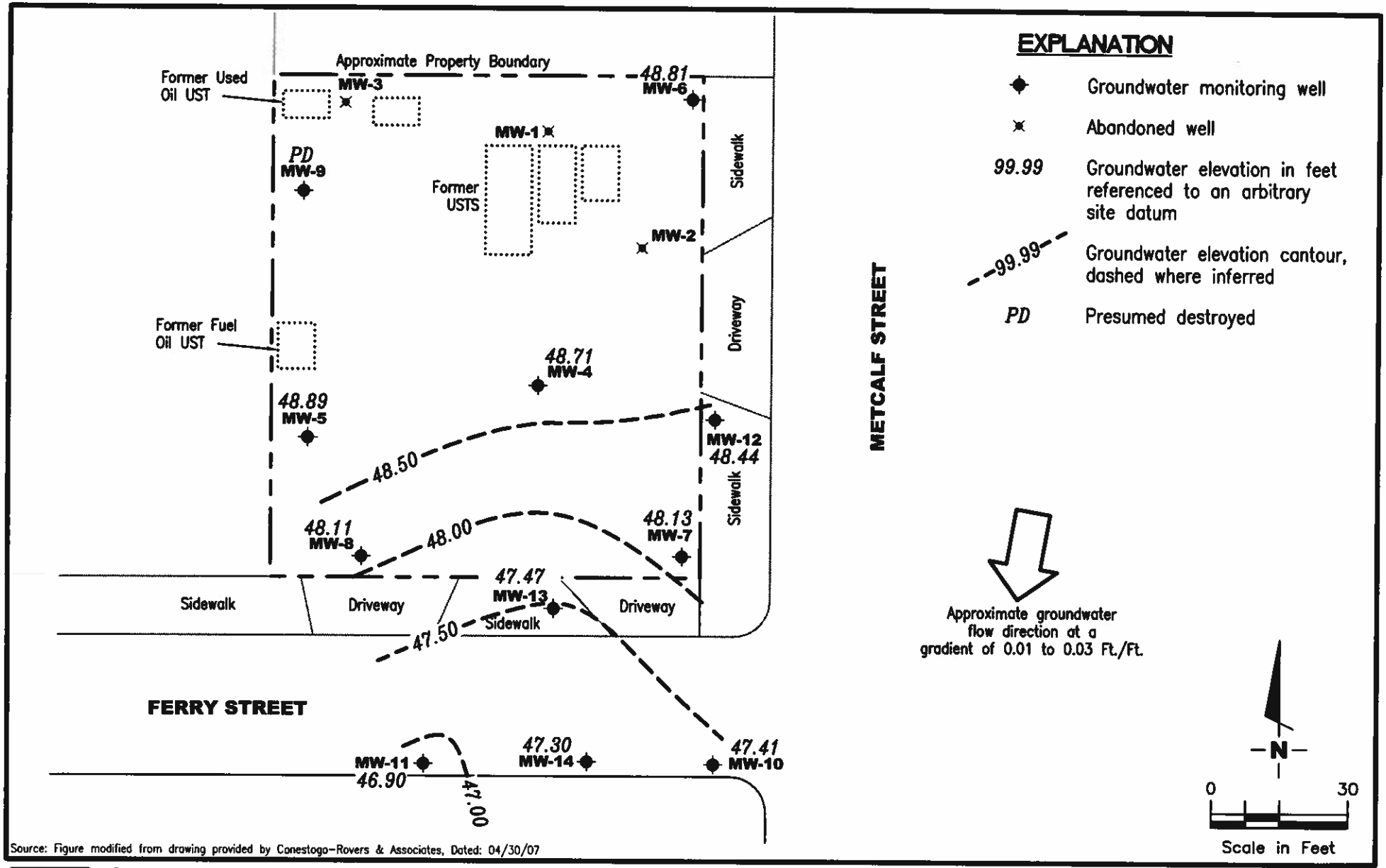
Dublin, CA 94568 (925) 551-7555

POTENTIOMETRIC MAP
Former Chevron Service Station #9-7502
124 Ferry Street
Sedro Woolley, Washington

FIGURE
2

PROJECT NUMBER	REVIEWED BY	DATE	REVISED DATE
386657		June 4, 2009	

FILE NAME: P:\Enviro\Chevron\9-7502\Q09-9-7502.DWG | Layout Tab: Pot2



Source: Figure modified from drawing provided by Conestoga-Rovers & Associates, Dated: 04/30/07

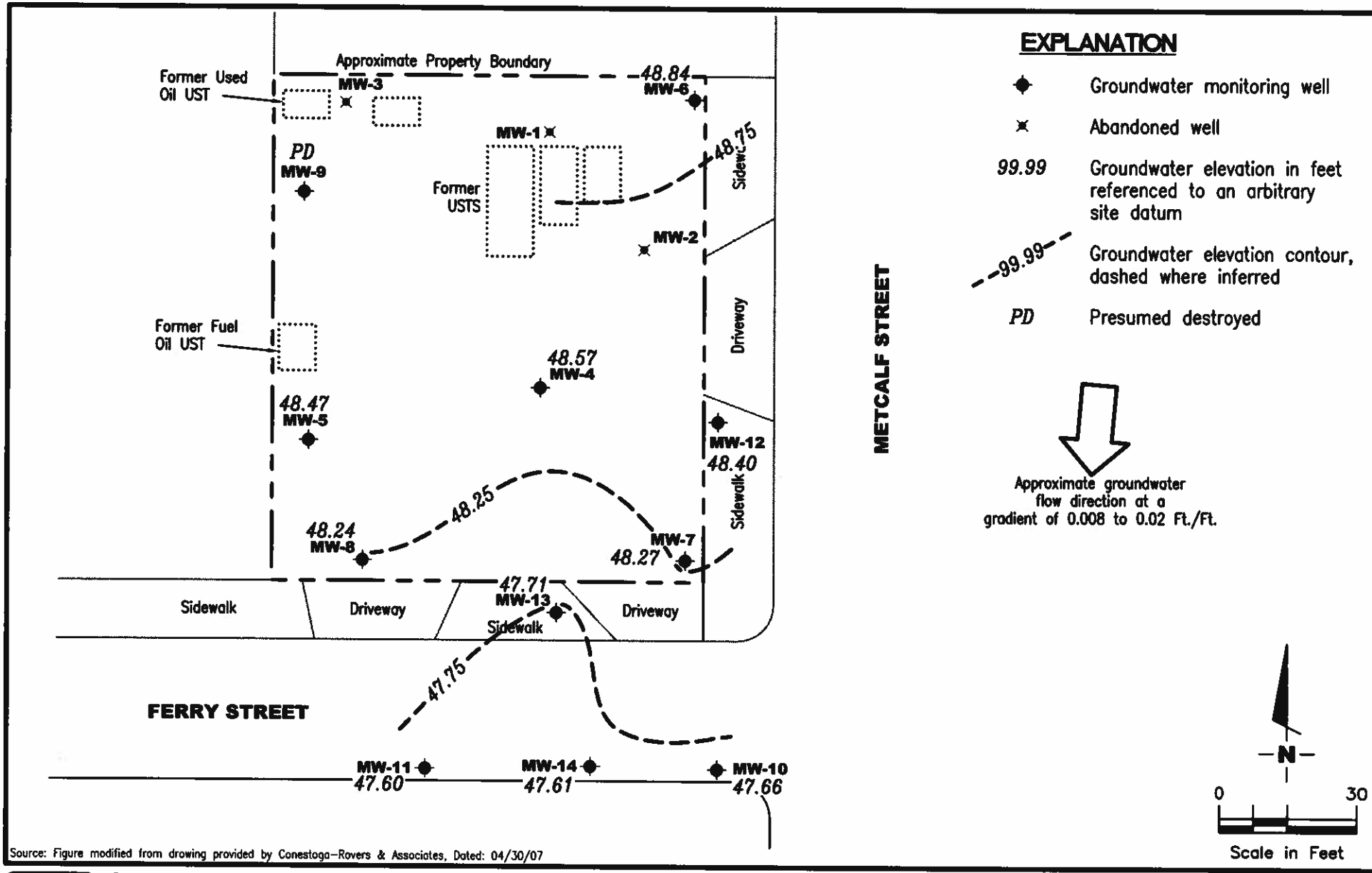
GETTLER - RYAN INC.
6747 Sierra Court, Suite J
Dublin, CA 94568 (925) 551-7555

POTENTIOMETRIC MAP
Former Chevron Service Station #9-7502
124 Ferry Street
Sedro Woolley, Washington

FIGURE
1

PROJECT NUMBER	REVIEWED BY	DATE	REVISED DATE
386657		March 30, 2010	

FILE NAME: P:\Enviro\Chevron\9-7502\Q10-9-7502.DWG | Layout Tab: Pol1



Source: Figure modified from drawing provided by Conestoga-Rovers & Associates, Dated: 04/30/07

GETTLER - RYAN INC.
6747 Sierra Court, Suite J
Dublin, CA 94568 (925) 551-7555

POTENTIOMETRIC MAP
Former Chevron Service Station #9-7502
124 Ferry Street
Sedro Woolley, Washington

FIGURE
1

PROJECT NUMBER	REVIEWED BY	DATE	REVISED DATE
386657		June 18, 2010	

FILE NAME: P:\Enviro\Chevron\9-7502\Q10-9-7502.DWG | Layout Tab: Pot2

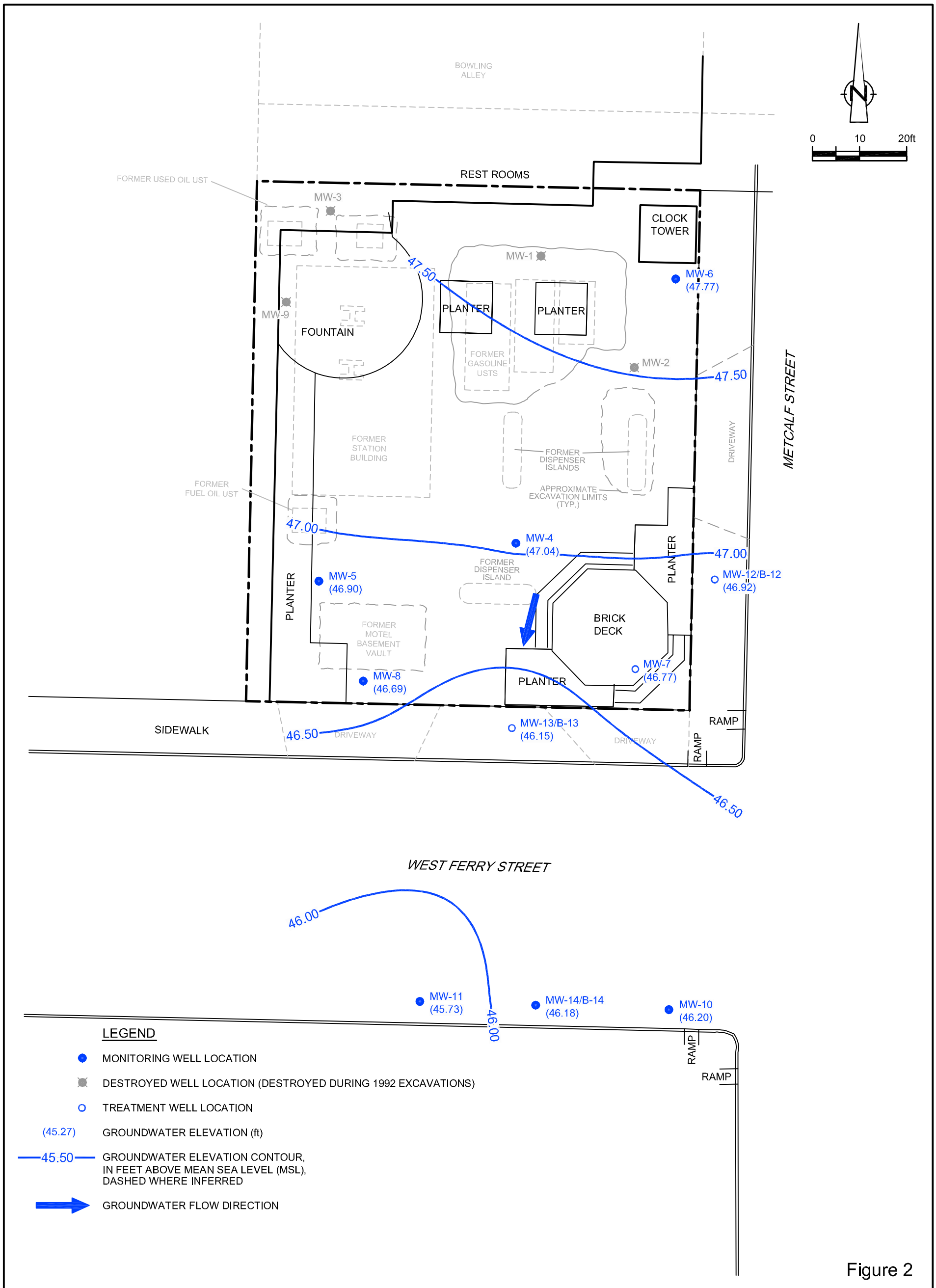


Figure 2

GROUNDWATER ELEVATION CONTOUR MAP
PRE-SURFACTANT INJECTION - SEPTEMBER 22, 2009
FORMER CHEVRON STATION 9-7502
124 FERRY STREET
Sedro-Woolley, Washington

NOTES:
1. MW-1 THROUGH MW-5 WERE INSTALLED IN MAY 1991.
2. MW-6 THROUGH MW-9 WERE INSTALLED IN OCTOBER 1991.
3. MW-10 AND MW-11 WERE INSTALLED IN JULY 2002.
4. MW-12 THROUGH MW-14 WERE INSTALLED IN MAY 2006.

CRA

60041-95(014)GN-WA001 NOV 16/2010

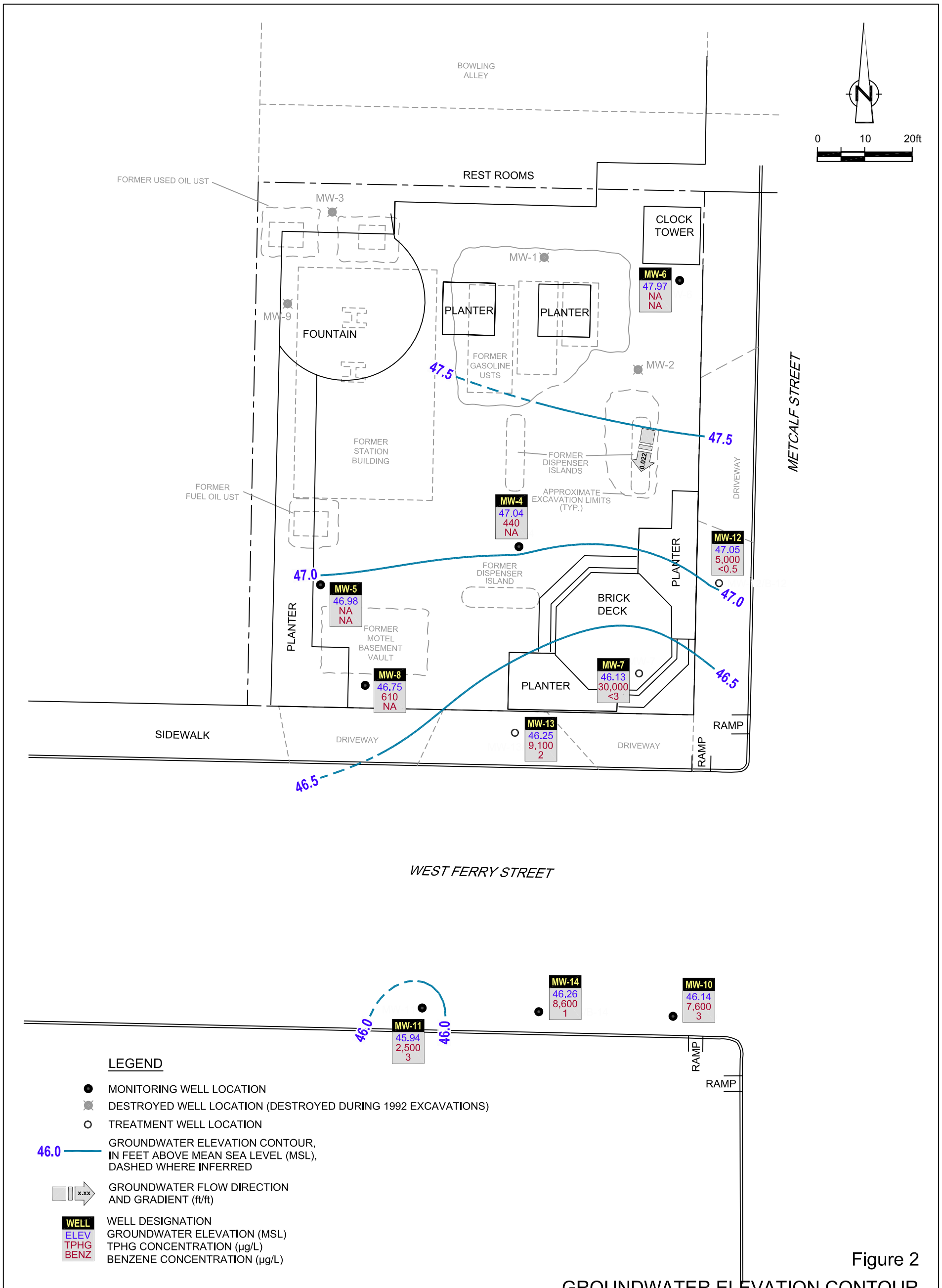
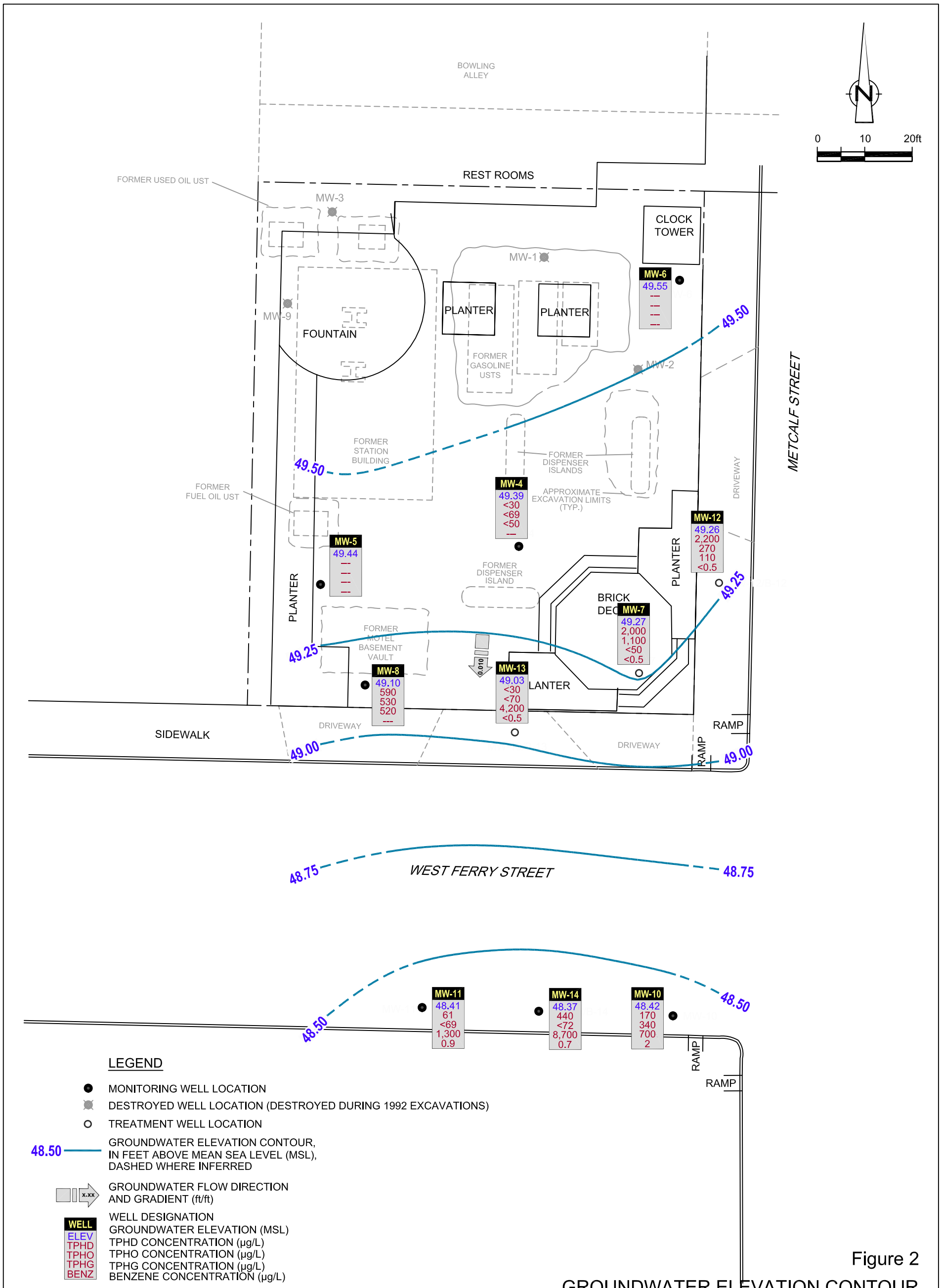


Figure 2

GROUNDWATER ELEVATION CONTOUR
AND HYDROCARBON CONCENTRATION MAP
FORMER CHEVRON STATION 9-7502
124 FERRY STREET
Sedro-Woolley, Washington
December 7, 2010

NOTES:
1. MW-1 THROUGH MW-5 WERE INSTALLED IN MAY 1991.
2. MW-6 THROUGH MW-9 WERE INSTALLED IN OCTOBER 1991.
3. MW-10 AND MW-11 WERE INSTALLED IN JULY 2002.
4. MW-12 THROUGH MW-14 WERE INSTALLED IN MAY 2006.

GRA



LEGEND

- MONITORING WELL LOCATION
- DESTROYED WELL LOCATION (DESTROYED DURING 1992 EXCAVATIONS)
- TREATMENT WELL LOCATION
- 48.50 — GROUNDWATER ELEVATION CONTOUR, IN FEET ABOVE MEAN SEA LEVEL (MSL), DASHED WHERE INFERRED
- x.xx — GROUNDWATER FLOW DIRECTION AND GRADIENT (ft/ft)
- WELL DESIGNATION
  - ELEV — GROUNDWATER ELEVATION (MSL)
  - TPHD — TPHD CONCENTRATION (µg/L)
  - TPHO — TPHO CONCENTRATION (µg/L)
  - TPHG — TPHG CONCENTRATION (µg/L)
  - BENZ — BENZENE CONCENTRATION (µg/L)
- --- NOT AVAILABLE

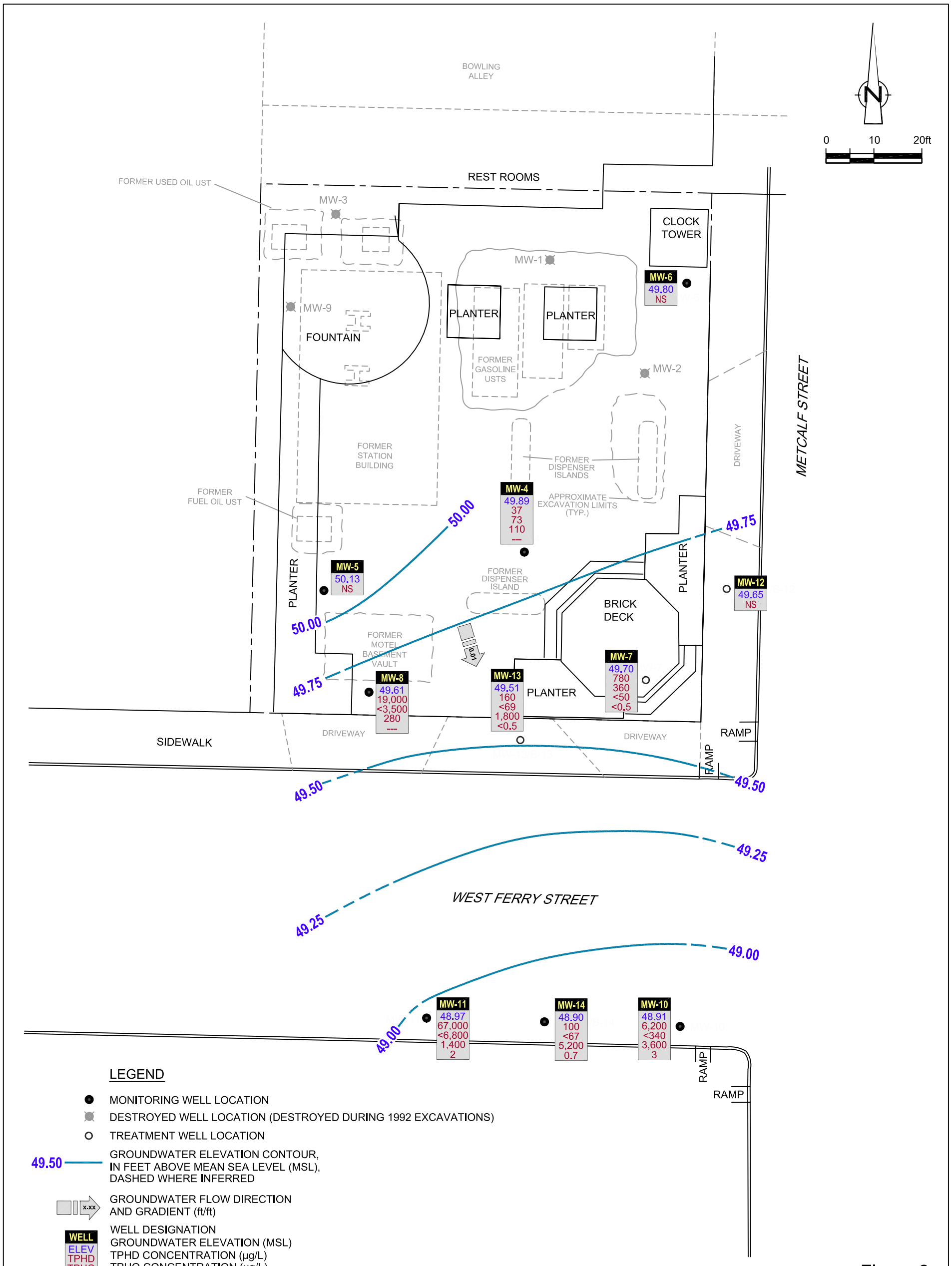
NOTES:
1. MW-1 THROUGH MW-5 WERE INSTALLED IN MAY 1991.
2. MW-6 THROUGH MW-9 WERE INSTALLED IN OCTOBER 1991.
3. MW-10 AND MW-11 WERE INSTALLED IN JULY 2002.
4. MW-12 THROUGH MW-14 WERE INSTALLED IN MAY 2006.

Figure 2

GROUNDWATER ELEVATION CONTOUR AND HYDROCARBON CONCENTRATION MAP FORMER CHEVRON STATION 9-7502 124 FERRY STREET

Sedro-Woolley, Washington
March 7, 2011

060041-2011(016)GN-EM002 MAY 3/2011



LEGEND

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- DESTROYED WELL LOCATION (DESTROYED DURING 1992 EXCAVATIONS)
- TREATMENT WELL LOCATION
- 49.50 — GROUNDWATER ELEVATION CONTOUR, IN FEET ABOVE MEAN SEA LEVEL (MSL), DASHED WHERE INFERRED
- x.xx — GROUNDWATER FLOW DIRECTION AND GRADIENT (ft/ft)

WELL	
ELEV	GROUNDWATER ELEVATION (MSL)
TPHD	TPHD CONCENTRATION (µg/L)
TPHO	TPHO CONCENTRATION (µg/L)
TPHG	TPHG CONCENTRATION (µg/L)
BENZ	BENZENE CONCENTRATION (µg/L)

NS NOT SAMPLED

--- NOT AVAILABLE

NOTES:

1. MW-1 THROUGH MW-5 WERE INSTALLED IN MAY 1991.
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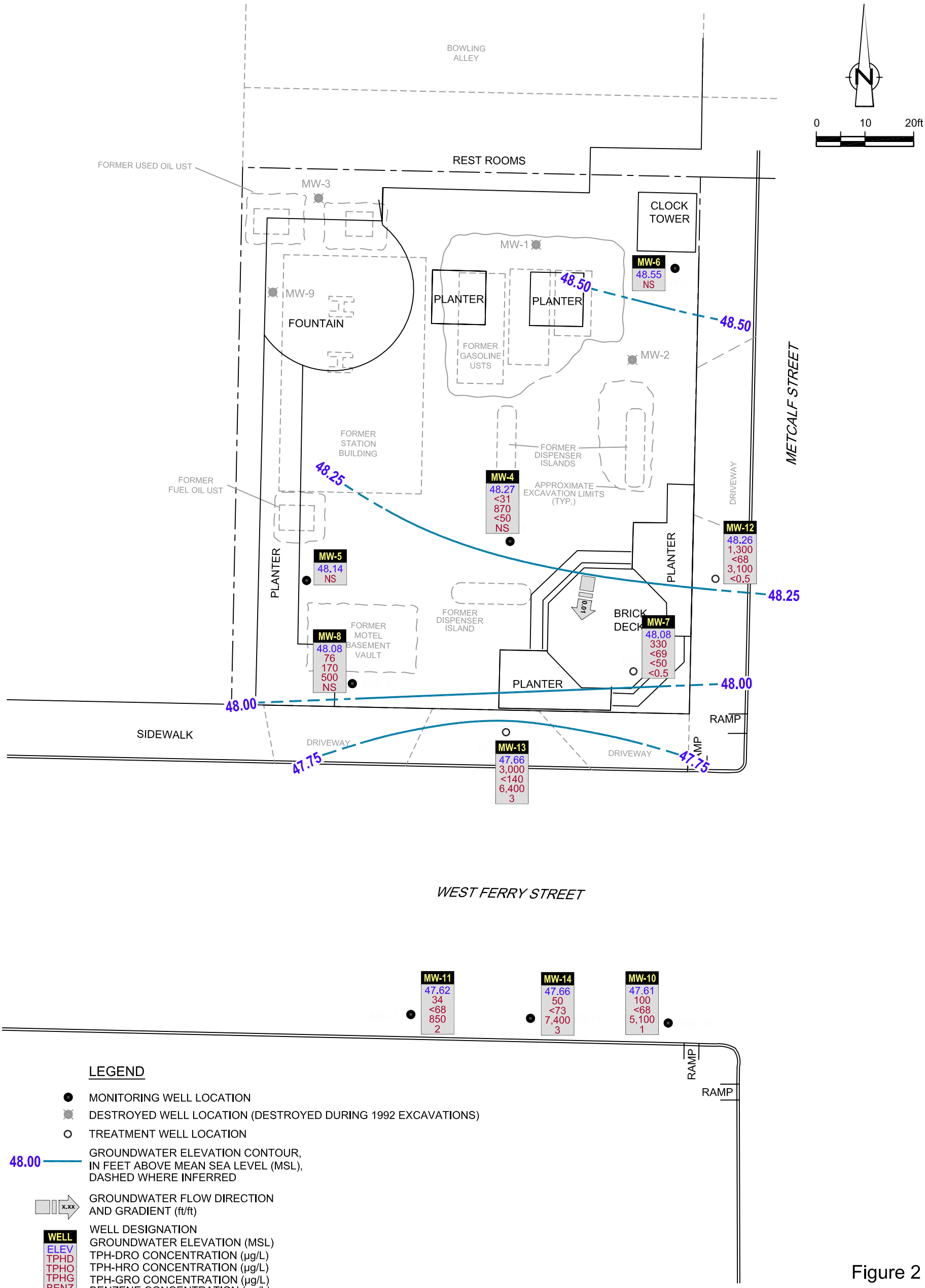
Figure 2

GROUNDWATER ELEVATION CONTOUR AND HYDROCARBON CONCENTRATION MAP FORMER CHEVRON STATION 9-7502 124 FERRY STREET

Sedro-Woolley, Washington

June 9, 2011

060041-95(017)GN-EM002 JAN 4/2012



LEGEND

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- DESTROYED WELL LOCATION (DESTROYED DURING 1992 EXCAVATIONS)
- TREATMENT WELL LOCATION
- 48.00 — GROUNDWATER ELEVATION CONTOUR, IN FEET ABOVE MEAN SEA LEVEL (MSL), DASHED WHERE INFERRED
- x.xx — GROUNDWATER FLOW DIRECTION AND GRADIENT (ft/ft)

WELL	
ELEV	GROUNDWATER ELEVATION (MSL)
TPHD	TPH-DRO CONCENTRATION (µg/L)
TPHO	TPH-HRO CONCENTRATION (µg/L)
TPHG	TPH-GRO CONCENTRATION (µg/L)
BENZ	BENZENE CONCENTRATION (µg/L)

NS NOT SAMPLED

NOTES:
1. MW-1 THROUGH MW-5 WERE INSTALLED IN MAY 1991.
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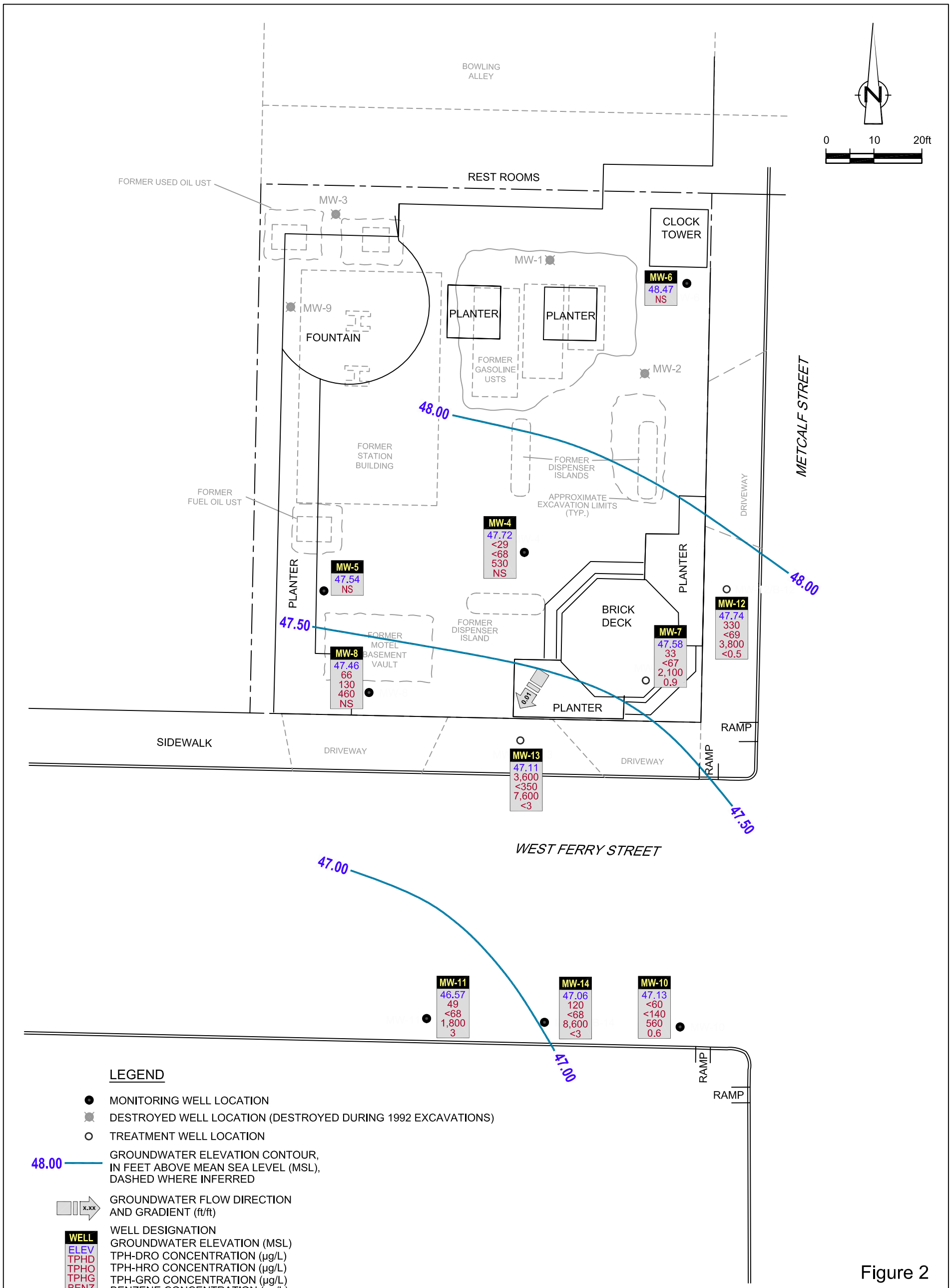
Figure 2

GROUNDWATER ELEVATION CONTOUR AND HYDROCARBON CONCENTRATION MAP FORMER CHEVRON STATION 9-7502 124 FERRY STREET

Sedro-Woolley, Washington
September 15 and 16, 2011



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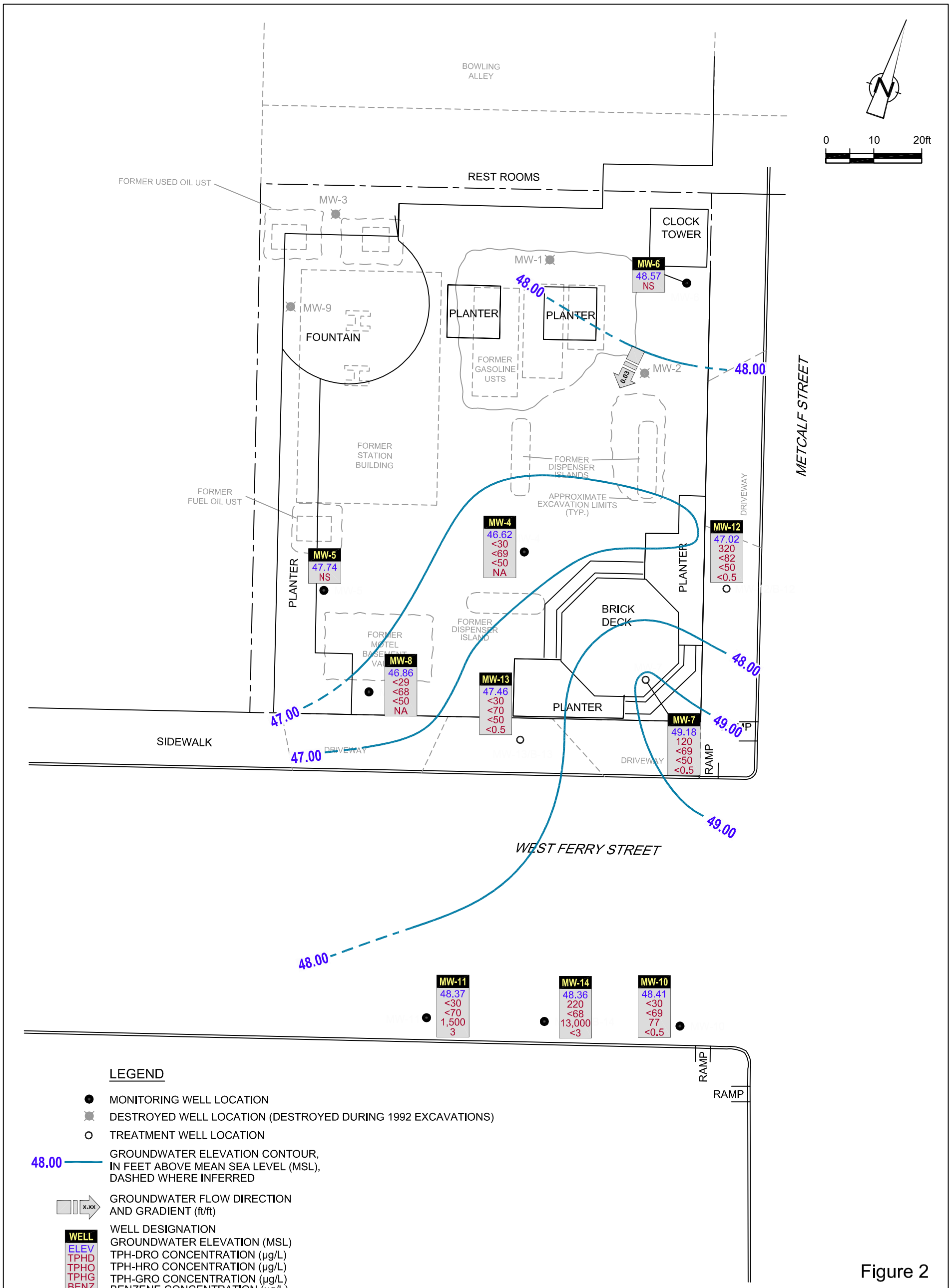
3. MW-10 AND MW-11 WERE INSTALLED IN JULY 2002.
4. MW-12 THROUGH MW-14 WERE INSTALLED IN MAY 2006.

Figure 2

GROUNDWATER ELEVATION CONTOUR AND HYDROCARBON CONCENTRATION MAP FORMER CHEVRON STATION 97502 124 FERRY STREET

Sedro-Woolley, Washington

December 13, 2011



LEGEND

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- DESTROYED WELL LOCATION (DESTROYED DURING 1992 EXCAVATIONS)
- TREATMENT WELL LOCATION
- 48.00 — GROUNDWATER ELEVATION CONTOUR, IN FEET ABOVE MEAN SEA LEVEL (MSL), DASHED WHERE INFERRED
- x.xx — GROUNDWATER FLOW DIRECTION AND GRADIENT (ft/ft)

WELL
ELEV — WELL DESIGNATION, GROUNDWATER ELEVATION (MSL)
TPHD — TPH-DRO CONCENTRATION (µg/L)
TPHO — TPH-HRO CONCENTRATION (µg/L)
TPHG — TPH-GRO CONCENTRATION (µg/L)
BENZ — BENZENE CONCENTRATION (µg/L)

NA NOT ANALYZED
NS NOT SAMPLED

NOTES:
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3. MW-10 AND MW-11 WERE INSTALLED IN JULY 2002.
4. MW-12 THROUGH MW-14 WERE INSTALLED IN MAY 2006.

Figure 2

GROUNDWATER ELEVATION CONTOUR AND HYDROCARBON CONCENTRATION MAP FORMER CHEVRON STATION 97502 124 FERRY STREET

Sedro-Woolley, Washington
March 15, 2012

060041-95(020)GN-EM002 MAY 21/2012

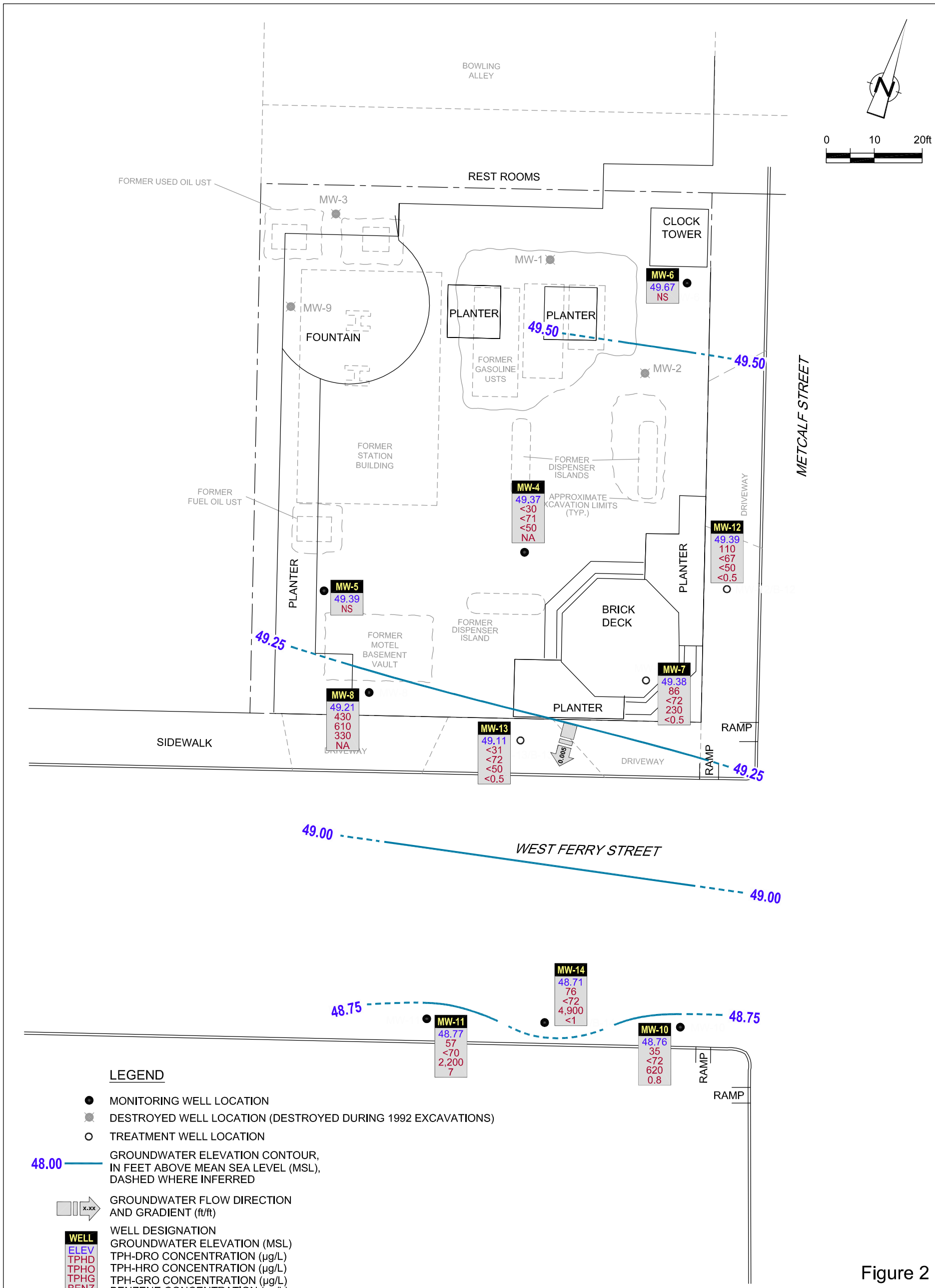

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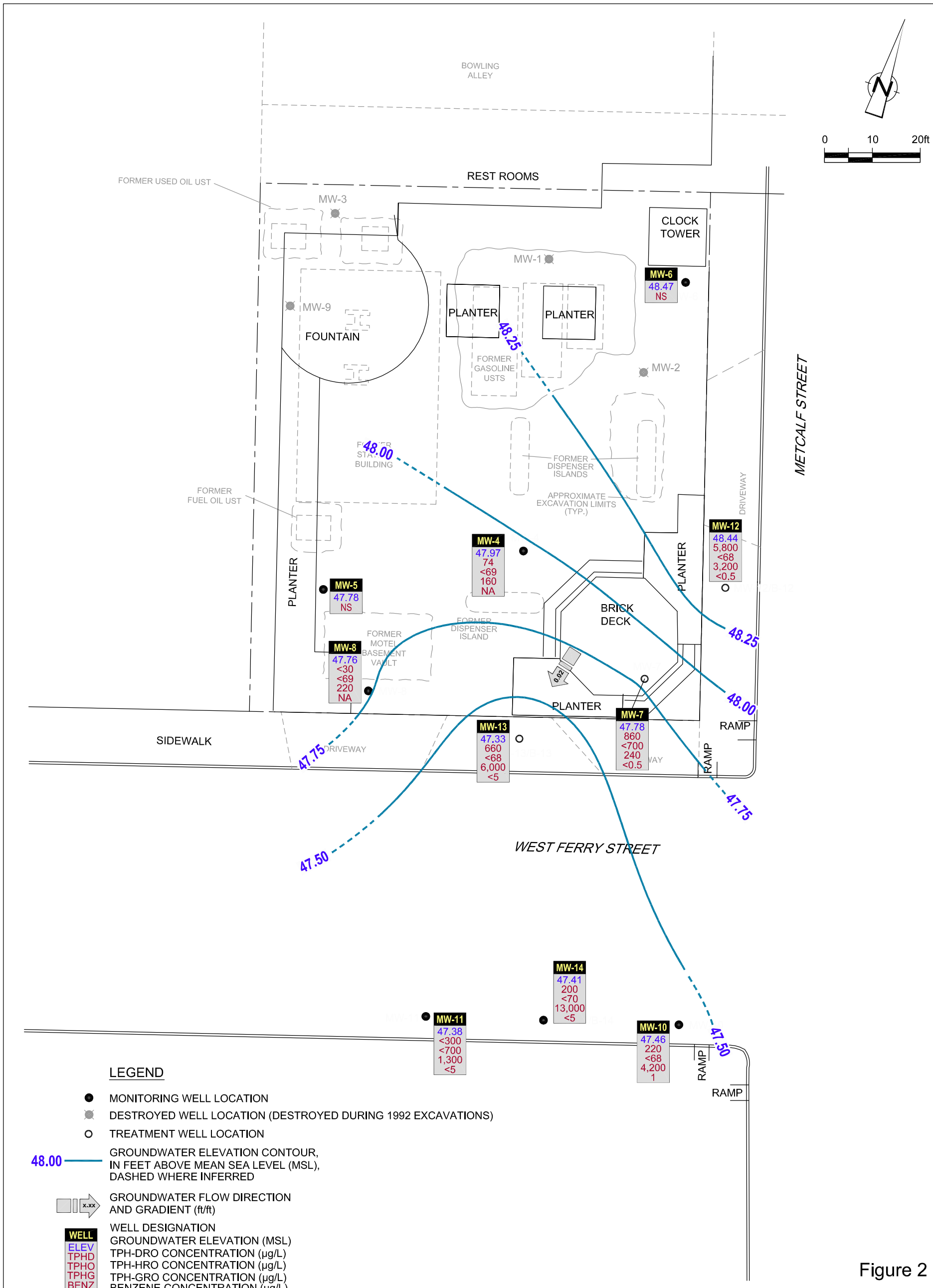
Figure 2

GROUNDWATER ELEVATION CONTOUR AND HYDROCARBON CONCENTRATION MAP FORMER CHEVRON STATION 97502 124 FERRY STREET

Sedro-Woolley, Washington

June 13, 2012



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4. MW-12 THROUGH MW-14 WERE INSTALLED IN MAY 2006.

Figure 2

GROUNDWATER ELEVATION CONTOUR AND HYDROCARBON CONCENTRATION MAP FORMER CHEVRON STATION 97502 124 FERRY STREET

Sedro-Woolley, Washington
September 10, 2012

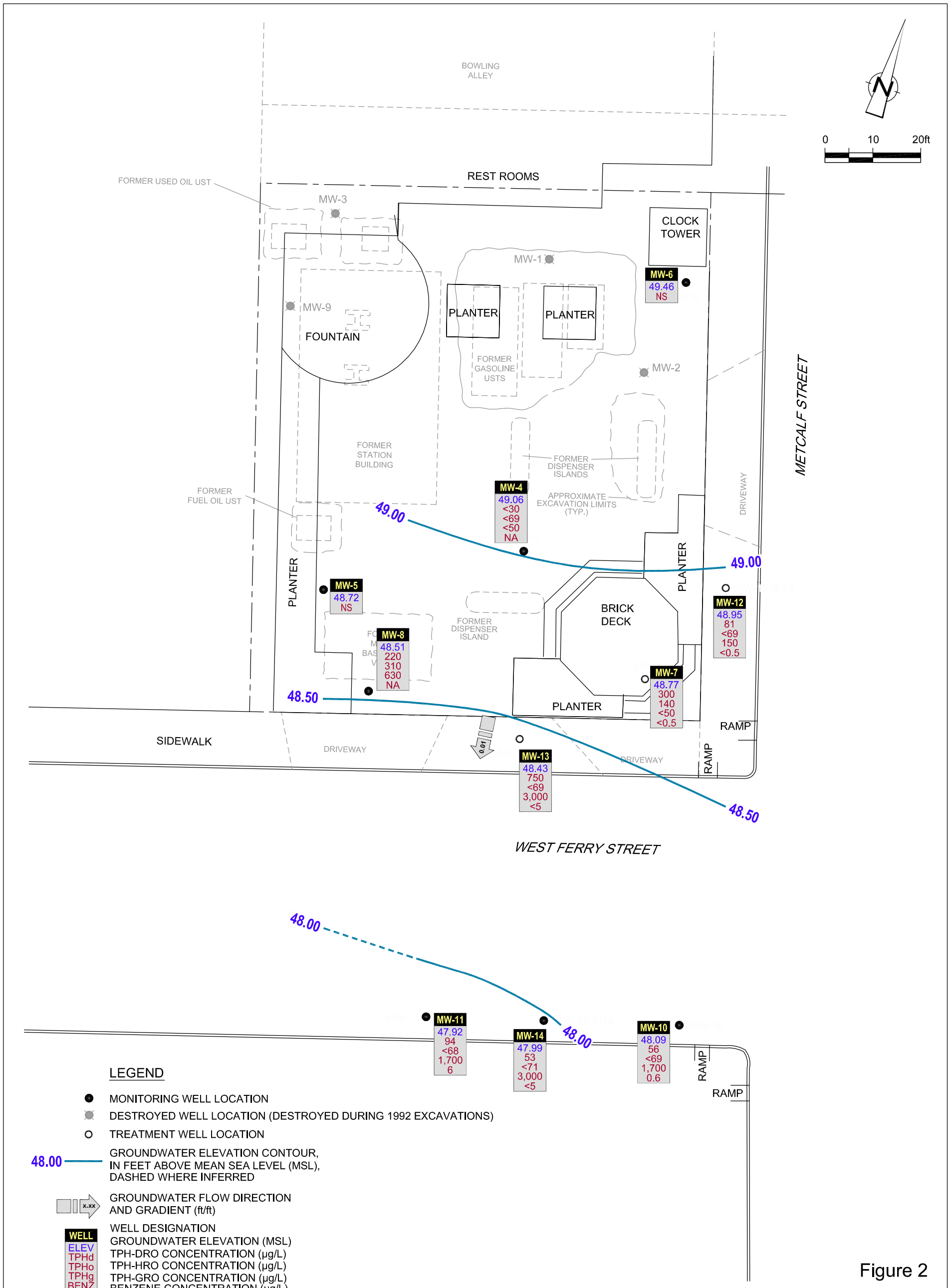

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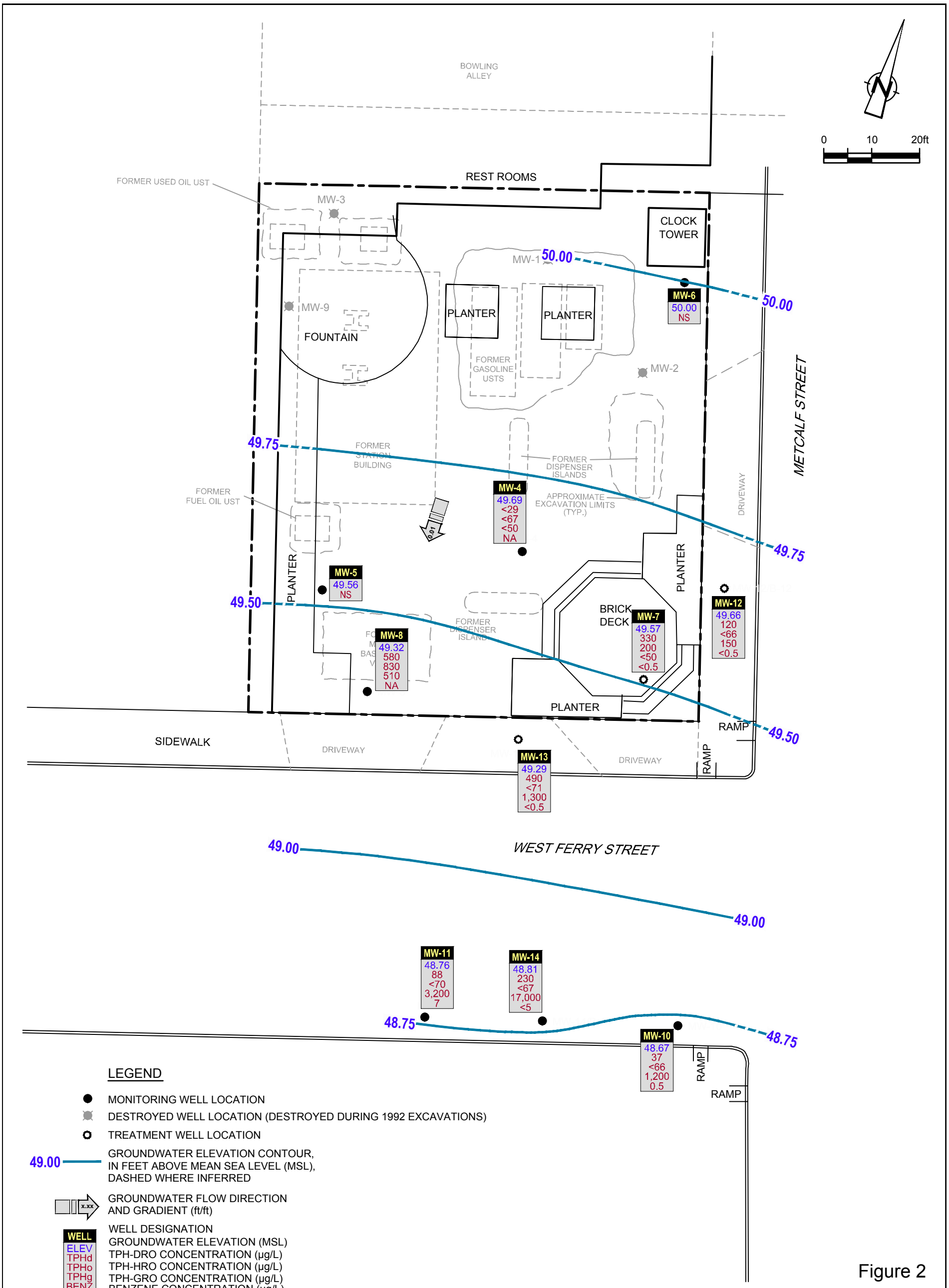
Figure 2

GROUNDWATER ELEVATION CONTOUR AND HYDROCARBON CONCENTRATION MAP FORMER CHEVRON STATION 97502 124 FERRY STREET

Sedro-Woolley, Washington
December 10, 2012

060041-95(023)GN-EM002 JAN 25/2012



LEGEND

- MONITORING WELL LOCATION
- DESTROYED WELL LOCATION (DESTROYED DURING 1992 EXCAVATIONS)
- TREATMENT WELL LOCATION
- 49.00 — GROUNDWATER ELEVATION CONTOUR, IN FEET ABOVE MEAN SEA LEVEL (MSL), DASHED WHERE INFERRED
- x.xx — GROUNDWATER FLOW DIRECTION AND GRADIENT (ft/ft)

WELL	WELL DESIGNATION
ELEV	GROUNDWATER ELEVATION (MSL)
TPHd	TPH-DRO CONCENTRATION (µg/L)
TPHo	TPH-HRO CONCENTRATION (µg/L)
TPHg	TPH-GRO CONCENTRATION (µg/L)
BENZ	BENZENE CONCENTRATION (µg/L)

NA NOT ANALYZED

NS NOT SAMPLED

NOTES:

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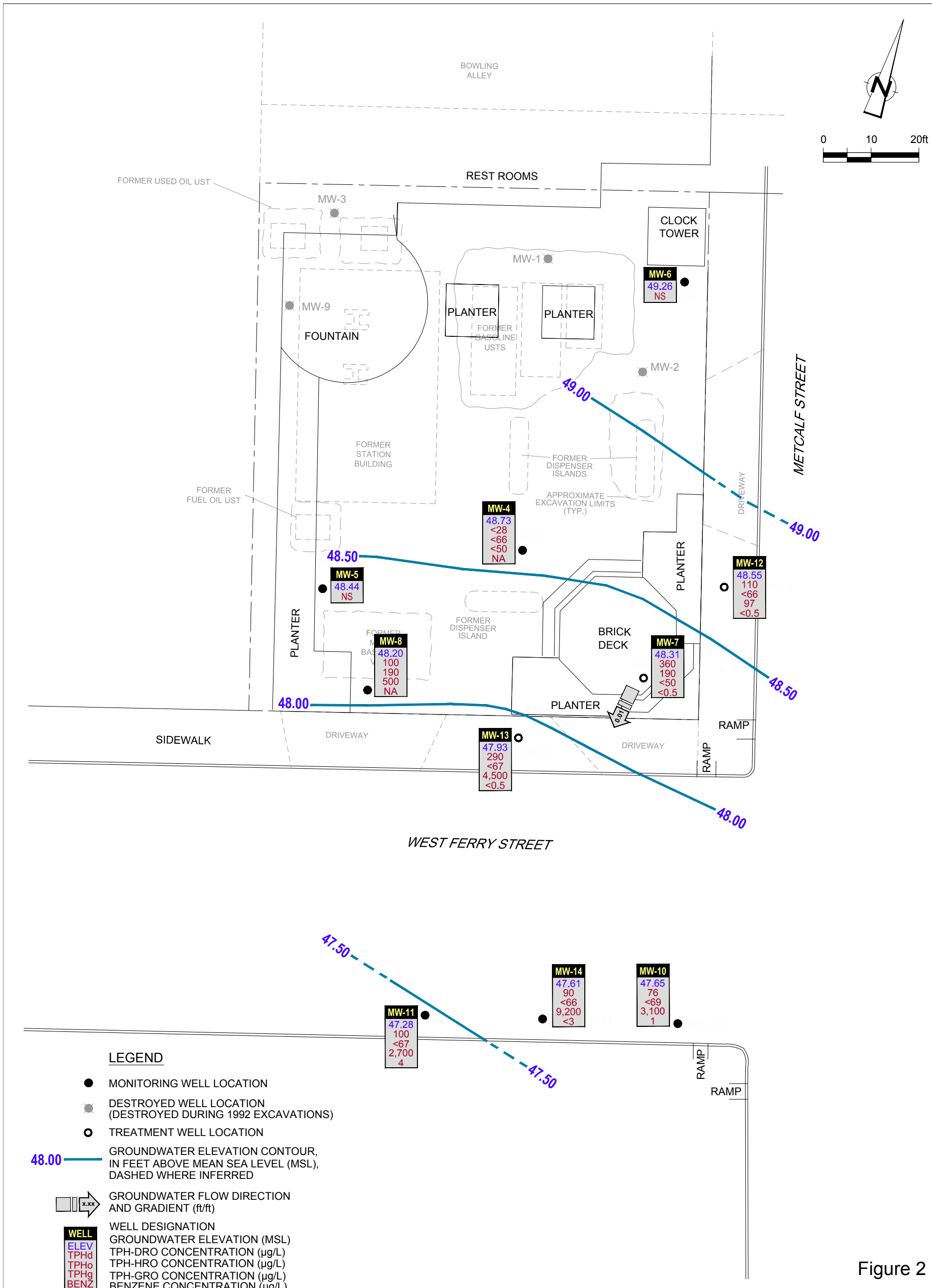
Figure 2

GROUNDWATER ELEVATION CONTOUR AND HYDROCARBON CONCENTRATION MAP FORMER CHEVRON STATION 97502 124 FERRY STREET

Sedro-Woolley, Washington

March 11, 2013

060041-95(024)GN-BR002 MAY 13/2013



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CRA

Figure 2

GROUNDWATER ELEVATION CONTOUR AND HYDROCARBON CONCENTRATION MAP FORMER CHEVRON SERVICE STATION 97502 124 FERRY STREET

Sedro-Woolley, Washington
December 11, 2013

060041-95(027)GN-EM002 FEB 18/2014

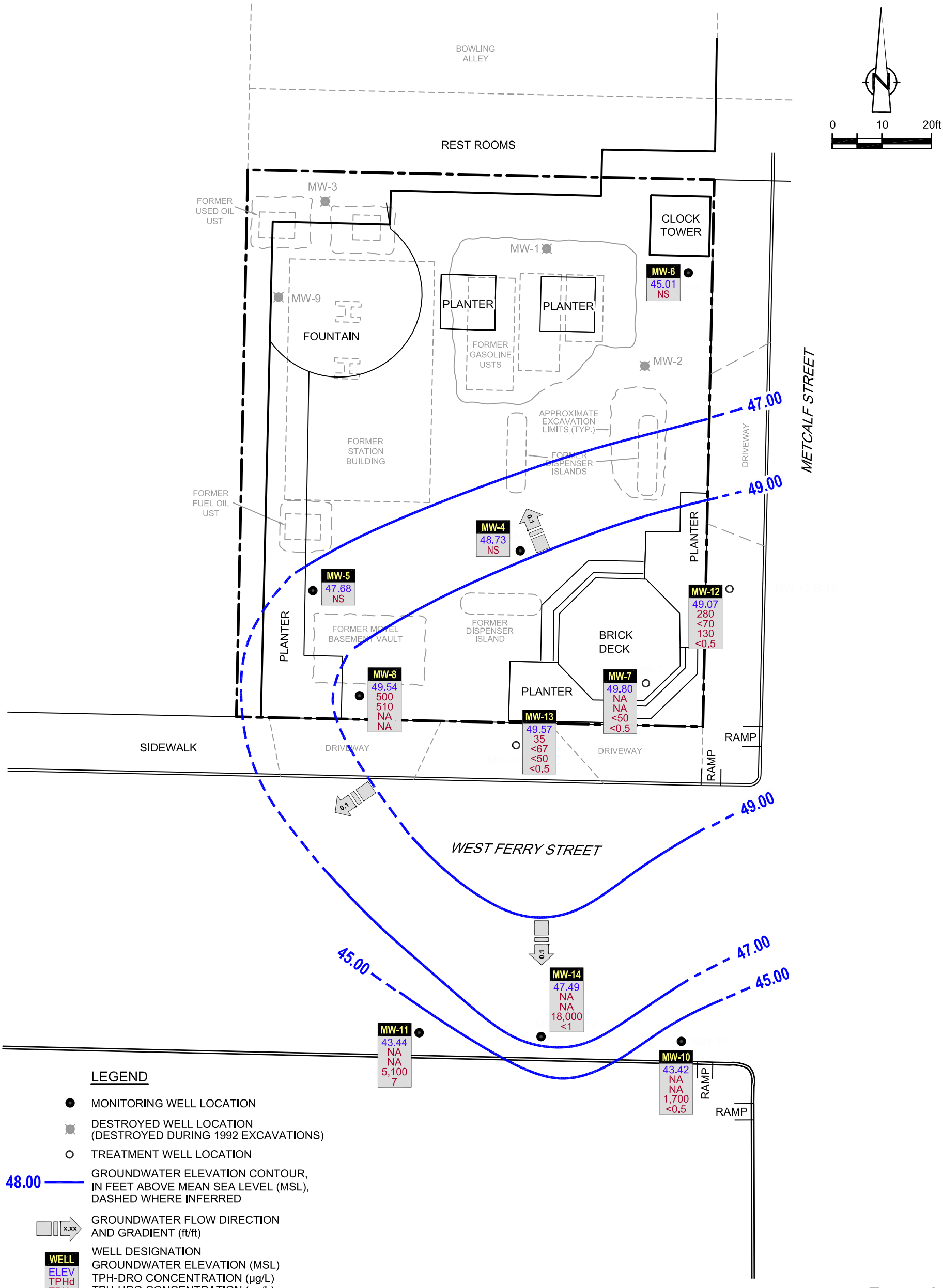

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Figure 2

GROUNDWATER ELEVATION CONTOUR AND HYDROCARBON CONCENTRATION MAP FORMER CHEVRON SERVICE STATION 97502 124 FERRY STREET

Sedro-Woolley, Washington
March 12, 2014

060041-95(028)GN-EM002 MAY 15/2014

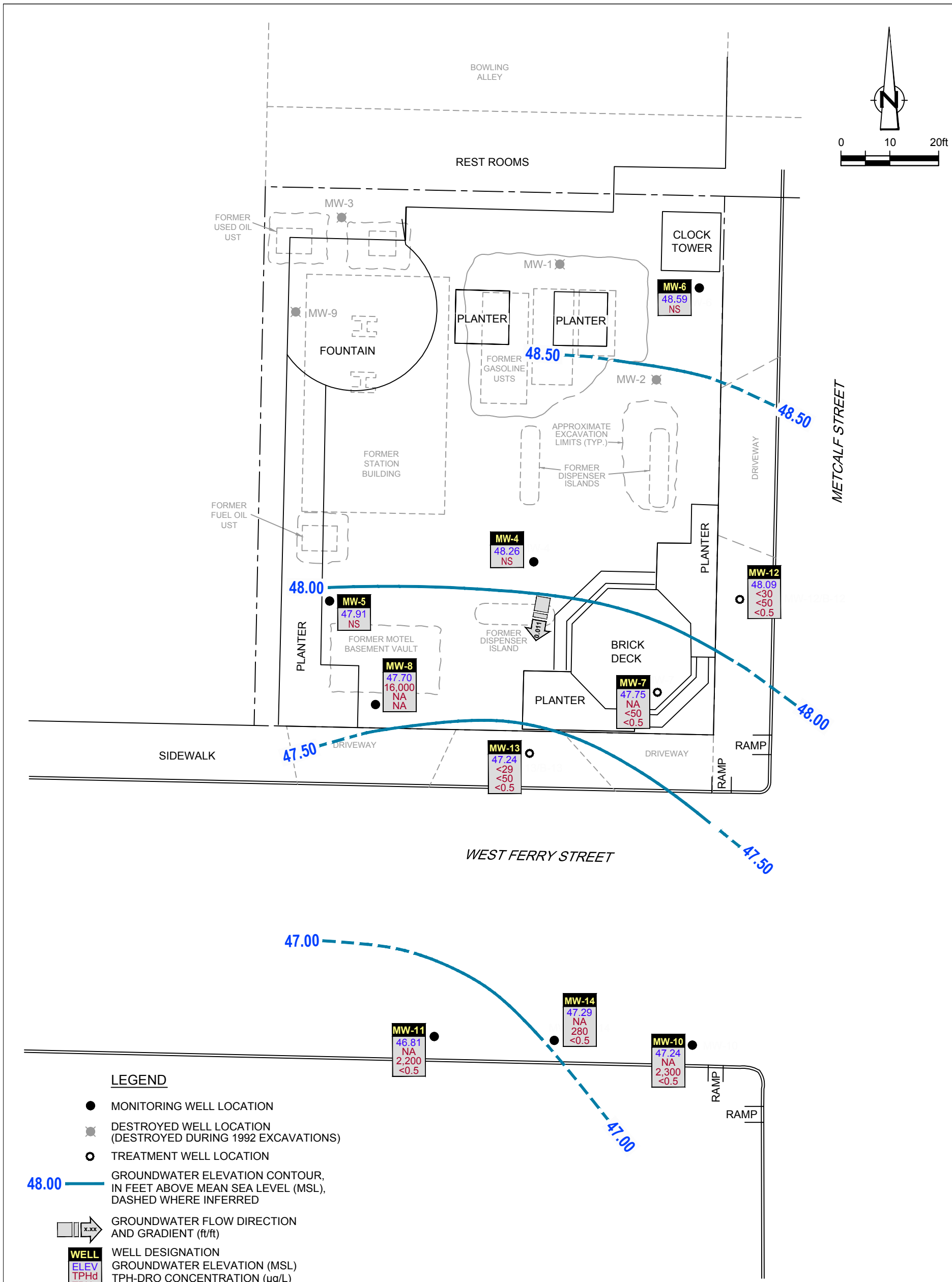


Figure 2

GROUNDWATER ELEVATION CONTOUR
AND HYDROCARBON CONCENTRATION MAP
FORMER CHEVRON SERVICE STATION 97502
124 FERRY STREET
Sedro-Woolley, Washington
September 27, 2014

060041-95(029)GN-EM002 DEC 15/2014

APPENDIX E

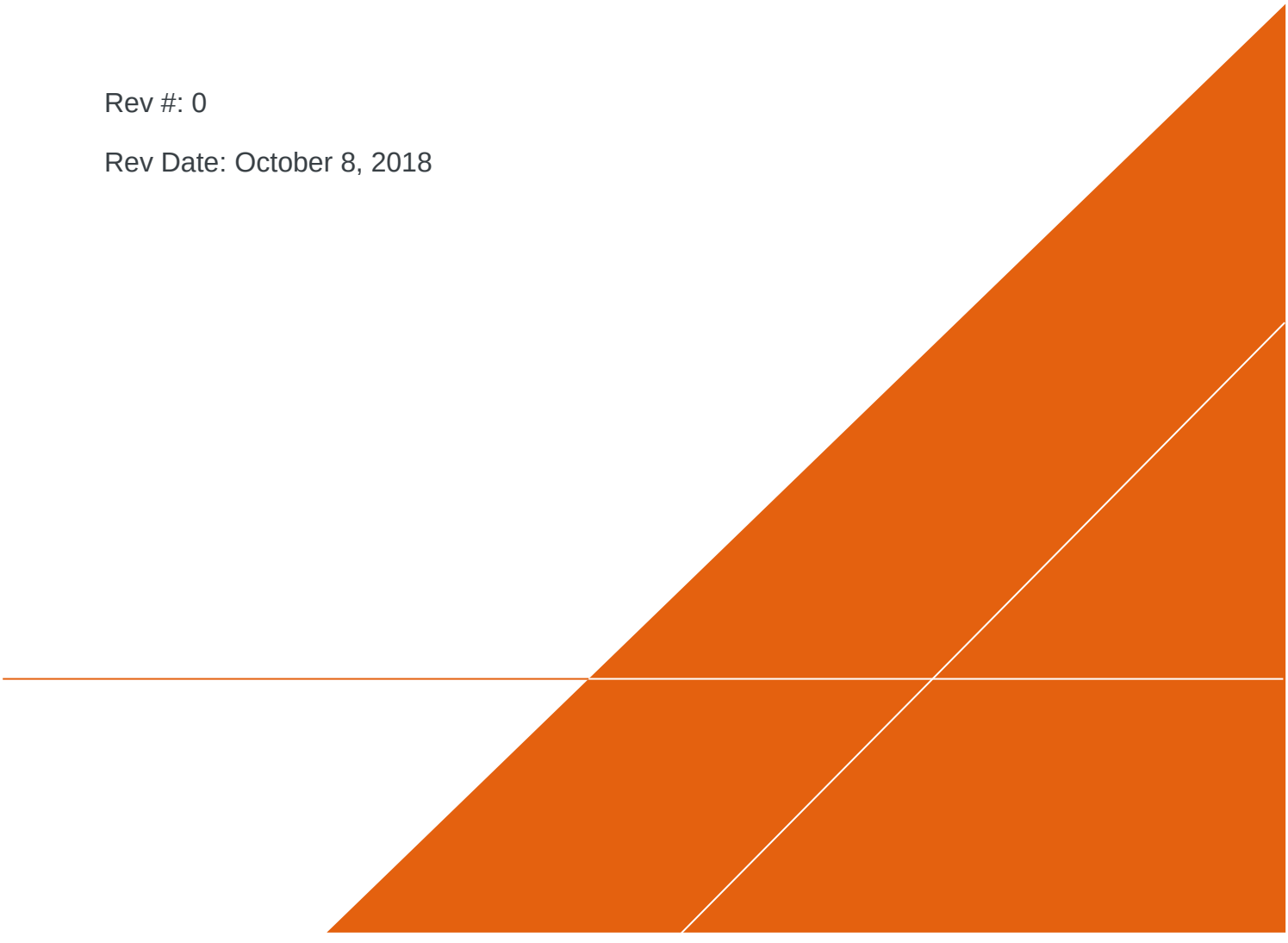
Technical Guidance Documents and Standard Operating Procedures

ARCADIS Design & Consultancy for natural and built assets

TGI - STANDARD GROUNDWATER SAMPLING FOR MONITORING WELLS

Rev #: 0

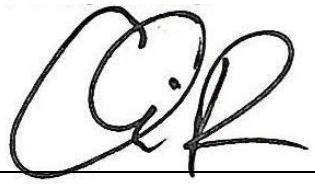
Rev Date: October 8, 2018



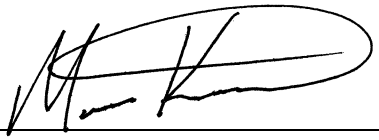
VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	October 8, 2018	All	Updated and re-written as a TGI	Marc Killingstad

APPROVAL SIGNATURES

Prepared by:  10/08/2018

Christopher Keen Date:

Technical Expert Reviewed by:  10/08/2018

Marc Killingstad (Technical Expert) Date:

1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to any and all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, state-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

This Technical Guidance Instruction (TGI) describes the methods to be used to collect groundwater samples using traditional purging and sampling techniques. For low-flow purging techniques, please refer to the *TGI - Low-Flow Groundwater Purging and Sampling Procedures for Monitoring Wells*. For no-purge/passive sampling techniques such as passive diffusion bag (PDB), HydraSleeve™ and bailer-grab groundwater sampling please refer to: *TGI – Passive Diffusion Bag Sampling, TGI – Groundwater Sampling with HydraSleeves™*, and *TGI - Bailer-Grab Groundwater Sampling*.

NOTE: *Monitoring wells will not be sampled until the well has been properly developed. Monitoring wells must be appropriately developed after installation and at least one (1) week prior to groundwater sample collection (refer TGI – Monitoring Well Development). Project teams will consider the last time the wells were developed and if additional development may be required to ensure adequate communication with the surrounding formation and collection of representative groundwater samples.*

During precipitation events, groundwater sampling will be discontinued until precipitation ceases or a cover has been erected over the sampling area and monitoring well.

Both filtered and unfiltered groundwater samples may be collected using this TGI. Filtered samples may be obtained using a 1.0-, 0.45-, or 0.1-micron disposable filter.

3 PERSONNEL QUALIFICATIONS

Arcadis field sampling personnel will have completed or are in the process of completing site-specific training as well as having current health and safety training as required by Arcadis, client, or regulations, such as 40-hour HAZWOPER training and/or OSHA HAZWOPER site supervisor training. Arcadis personnel will also have current training as identified in the site-specific Health and Safety Plan (HASP) which may include first aid, cardiopulmonary resuscitation (CPR), Blood Borne Pathogens (BBP) as needed. The HASP will also identify any access control requirements.

Prior to mobilizing to the field, the groundwater sampling team will review and be thoroughly familiar with relevant site-specific documents including but not limited to the task-specific work plan or field implementation plan (FIP)/field sampling plan, Quality Assurance Project Plan (QAPP), HASP, historical information, and other relevant site documents.

Arcadis field sampling personnel will be knowledgeable in the relevant processes, procedures, and TGIs and possess the demonstrated required skills and experience necessary to successfully complete the desired field work. Additionally, the groundwater sampling team will review and be thoroughly familiar with documentation provided by equipment manufacturers and become familiar with the operation of (i.e., hands-on experience) all equipment that will be used in the field prior to mobilization.

Ideally, Arcadis personnel directing, supervising, or leading groundwater sample collection activities will have a minimum of one (1) year of previous groundwater sampling experience. Field employees with less than six (6) months of experience will be accompanied by a supervisor (as described above) to ensure that proper sample collection techniques are employed.

4 EQUIPMENT LIST

The following materials will be available, as required, during groundwater sampling:

- Site-specific HASP and health and safety documents identified in the HASP
- Field Implementation Plan (FIP) that includes site map, well construction records (table or logs), sampling plan (sample analyses, sample volume required, and sample holding time), and prior groundwater sampling records (if available)
- Field notebook and/or smart device (smart phone or tablet)
- Groundwater sampling field forms (**Attachment A**)
- Appropriate personal protective equipment (PPE) (e.g., latex or nitrile gloves, safety glasses, etc.) as specified in the HASP
- Traffic cones, delineators, and caution tape as appropriate for securing the work area as specified in the Traffic Safety Plan (TSP)

- Photoionization detector (PID), flame ionization detector (FID) or other air monitoring equipment, as needed, in accordance with the HASP
- Dedicated plastic sheeting (e.g., Weatherall Visqueen) or other clean surface to prevent sampling equipment from coming in contact with the ground
- If bailers are to be used in sampling:
    - appropriate number of dedicated bottom-loading, bottom-emptying bailers (i.e., polyvinyl chloride [PVC], polyethylene, Teflon®, or stainless steel)
    - polypropylene or nylon rope
- If submersible pumps are to be used in sampling:
    - appropriate amount of dedicated tubing (polyethylene, Teflon®, Teflon®-lined polyethylene, Tygon®) and other equipment necessary for purging selected in accordance with the FIP/sampling plan/work plan
    - generator or battery for operation of pumps (if required)
    - a pump selected in accordance with the FIP/sampling plan/work plan (parameter-specific [e.g., submersible, bladder, peristaltic])
- Graduated buckets to measure purge water volume
- Electronic water-level indicator (e.g., Solinist Model 101) or oil/water interface probe with 0.01-foot accuracy (oil/water as appropriate, note that sampling will not be performed when sheen or light non-aqueous phase liquid [LNAPL] is present)
- Down-hole multiparameter water-quality sonde (temperature/pH/specific conductivity/oxidation reduction [ORP]/turbidity/dissolved oxygen) meter and flow-through measurement cell; for example:
    - YSI 6-Series Multi-Parameter Instrument
    - Horiba U-22 Multi-Parameter Instrument.
    - Hydrolab Series 3 or Series 4a Multiprobe and Display.
- Groundwater sample containers and labels (supplied by the laboratory) appropriate for the analytical method(s) with preservative, as needed (parameter-specific)
- Filter, as needed, in accordance with the analytical method and parameter, and as specified in the FIP/sampling plan
- Decontamination equipment (buckets, distilled or deionized water, cleansers appropriate for removing expected chemicals of concern, paper towels)
- Appropriate blanks (trip blank supplied by the laboratory), as specified in the FIP/sampling plan
- Ziploc-type freezer bags for use as ice containers;
- Appropriate transport containers (coolers) with ice and appropriate labeling, packing, and shipping materials

- Chain-of-custody forms
- Digital camera (or phone with camera)
- Keys to wells and contingent bolt cutters for rusted locks and replacement keyed-alike locks
- Drums or other containers appropriate for purge water, as specified by the site investigation-derived waste (IDW) management plan and/or FIP/sampling plan and appropriate drum labels

5 CAUTIONS

Different USEPA regions and/or state regulatory agencies may stipulate deviations from this document. It is the responsibility of the Project Team (Project Manager and Technical Lead) to be fully aware of the requirements from the applicable regulatory framework.

If heavy precipitation occurs and no cover over the sampling area and monitoring well can be erected, sampling must be discontinued until adequate cover is provided. Rain water could contaminate groundwater samples.

Avoid extreme weather situations. Be aware that thermal currents and vertical mixing of cold and warm water inside the well casing could create a convection cell within the well and compromise data collection (e.g., biological mechanisms).

- Direct sunlight and hot ambient temperatures may cause the groundwater in the tubing or flow-through-cell to heat up and de-gas. This may result in the loss of volatile organic compounds (VOCs) and dissolved gases. Shade the equipment from direct sunlight, keep the tubing as short as possible, and avoid the hottest times of the day. Store and/or stage empty and full sample containers and coolers out of direct sunlight.
- Sampling during freezing conditions may adversely impact the data quality objectives. USEPA recommends low-flow sampling be conducted at air temperatures above 32°F (0°C) or taking special precautions to prevent groundwater from freezing in the equipment.

It may be necessary to field filter the groundwater for some parameters (e.g., metals) during collection, depending on preservation, analytical method, and project quality objectives. The task-kick-off notes and the FIP/sampling plan will list the samples that require field filtering.

To mitigate potential cross-contamination, groundwater samples are to be collected in a pre-determined order from least impacted to more impacted based on previous analytical data. If no analytical data are available, samples are to be collected in the following order:

1. First sample the upgradient well(s).
2. Next, sample the well located furthest downgradient of the interpreted or known source.
3. The remaining wells will be progressively sampled in order from downgradient to upgradient, such that the wells closest to the interpreted or known source are sampled last.

When using a gasoline generator, this power source will be set-up at least 30 feet downwind from the well to avoid exhaust fumes to contaminate samples.

Be careful not to over-tighten lids with Teflon® liners or septa (e.g., 40-mL vials). Over-tightening can cause the glass to shatter and/or impair the integrity of the seal.

NOTE: *Field logs and some forms are considered to be legal documents. All field logs and forms will be filled out in indelible ink. Do not use permanent marker or felt-tipped pens for labels on sample container or sample coolers. Permanent markers could introduce volatile constituents into the samples.*

NOTE: *An Arcadis employee that is appropriately trained at the correct level of internal hazardous materials/DOT (Department of Transportation) shipping must complete an Arcadis shipping determination to address applicable DOT and IATA (International Air Transport Association) shipping requirements. Review the applicable Arcadis procedures and guidance instructions for sample packaging and labeling. Prior to using air transportation, confirm air shipment is acceptable under DOT and IATA regulations.*

6 HEALTH AND SAFETY CONSIDERATIONS

The HASP will be followed, as appropriate, to ensure the safety of field personnel.

Appropriate personal protective equipment (PPE) will be worn at all times in line with the task and the site-specific HASP.

Review all site-specific and procedural hazards as they are provided in the HASP, and review Job Safety Analysis (JSA) documents in the field each day prior to beginning work.

Access to wells may expose field personnel to hazardous materials such as contaminated groundwater or non-aqueous phase liquid (NAPL) (e.g., oil). Other potential hazards include pressurized wells, stinging insects that may inhabit well heads, other biologic hazards (e.g. ticks in long grass/weeds around well head), and potentially the use of sharp cutting tools (scissors, knife)—open well caps slowly and keep face and body away to allow to vent any built-up pressure; only use non-toxic peppermint oil spray for stinging insect nests; review client-specific health and safety requirements, which may preclude the use of fixed/folding-blade knives, and use appropriate hand protection. Overtightening of lids with Teflon® liners can cause the glass to shatter and create a risk for hand injuries.

Generators and cord and plug equipment will employ an overcurrent protection device such as an integrated ground fault circuit interrupter (GFCI) cord. Grundfos pump controllers will not run properly with a GFCI, so the power source will be equipped with other overcurrent protection means.

If thunder or lighting is present, discontinue sampling until 30 minutes have passed after the last occurrence of thunder or lighting.

7 PROCEDURE

The general procedure for using traditional purging and sampling techniques to sample monitoring wells are outlined below:

1. Review equipment list (**Section 4** above) to confirm that the appropriate equipment has been acquired.
2. Don PPE as required in the HASP

   a. NOTE: *Depending on site-specific security and safety considerations, this often must be done prior to entering the work area*

3. Calibrate field instruments according to manufacturer procedures for calibration and document accordingly on the calibration logs, field form, and/or field logbook
4. All equipment will either be new or decontaminated in accordance with appropriate guidance document (*TGI – Groundwater and Soil Sampling Equipment Decontamination)* prior to use
5. Record site and monitoring well identification on the groundwater sampling log (**Attachment A**), along with date, arrival time, weather conditions, personnel present, equipment utilized, and other relevant data requested on the log.
6. Label all sample containers with indelible ink
7. Place plastic sheeting adjacent to the well for use as a clean work area, if conditions allow, otherwise, exercise care to prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity
8. Visually inspect the well to ensure that it is undamaged, properly labeled and secured
   a. Damage or other conditions that may affect the integrity of the well will be recorded in the Field Activity Daily Log and brought to the attention of the designated Field Manager and/or Project Manager
   b. Record well construction and conditions on the Groundwater Sampling Field Form (**Attachment A**)
9. Remove lock from well and if rusted or broken, replace with a new brass keyed-alike lock
10. Safely open well
    a. Unlock and open the well cover while standing upwind of the well
    b. Remove well cap and place on the plastic sheeting
    c. Insert the PID probe approximately 4 to 6 inches into the casing or the well headspace and cover it with a gloved hand
    d. Record the PID reading on the field log
    e. Perform air monitoring in the breathing zone according to the HASP and/or JSA
11. Set the sampling device, meters, and other sampling equipment on the plastic sheeting
    a. If a dedicated sampling device stored in the well is to be used, this may also be set temporarily on the plastic sheeting
    b. If a dedicated sampling device is stored below the water table, removing it may compromise water-level data, so water-level measurements will be taken prior to removing the device (see next step)
12. Obtain a water-level depth and bottom-of-well depth using an electric well probe prior to placing the pump and record on the groundwater sampling log using indelible ink

a. Make sure to decontaminate the probe(s) after each use in accord with the FIP/sampling plan or the equipment decontamination TGI

NOTE: *Water levels may be measured at all wells prior to initiating any sampling activities, depending on FIP requirements.*

13. Prepare for pump installation:
    a. For submersible and non-dedicated bladder pumps, decontaminate the pump according to site decontamination procedures
    b. Non-dedicated bladder pumps will require a new bladder and attachment of an air-line, sample discharge line, and safety cable prior to placement in the well
    c. Attach the air-line tubing to the air-port on the top of the bladder pump
    d. Attach the sample discharge tubing to the water port on the top of the bladder pump taking care not to reverse the air and discharge tubing lines during bladder pump setup, as this could result in bladder failure or rupture
    e. Attach and secure a safety cable to the eyebolt on the top of bladder pump (if present, depending on pump model used)
14. Slowly lower the pump, safety cable, tubing, and electrical lines into the well to a depth corresponding to the approximate center of the saturated screen section of the well
    a. Avoid twisting and tangling of safety cable, tubing, and electrical lines while lowering the pump into the well; twisted and tangled lines could result in the pump becoming stuck in the well casing
    b. Make sure to keep tubing and lines from touching the ground or other surfaces while introducing them into the well, as this could lead to well contamination
    c. If a peristaltic pump is being used, slowly lower the sample tubing into the well to a depth corresponding to the approximate center of the saturated screen section of the well
    d. The pump intake or sample tubing must be kept at least 2 feet above the bottom of the well to prevent mobilization of any sediment present in the bottom of the well
15. If using a bladder pump, connect the air-line to the pump controller output port
    a. The pump controller will then be connected to a supply line from an air compressor or compressed gas cylinder using an appropriate regulator and air hose
    b. Tighten the regulator connector onto the gas cylinder (if used) to prevent leaks. Teflon® tape may be used on the threads of the cylinder to provide a tighter seal
    c. Once the air compressor or gas cylinder is connected to the pump controller, turn on the compressor or open the valve on the cylinder to begin the gas flow
    d. Turn on the pump controller power if an on/off switch is present and verify that all batteries are charged and fully operating before beginning to pump

16. Calculate the number of gallons of water in the well using the length of water column (in feet). Record the well volume on the groundwater sampling log using indelible ink
17. Remove the required purge volume of water from the well (measure purge water volume in measuring buckets)
    a. The required purge volume will be three to five well volumes (the water column in the well screen and casing) unless the well runs dry, in which case, the water that comes into the well will be sampled (USEPA, 1986)
    b. For wells screened across the water table, the well may be pumped dry and sampling can commence as soon as the volume in the well has recovered sufficiently to permit collection of samples
    c. For wells screened entirely below the water table, the well may be pumped until the drawdown is at a level slightly higher than top of the well screen
    d. Sampling may commence after one well volume has been removed and the well has recovered sufficiently to permit collection of samples
    e. In any case, the pumping rate will be decreased during sampling to limit the potential for volatilization of organics potentially present in the groundwater
18. Field parameter measurements will be periodically collected in accordance with FIP/sampling plan specifications
    a. Typical time intervals of field parameter measurement are (1) after each well volume removed, and (2) before sampling
    b. If the field parameters are being measured above-ground (rather than with a downhole probe), then the final pre-sampling parameter measurement will be collected at the reduced flow rate to be used during sampling
    c. Physical appearance of the purged water will be noted on the groundwater sampling log
    d. Water-level measurements will be collected and recorded to verify that the well purging is in accordance with the guidelines set forth in the previous step
19. Unless otherwise specified by the applicable regulatory agencies, all purge water will be containerized
    a. Containerized purge water will be managed in accordance with the FIP/sampling plan/work plan
    b. If historical concentrations in the well are less than federal- or state-regulated concentrations appropriate for current land use, *and permission has been granted by the oversight regulatory agency* to dispose of clean purge water on the ground next to the well(s), then purge water may be allowed to infiltrate into the ground surface downgradient from the monitoring well after the well is sampled—*this will be specified in the FIP/sampling plan*

20. After the appropriate purge volume of groundwater in the well has been removed, or if the well has run dry and allowed to recover, obtain the groundwater sample needed for analysis via the dedicated bailer or from the dedicated sample tubing, pour the groundwater directly from the sampling device into the appropriate container in the order of volatilization sensitivity of the parameters sampled, and tightly screw on the cap (snug, but not too tight)

    NOTE: *The suggested order for sample parameter collection, based on volatilization sensitivity, is presented below:*

    a. *volatile organic compounds (VOCs);*
    b. *semi-volatile organic compounds (SVOCs);*
    c. *polychlorinated biphenyls (PCBs)/pesticides;*
    d. *metals; and*
    e. *wet chemistry*.

    NOTE: *When sampling for volatiles, water samples will be collected directly from the bailer or dedicated tubing into 40-mL vials with Teflon®-lined septa*.

    NOTE: *For other analytical samples, sample containers for each analyte type will be filled in the order specified by the FIP/sampling plan. If a bailer is used, then the sample for dissolved metals and/or filtered PCBs will either be placed directly from the bailer into a pressure filter apparatus or pumped directly from the bailer with a peristaltic pump, through an in-line filter, into the pre-preserved sample bottle. If dedicated sample tubing is used, then the filter will be installed in-line just prior to filtered sample collection.*

    NOTE: *If sampling for total and filtered metals and/or PCBs, a filtered and unfiltered sample will be collected. Sample filtration for the filtered sample will be performed in the field utilizing a pump prior to preservation. Attach (clamp) a new 1.0-, 0.45-, or 0.1-micron filter to the discharge tubing of the pump (note the filter flow direction). Turn the pump on and allow 100 mL (or manufacturer recommended amount) of fluid to flow through the filter before sample collection. Dispense the filtered liquid directly into the laboratory sample bottles. If bailers are used for purging and sampling, a proper volume of purge water will be placed in a disposable or decontaminated polyethylene container and pumped through the filter and into the sample container using a peristaltic pump.*

21. As samples are collected, note the corresponding time on the sample label
22. Secure sample containers with packing material and maintain at approximately 4°C on wet ice contained in double Ziploc-type freezer bags stored in an insulated, durable transport cooler
23. Turn off the pump and air compressor or close the gas cylinder valve if using a bladder pump setup.
24. Slowly remove the pump, tubing, lines, and safety cable from the well
    a. If using dedicated tubing/lines, do not allow them to touch the ground or any other surfaces which could result in contamination

b. If tubing is to be dedicated to a well, it will be folded to a length – without pinching it – that will allow the well to be capped and also facilitate retrieval of the tubing during later sampling events

c. Use a length of rope or string to tie the tubing to the well cap

d. Alternatively, if tubing and safety line are to be saved and reused for sampling the well at a later date, they may be coiled neatly and placed in a clean plastic bag that is clearly labeled with the well ID and tightly sealed before placing it in storage

25. Record the time sampling procedures were completed on the groundwater sampling field forms using indelible ink

26. Secure the well: replace the well cap and lock well or install a new lock if needed

    a. If new locks were installed, forward copies of the keys to the client Project Manager (PM) and Arcadis CPM at the end of the sampling activities

27. Complete the procedures for chain-of-custody, handling, packing, and shipping

    a. Chain-of-custody forms will be filled out and checked against the labels on the sample containers progressively after each sample is collected

28. Properly dispose of personal protective equipment (PPE) and disposable equipment—place all disposable sampling materials (e.g., plastic sheeting, disposable tubing or bailers, and PPE) in appropriate containers

29. Complete decontamination of sampling equipment (e.g., submersible or bladder pump) as appropriate (*TGI – Groundwater and Soil Sampling Equipment Decontamination*)

30. At the end of each day of the sampling event, perform calibration check of field instruments and record procedure and results in field log

8 WASTE MANAGEMENT

Investigation-Derived Waste (IDW), including purge water, decontamination liquids, and disposable materials (plastic sheeting, PPE, etc.) will be stored on site in appropriately labeled containers (disposable materials will be contained separately) and disposed of properly. Containers must be labeled at the time of collection and will include date, location(s), site name, city, state, and description of matrix contained (e.g., soil, PPE). Waste will be managed in accordance with the *TGI – Investigation-Derived Waste Handling and Storage,* the procedures identified in the FIP or QAPP as well as state-, federal- or client-specific requirements. Be certain that waste containers are properly labeled and documented in the field log book.

9 DATA RECORDING AND MANAGEMENT

Management of the original documents from the field will be completed in accordance with the site-specific QAPP. Records generated as a result of this TGI will be controlled and maintained in the project record files in accordance with project requirements.

In general, sampling activities will be documented on appropriate field logs as well as in a proper field notebook. All field data will be recorded in indelible ink. Field forms, logs/notes (including daily field and calibration logs), digital records, and chain-of-custody records will be maintained by the field team lead.

Initial field logs and chain-of-custody records will be transmitted to the Arcadis CPM and/or Technical Lead at the end of each day unless otherwise directed by the CPM. The field team leader retains copies of the field documentation.

Additionally, all documents (and photographs) will be scanned and electronically filed in the appropriate project directory for easy access.

10 QUALITY ASSURANCE

Quality assurance procedures will be conducted in accordance with the Arcadis Quality Management System or the site-specific QAPP.

Field-derived quality assurance blanks will be collected as specified in the FIP/sampling plan, depending on the project quality objectives. Typically, field rinse blanks (equipment blanks) will be collected when non-dedicated equipment (e.g., submersible pump) is used during groundwater sampling. Field rinse blanks will be used to confirm that decontamination procedures are sufficient and samples are representative of site conditions. Trip blanks for VOCs, which aid in the detection of contaminants from other media, sources, or the container itself, will be kept with the coolers and the sample containers throughout the sampling activities and during transport to the laboratory.

In addition to the quality control samples to be collected in accordance with this TGI, the following quality control procedures will be observed in the field:

- Collect samples from monitoring wells, in order of increasing concentration, to the extent known based on review of historical site information if available
- Equipment blanks will include the pump and tubing (if using disposable tubing) or the pump only (if using tubing dedicated to each well)
- Collect equipment blanks after wells with higher concentrations (if known) have been sampled
- Operate all monitoring instrumentation in accordance with manufacturer's instructions and calibration procedures
    - Calibrate instruments at the beginning of each day and verify the calibration at the end of each day
    - Record all calibration activities in the field notebook
- Clean all groundwater sampling equipment prior to use in the first well and after each subsequent well following the procedures outlined for equipment decontamination

11 REFERENCES

United States Environmental Protection Agency (USEPA). 1986. RCRA Groundwater Monitoring Technical Enforcement Guidance Document (September 1986).

USEPA. 1991. Handbook Ground Water, Volume II: Methodology, Office of Research and Development, Washington, DC. EPA/625/6-90/016b (July 1991).

U.S. Geological Survey (USGS). 1977. National Handbook of Recommended Methods for Water-Data Acquisition: USGS Office of Water Data Coordination. Reston, Virginia.

12 ATTACHMENTS

Attachment 1 – Groundwater Sampling Field Form

ATTACHMENTS 1

Groundwater Sampling Field Form

GROUNDWATER SAMPLING FORM

ARCADIS

Project No. _____ Well ID _____ Date _____

Project Name/Location _____ Weather _____

Measuring Pt. Description _____ Screen Setting (ft-bmp) _____ Casing Diameter (in.) _____ Well Material ____ PVC ____ SS

Static Water Level (ft-bmp) _____ Total Depth (ft-bmp) _____ Water Column (ft) _____ Gallons in Well _____

MP Elevation _____ Pump Intake (ft-bmp) _____ Purge Method: _____ Sample Method _____

Pump On/Off _____ Volumes Purged _____ Centrifugal / Submersible / Other _____

Sample Time: Label _____ Gallons Purged _____

Purge Start _____ Replicate/ Code No. _____ Sampled by _____

Purge End _____

Time	Minutes Elapsed	Rate (gpm)/(mL/min) 200mL/min +	Depth to Water (ft) -0.3	Gallons Purged	pH ± 0.1	Cond. (µMhos)/(mS/cm) ± 3%	Turbidity (NTU) ± 10%	DO (mg/L) ± 10%	Temp. (°C)/(°F) ± 3%	Redox (mV) ± 10mV	Appearance	
											Color	Odor
Stabilization Calculations (±)												
Stabilization Criteria					**± 0.1 s.u.**	**±3%**	**± 10% or within 1 NTU (1)**	**± 10%**	**±3%**	**±10 mV**		

(1) **Turbidity** < 50 NTU and ±10% or within 1 NTU of a previous reading when <10 NTU

Constituents Sampled	Container	Number	Preservative

Comments _____

Well Casing Volumes

Gallons/Foot					
	1" = 0.04	1.5" = 0.09	2.5" = 0.26	3.5" = 0.50	6" = 1.47
	1.25" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65	

Well Information

Well Location: _____ Well Locked at Arrival: Yes / No

Condition of Well: _____ Well Locked at Departure: Yes / No

Well Completion: Flush Mount / Stick Up Key Number To Well: _____

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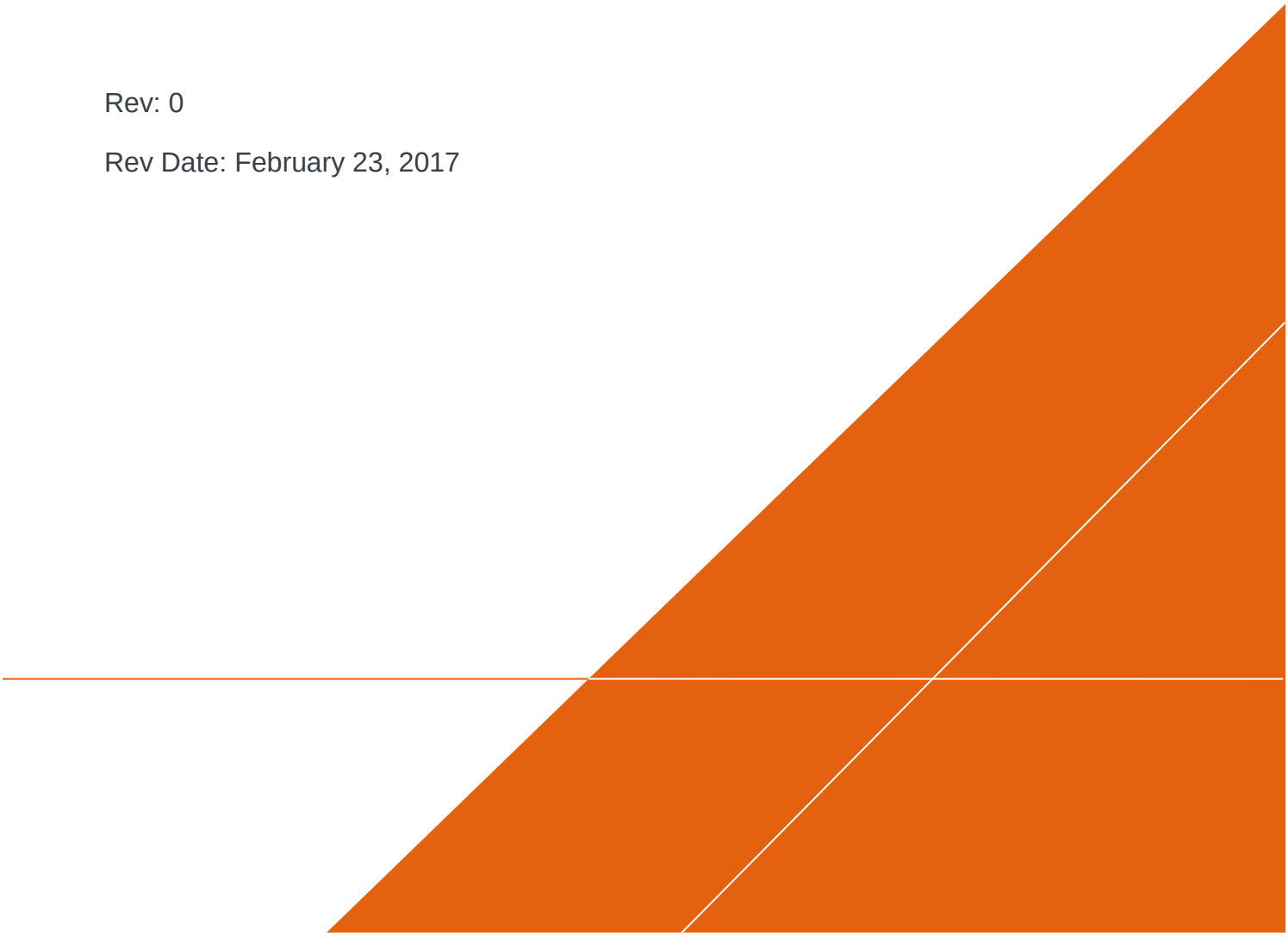
TGI – GROUNDWATER AND SOIL SAMPLING EQUIPMENT DECONTAMINATION

Rev: 0

Rev Date: February 23, 2017



VERSION CONTROL

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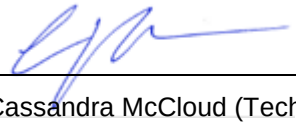
0	February 23, 2017	ALL	Conversion from SOP to TGI	Cassandra McCloud / Pete Frederick

APPROVAL SIGNATURES

Prepared by:  Date: 02/23/2017

Derrick Maurer

Technical Expert Reviewed by:  Date: 02/23/2017

Cassandra McCloud (Technical Expert)

1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to any and all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, state-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

Decontamination is performed on sampling equipment prior to sample collection to ensure that the sampling equipment that contacts a sample, or monitoring equipment that is brought into contact with environmental media to be sampled, is free from analytes of interest and/or constituents that could interfere with laboratory analysis for analytes of interest. Sampling equipment must be appropriately cleaned prior to use for sampling or coming into contact with environmental media to be sampled, and following completion of the sampling event prior to shipment or storage. The effectiveness of the decontamination procedure should be verified by collecting and analyzing equipment blank samples.

The sampling equipment cleaning procedures described herein includes pre-field, in the field, and post-field cleaning of sampling equipment which may be conducted at an established equipment decontamination area (EDA) on site, as appropriate and necessary. Sampling equipment that may require decontamination at a given site includes: soil sampling tools; groundwater, sediment, and surface-water sampling devices; water testing instruments; down-hole instruments; and other activity-specific sampling equipment. Non-disposable equipment will be cleaned before collecting each sample, between each

sample collected, and prior to placing sampling equipment in protective cases, or containers for transport. Cleaning procedures for sampling equipment should be monitored by collecting equipment blank samples as required in project work plans, field sampling plans, quality assurance project plans (QAPP), or other pertinent project documents. Dedicated and/or single-use (i.e., not to be re-used) sampling equipment will not require decontamination.

3 PERSONNEL QUALIFICATIONS

Arcadis field sampling personnel will have completed or are in the process of completing site-specific training as well as having current health and safety training as required by Arcadis, client, or regulations, such as 40-hour HAZWOPER training and/or OSHA HAZWOPER site supervisor training. Arcadis personnel will also have current training as specified in the Health and Safety Plan (HASP) which may include first aid, cardiopulmonary resuscitation (CPR), Blood Borne Pathogens (BBP) as needed. In addition, Arcadis field sampling personnel will be knowledgeable in the relevant processes, procedures, and Technical Guidance Instructions (TGIs) and possess the demonstrated required skills and experience necessary to successfully complete the desired field work. The project health and safety plan (HASP) and other documents will identify other training requirements or access control requirements.

4 EQUIPMENT LIST

The equipment required for equipment decontamination is presented below:

- Health and safety equipment, including appropriate PPE, as required in the site Health and Safety Plan (HASP)
- Deionized water that meets that analytical criteria for deionized water with no detectable constituents above the reporting limits for the methods to be used and analytes being analyzed for. Deionized water is used for inorganics, and organic-free water for VOCs, SVOCs, pesticides, etc.
- Non-phosphate detergent such as Alconox or, if sampling for phosphorus or phosphorus-containing compounds, Liquinox (or equivalent).
- Tap water
- Rinsate collection plastic containers
- DOT-approved waste shipping container(s), as specified in the work plan, field sampling plan, or regulatory requirements if decontamination waste is to be shipped for disposal
- Brushes
- Large heavy-duty garbage bags
- Spray bottles
- (Optional) – Isopropyl alcohol (free of ketones) or methanol. These can be wipes or diluted with water (usually 1part isopropyl/methanol to 10 parts water) if a spray is needed.
- Airtight, sealable plastic baggies, such as Ziploc-type
- Plastic sheeting

5 CAUTIONS

Rinse equipment thoroughly and allow the equipment to dry before re-use or storage to prevent introducing solvent into sample medium. If manual drying of equipment is required, use clean lint-free material to wipe the equipment dry. Ensure all rinsate materials do not adversely affect sample collection efficiency or analytical results.

Store decontaminated equipment in a clean, dry environment. Do not store near combustion engine exhausts. Properly containerize equipment to ensure cross-contamination doesn't happen from other uncontaminated surfaces or equipment.

If equipment is damaged to the extent that decontamination is uncertain due to cracks, gouges, crevices, or dents, the equipment should not be used and should be discarded or submitted for repair prior to use for sample collection.

A proper shipping determination regarding hazardous materials will be performed by a DOT-trained individual for cleaning materials shipped by Arcadis.

Caution should be exercised to avoid contact with the pump casing and water in the container while the pump is running (do not use metal drums or garbage cans) to avoid electric shock.

6 HEALTH AND SAFETY CONSIDERATIONS

Review the safety data sheets (SDS) for the cleaning agents and materials used in decontamination. If solvent is used during decontamination, use appropriate PPE and work in a well-ventilated area and stand upwind while applying solvent to equipment. Apply solvent in a manner that minimizes potential for exposure to workers and bystanders. Follow health and safety procedures outlined in the HASP.

7 PROCEDURE

A designated area will be established to clean sampling equipment in the field prior to and following sample collection. Equipment cleaning areas will be set up within or adjacent to the specific work area, but not at a location that expose equipment to contamination (i.e. exposed to combustion engine exhaust). Detergent solutions will be prepared in clean containers for use in equipment decontamination. Decontaminated equipment should be handled by workers wearing clean gloves, properly changed to prevent cross-contamination.

Cleaning Sampling Equipment

1. Wash the equipment/pump with potable water.
2. Wash with detergent solution (Alconox, Liquinox or equivalent) to remove all visible particulate matter and any residual oils or grease.
3. If equipment is very dirty, precleaning gross debris with a brush and tap water may be necessary.
4. If non-aqueous phase liquids are present, the use of isopropyl alcohol (free of ketones) or methanol is recommended. Cloth wipes or diluted solution can be used to remove the non-aqueous phase liquids that are hard to remove with detergent solution in step 2. Consult with project manager if

non-aqueous phase liquids are present onsite and design an appropriate decontamination procedure that includes step 4.

5. Rinse with deionized water.

Decontaminating Submersible Pumps

Submersible pumps may be used during well development, groundwater sampling, or other investigative activities. The pumps must be cleaned and flushed before and between uses. This cleaning process will consist of an external detergent solution wash and tap water rinse, a flush of detergent solution through the pump, followed by a flush of potable water through the pump. Flushing will be accomplished by using an appropriate container filled with detergent solution and another container filled with potable water. The pump should be flushed with deionized water as the last step prior to use. The pump will run long enough to effectively flush the pump housing and hose (unless new, disposable hose is used). Disconnect the pump from the power source before handling. The pump and hose should be placed on or in clean polyethylene sheeting to avoid contact with the ground surface.

8 WASTE MANAGEMENT

Equipment decontamination rinsate will be managed in conjunction with all other waste produced during the field sampling effort. Waste management procedures are outlined in the work plan or Waste Management Plan (WMP).

9 DATA RECORDING AND MANAGEMENT

Equipment cleaning and decontamination will be noted in the field notebook for project documentation. Information will include the type of equipment cleaned, the decontamination location, specific procedures utilized, solvents and/or cleaning agents used, source of water, and deviations or omissions from this TGI.

Unusual field conditions should be noted if there is potential to impact the efficacy of the decontamination or subsequent sample collection.

An inventory of the solvents brought on site and used and removed from the site will be maintained in the project documentation. Records will be maintained for solvents used in decontamination, including lot number and expiration date.

Containers with decontamination fluids will be labeled.

10 QUALITY ASSURANCE

Equipment blanks should be collected to verify that the decontamination procedures are effective in minimizing potential for cross contamination. The equipment blank is prepared by pouring deionized water (or organic-free water, for organic analyses) over the clean and dry tools and collecting the water into appropriate sample containers. Equipment blanks should be analyzed for the same set of parameters that are performed on the field samples collected with the equipment that was cleaned as specified in the sampling and analysis plan. Equipment blanks are collected per equipment set, which represents all of the tools needed to collect a specific sample.

11 REFERENCES

USEPA Region 9 - Field Sampling Guidance #1230, Sampling Equipment Decontamination.

USEPA Region 1 - Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells.

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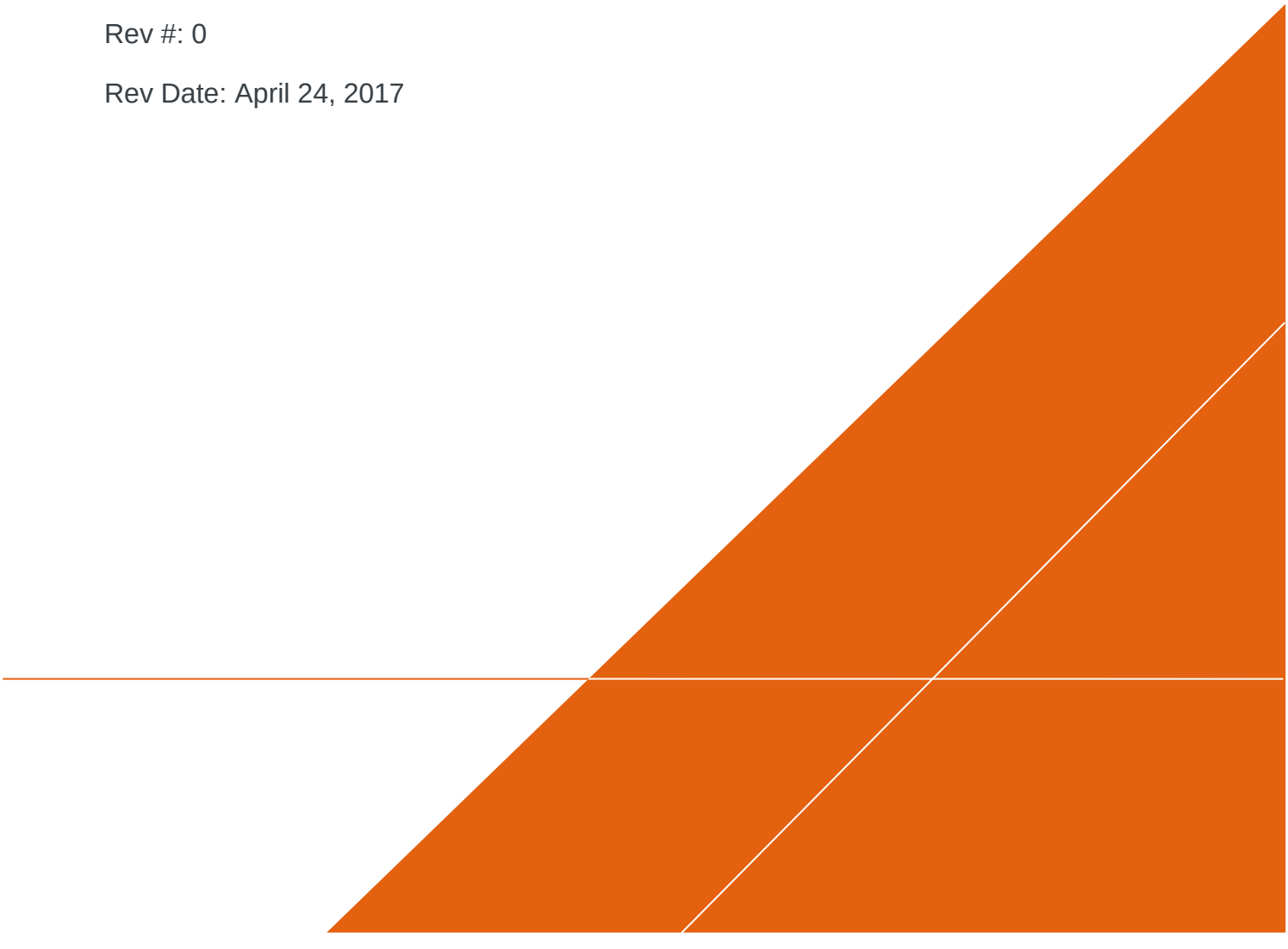
TGI - MONITORING WELL INSTALLATION

Rev #: 0

Rev Date: April 24, 2017



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0	4/24/2017	All	Re-written as a TGI	Marc Killingstad Peter C. Frederick

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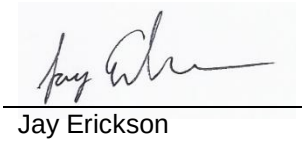
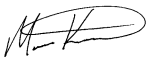
Prepared by:		4/20/17
	Jay Erickson	Date:
Technical Expert Reviewed by:		4/24/17
	Marc Killingstad	Date:

1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

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2 SCOPE AND APPLICATION

This Technical Guidance Instruction (TGI) describes methods used to install groundwater monitoring wells in granular aquifers. It is assumed that the monitoring well has been properly designed, including sizing of the filter pack and screen, the length of the screen, total depth of the well, material strength and compatibility and surface completion. Typical monitoring wells are constructed of manufactured screen and engineered filter pack and are generally suitable for formations with granular materials having a grain size distribution with up to 50% passing a #200 sieve and up to 20% clay-sized material. Monitoring wells installed in formations finer than this may not be able to produce turbidity free water.

The monitoring well installation procedures set forth herein are consistent with the approach and methods presented in the American Society of Testing and Materials (ASTM) D5092 – *Standard Practice for Design and Installation of Groundwater Monitoring Wells* (ASTM D5092). As such, following this TGI in combination with proper well design (see appropriate TGI), well development (see appropriate TGI), groundwater sampling procedures (see appropriate TGI), and well maintenance and rehabilitation (see appropriate TGI), will result in a monitoring well suitable for: (1) collection of groundwater samples

representative of the surrounding formation and free of artificial turbidity; (2) measurement of accurate groundwater levels; and (3) hydraulic conductivity testing of formation sediments immediately adjacent to the open interval of the well (e.g., slug testing).

Monitoring well boreholes in unconsolidated (overburden) materials are typically drilled using the hollow-stem auger drilling method. Other drilling methods that are also suitable for installing overburden monitoring wells, and are sometimes necessary due to site-specific geologic conditions or project objectives, include: drive-and-wash, spun casing, Rotasonic, dual-rotary (Barber Rig), and fluid/mud rotary with core barrel or roller bit. Direct-push techniques (e.g., Geoprobe or cone penetrometer) and driven well points may also be used in some cases within the overburden. Monitoring wells to be installed within consolidated materials such as fractured bedrock are commonly drilled using water-rotary (coring or tri-cone roller bit), air rotary or Rotasonic methods. For guidance when installing monitoring wells in consolidated materials, please refer to the appropriate document. The drilling method to be used at a given site will be selected based on site-specific consideration of anticipated drilling/well depths, site or regional geologic knowledge, type of monitoring to be conducted using the installed well, project objectives, and cost.

No oils or grease will be used on equipment introduced into the boring (e.g., drill rod, casing, or sampling tools). No polyvinyl chloride (PVC) glue/cement will be used in constructing or retrofitting monitoring wells that will be used for water-quality monitoring. No coated bentonite pellets will be used in the well drilling or construction process. Specifications of materials to be installed in the borehole will be obtained prior to mobilizing onsite; these materials generally include:

- Well casing (length, material, and diameter);
- Well screen (length, material, diameter, and slot size);
- Bentonite (type, as applicable, chips, non-coated and granular bentonite are acceptable);
- Filter pack (filter pack type and fine sand seal type, as applicable); and
- Grout (type, as applicable).

Well materials will be inspected and, if needed, cleaned or replaced prior to installation.

3 PERSONNEL QUALIFICATIONS

Monitoring well installation activities will be performed by persons who have been trained in proper well installation procedures under the guidance of an experienced field geologist, engineer, or technician. Where field sampling is performed for soil or bedrock characterization, field personnel will have undergone in-field training in soil or bedrock description methods, as described in the appropriate Standard Operating Procedures (SOPs) and/or TGIs for those activities.

4 EQUIPMENT LIST

The following materials will be available during soil boring and monitoring well installation activities, as required:

- Site Plan with proposed soil boring/well locations;

- Work Plan (or equivalent), Field Sampling Plan (FSP), and site-specific Health and Safety Plan (HASP);
- Personal protective equipment (PPE), as required by the HASP;
- Traffic cones, delineators, caution tape, and/or fencing as appropriate for securing the work area, if such are not provided by drillers;
- Appropriate soil sampling equipment (e.g., stainless steel spatulas, knife);
- Soil and/or bedrock logging equipment as specified in the appropriate project documents;
- Appropriate sample containers and labels;
- Drum labels as required for investigation derived waste handling;
- Chain-of-custody forms;
- Insulated coolers with ice, when collecting samples requiring preservation by chilling;
- Photoionization detector (PID) or flame ionization detector (FID);
- Ziplock style bags;
- Water level or oil/water interface meter;
- Locks and keys for securing the well after installation;
- Decontamination equipment (bucket, distilled or deionized water, cleansers appropriate for removing expected chemicals of concern, paper towels);
- Engineer's tape/measuring wheel;
- Weighted tape;
- Disposable bailers;
- Digital camera (or phone with camera)
- Field notebook or Personal Digital Assistant (PDA); and
- Appropriate field forms, consider including a photo of the well head and a Google Earth map showing the well location.

Prior to mobilizing to the site, Arcadis personnel will contact the drilling subcontractor or in-house driller (as appropriate) to confirm that appropriate sampling and well installation equipment will be provided. Specifications of the sampling and well installation equipment are expected to vary by project, and so communication with the driller is necessary to ensure that the materials provided will meet the project objectives. Equipment/materials typically provided by the driller could include:

- Drilling equipment required by the ASTM standard guidance document D1586, when performing split-spoon sampling;
- Disposable plastic liners (when drilling with direct-push equipment);
- Drums for investigation derived waste;

- Drilling and sampling equipment decontamination materials;
- Decontamination pad materials, if required; and
- Well construction materials.

5 CAUTIONS

Prior to beginning field work, underground utilities in the vicinity of the drilling areas will be delineated by the drilling contractor or an independent underground utility locator service. See appropriate guidance for proper utility clearance protocol.

Prior to beginning field work, contact the project technical team to ensure that all field logistics (e.g., access issues, health and safety issues, communication network, schedules, etc.) and task objectives are clearly understood by all team members.

Some regulatory agencies require a minimum annular space between the well or permanent casing and the borehole wall. When specified, the minimum clearance is typically 2 inches on all sides (e.g., a 2-inch diameter well requires a 6-inch diameter borehole). In addition, some regulatory agencies have specific requirements regarding grout mixtures. Determine whether the oversight agency has any such requirements prior to finalizing the drilling and well installation plan.

If dense non-aqueous phase liquids (DNAPL) are known or expected to exist at the site, refer to the project specific documents for additional details regarding drilling and well installation to reduce the potential for inadvertent DNAPL remobilization.

Similarly, if light non-aqueous phase liquids (LNAPLs) are known or expected to be present as “perched” layers above the water table, refer to the DNAPL Contingency Plan. Follow the general provisions and concepts in the DNAPL contingency plan during drilling above the water table at known or expected LNAPL sites.

Avoid using drilling fluids or materials that could impact groundwater or soil quality, or could be incompatible with the subsurface conditions.

Similarly, consider the compatibility between the well materials and the surrounding environment. For example, PVC well materials are not preferred when DNAPL is present. In addition, some groundwater conditions leach metals from stainless steel or are corrosive to metal well materials. If questions arise, contact the CPM and/or project technical lead to discuss.

Water used for drilling and sampling of soil or bedrock, decontamination of drilling/sampling equipment, or grouting boreholes upon completion will be of a quality acceptable for project objectives. Testing of water supply should be considered.

Specifications of materials used for backfilling the borehole will be obtained, reviewed and approved to meet project quality objectives. Bentonite is not recommended where DNAPLs are likely to be present or in groundwater with high salinity. In these situations, neat cement grout is preferred.

As noted above, coated bentonite pellets will not be used in monitoring well construction, as the coating could impact the water quality in the completed well.

Heat of hydration during neat cement grout curing must be considered to avoid damage to PVC well materials. The annular space for a typical monitoring well is small enough that heat of hydration should not create excessive temperature increases which may damage PVC well material. However, washouts in the borehole can lead to thick accumulations of grout which can produce enough heat during curing to weaken and potentially damage PVC casing. If heat of hydration is a concern, contact the project technical lead to address the issue.

6 HEALTH AND SAFETY CONSIDERATIONS

Field activities associated with monitoring well installation will be performed in accordance with a site-specific HASP, a copy of which will be present on site during such activities.

7 PROCEDURE

The procedures for installing groundwater monitoring wells are presented below:

Hollow-Stem Auger, Drive-and-Wash, Spun Casing, Fluid/Mud Rotary, Rotasonic, and Dual-Rotary Drilling Methods

1. Prior to monitoring well installation, determine the expected volumes of filter pack and seal materials including bentonite (if applicable) and grout (neat cement or cement-bentonite).
2. Locate boring/well location, establish work zone, and set up sampling equipment decontamination area.
3. Advance boring to desired depth. Collect soil and/or bedrock samples at appropriate interval as specified in the Work Plan (or equivalent) and/or FSP. Collect, document, and store samples for laboratory analysis as specified in the Work Plan and/or FSP. Decontaminate equipment between samples in accordance with the Work Plan (or equivalent) and/or FSP. A common sampling method that produces high-quality soil samples with relatively little soil disturbance is described in ASTM D1586 – *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils* (ASTM D1586). Split-spoon samples are obtained during drilling using hollow-stem auger, drive-and-wash, spun casing, and fluid/mud rotary. Rotasonic drilling produces soil cores that, for the most part, are relatively undisturbed, but note that when drilling in consolidated or finer-grained sediment the vibratory action during core barrel advancement may create secondary fractures or breaks. Dual-rotary removes cuttings by compressed air or water/mud and allow only a general assessment of geology.
4. Describe each soil sample as outlined in the appropriate project records. Record descriptions in the field notebook and/or personal digital assistant (PDA). It is also beneficial to photo document the samples. It should be noted that PDA logs must be electronically backed up and transferred to a location accessible to other project team members as soon as feasible to retain and protect the field data. During soil boring advancement, document all drilling events in field notebook, including blow counts (number of blows required to advance split-spoon sampler in 6-inch increments) and work stoppages. Blow counts will not be available if Rotasonic, dual-rotary, or direct-push methods are used.

5. If it is necessary to install a monitor well into a permeable zone below a confining layer, particularly if the deeper zone is believed to have water quality that differs significantly from the zone above the confining layer, then a telescopic well construction should be considered. In this case, the borehole is advanced approximately 3 to 5 feet into the top of the confining layer, and a permanent casing (typically PVC, black steel or stainless steel) is installed into the socket drilled into the top of the confining layer. The casing is then grouted in place. The preferred methods of grouting telescoping casings include: pressure-injection grouting using an inflatable packer installed temporarily into the base of the casing, such that grout is injected out the bottom of the casing until it is observed at ground surface outside the casing; displacement-method grouting (also known as the Halliburton method), which entails filling the casing with grout and displacing the grout out the bottom of the casing by pushing a drillable plug, typically made of wood to the bottom of the casing, following by tremie grouting the remainder of the annulus outside the casing; or tremie grouting the annulus surrounding the casing using a tremie pipe installed to the base of the borehole. In all three cases, the casing is grouted to the ground surface, and the grout is allowed to set prior to drilling deeper through the casing. Site-specific criteria and work plans should be created for the completion of non-standard monitoring wells, including telescopic wells.

6. Before installing a screened, it is important to confirm that the borehole has been advanced into the targeted saturated zone. This is particularly important for wells installed to monitor the water table and/or the shallow saturated zone, as the capillary fringe may cause soils above the water table to appear saturated. If one or more previously installed monitoring wells exist nearby, use the depth to water at such well(s) to estimate the water-table depth at the new borehole location.

   To verify that the borehole has been advanced into the saturated zone, it is necessary to measure the water level in the borehole. For boreholes drilled without using water (e.g., hollow-stem auger, cable-tool, air rotary, air hammer), verify the presence of groundwater (and /or LNAPL, if applicable) in the borehole using an electronic water level probe, oil-water interface probe, or a new or decontaminated bailer. For boreholes drilled using water (e.g., drive and wash, spun-casing with roller-bit wash, Rotasonic, or water rotary with core or roller bit), monitor the water level in the borehole as it re-equilibrates to the static level. In low-permeability units like clay, fine-grained glacial tills, shale and other bedrock formations, it may be necessary to wait overnight to allow the water level to equilibrate. Document depth to water in the borehole on the appropriate field forms and field notebook. If there are questions concerning the depth of the well/screen interval, consult with the project technical lead prior to finalizing well depth/screen interval. To the extent practicable, ensure that the depth of the well below the apparent water table is deep enough so that the installed well can monitor groundwater year-round, accounting for seasonal water-table fluctuations. When in doubt, err on the side of slightly deeper well installation.

7. Upon completing the borehole to the desired depth, if a screened well construction is desired, install the monitoring well by lowering the screen and casing assembly with sump through the augers or casing. Monitoring wells typically will be constructed of 2-inch-diameter (although sometimes 4-inch), flush-threaded PVC or stainless steel slotted or wire wrapped well screen and blank riser casing. Smaller diameters may be used if wells are installed using direct-push methodology or if multiple wells are to be installed in a single borehole. The screen length will be specified in the Work Plan (or equivalent) or FSP based on regulatory requirements and specific monitoring objectives. Monitoring well screens are usually 5 to 10 feet long, but may be up to 25 feet long in very low permeability, thick

geologic formations. The screen length will depend on the purpose for the well and the objectives of the groundwater investigation and will (in most cases) be determined prior to the field mobilization.

The slot size and filter pack gradation should be predetermined in the Work Plan (or equivalent) or FSP and based on site-specific grain-size analysis (sieve analysis) or other geologic considerations or monitoring objectives. Typically, slot sizes for monitoring wells will range from 0.010 inches to 0.020 inches while the filter pack will be 20-40, Morie No. 0, or equivalent. In very fine-grained formations where sample turbidity needs to be minimized, it may be preferred to use a 0.006-inch slot size and 30-65, Morie No. 00, or equivalent filter pack. Alternatively, where monitoring wells are installed in coarse-grained deposits and higher well yield is required, a 0.020-inch slot size and 10-20, Morie No. 1, or equivalent filter pack may be preferred. If the screen slot size and filter pack have not been based on site-specific grain-size analysis, consider collecting soil samples during well installation so future wells can be properly designed.

A blank sump may be attached below the well screen if the well is being installed for DNAPL recovery/monitoring purposes. If so, the annular space around the sump may be backfilled with neat cement grout using a tremie to the bottom of the well screen prior to placing the filter pack around the screen. A blank riser will extend from the top of the screen to approximately 2.5 feet above grade or, if necessary, just below grade where conditions warrant a flush-mounted monitoring well. For wells greater than 50 feet deep, centralizers may be desired to assist in centering the monitoring well in the borehole during construction.

8. When the monitoring well assembly has been set in place and the grout has been placed around the sump (if any), place a washed silica filter pack in the annular space from the bottom of the boring to a height of 1 to 2 feet above the top of the well screen (following specifications in the Work Plan) using a tremie. The filter pack is placed and drilling equipment extracted in increments until the top of the sand pack is at the appropriate depth. Verify that the expected volume of filter pack matches with the actual amount installed. There can be differences due to irregularities in the borehole. Washout of the borehole will result in the need for greater than calculated well materials. If a difference of more than 10% is noted, consult with the project technical team. The filter pack will be consistent with the screen slot size and the soil particle size in the screened interval, as specified in the Work Plan (or equivalent) or FSP. The well should be gently surged to prevent filter pack material bridging and to settled the filter pack prior to well seal installation.
9. A hydrated bentonite seal (a minimum of 2 feet thick) will then be placed in the annular space above the sand pack (alternatively, in some cases a fine sand seal may be installed instead of bentonite—follow the specifications in the Work Plan). If non-hydrated bentonite is used, the bentonite should be permitted to hydrate in place for a minimum of 30 minutes before proceeding. *No coated bentonite pellets will be used in monitoring well drilling or construction*. Potable water may be added to hydrate the bentonite if the seal is above the water table. Monitor the placement of the sand pack and bentonite with a weighted tape measure.
10. During the extraction of the augers or casing, a cement/bentonite or neat cement grout will be placed in the annular space from the bentonite seal to a depth approximately 2 ft. below groundwater surface (bgs) or as specified in the Work Plan (or equivalent). As with the filter pack, it is recommended that seal material be placed with a tremie pipe. Ensure that seal materials are mixed at the proper ratios with water following manufacturer's recommendations.

11. Install the monitoring well completion as specified Work Plan (or equivalent). Typical completions are a locking, steel protective casing (extended at least 1.5 feet below grade and 2 feet above grade) over the riser casing and secure with a neat cement seal. Alternatively, for flush-mount completions, place a steel curb box with a bolt-down lid over the riser casing and secure with a neat cement seal. In either case, the cement seal will extend approximately 1.5 to 2.0 feet below grade and laterally at least 1 foot in all directions from the protective casing, and should slope gently away to promote drainage away from the well.
12. Monitoring wells should be labeled using indelible ink or paint with the appropriate designation on both the inner and outer well casings or inside of the curb box lid.
13. When an above-grade completion is used, the riser will be sealed using an expandable locking plug and the top of the well will be vented by drilling a small-diameter (1/8 inch) hole near the top of the well casing or through the locking plug, or by cutting a vertical slot in the top of the well casing. When a flush-mount installation is used, the riser will be sealed using an unvented, expandable locking plug.
14. During well installation, record construction details and actual measurements relayed by the drilling contractor and tabulate materials used (e.g., screen and riser footages; bags of bentonite, cement, and sand) in the field notebook as well as appropriate field forms.
15. After completing the well installation, lock the well, clean the area, and dispose of materials in accordance with the procedures outlined in Section 7 below.

Direct-Push Method

The direct-push drilling method may also be used to complete soil borings and install monitoring wells. Examples of this technique include the Diedrich ESP vibratory probe system, GeoProbe®, or AMS Power Probe® dual-tube system. Environmental probe systems typically use a hydraulically operated percussion hammer. Depending on the equipment used, the hammer delivers 140- to 350-foot pounds of energy with each blow. The hammer provides the force needed to penetrate very stiff to medium dense soil formations. The hammer simultaneously advances an outer steel casing that contains a dual-tube liner for sampling soil. The outside diameter (OD) of the outer casing ranges from 1.75 to 2.4 inches and the OD of the inner sampling tube ranges from 1.1 to 1.8 inches. The outer casing isolates shallow layers and permits the unit to continue to probe at depth. The double-rod system provides a borehole that may be tremie-grouted from the bottom up. Alternatively, the inside diameter (ID) of the steel casing provides clearance for the installation of small-diameter (e.g., 0.75- to 1-inch ID) micro-wells. The procedures for installing monitoring wells in soil using the direct-push method are described below.

1. Locate boring/well location, establish work zone, and set up sample equipment decontamination area.
2. Advance soil boring to designated depth, collecting samples at intervals specified in the Work Plan (or equivalent). Samples will be collected using dedicated, disposable, plastic liners. Describe samples in accordance with the procedures outlined in Step 3 above. Collect samples for laboratory analysis as specified in the Work Plan (or equivalent) and/or FSP.
3. Upon advancing the borehole to the desired depth, install the micro-well through the inner drill casing. The micro-well will consist of approximately 1-inch ID PVC or stainless steel slotted screen and blank riser. The sand pack, bentonite seal, and cement/bentonite grout will be installed as described, where applicable, in Steps 9 through 11 above.

4. Install protective steel casing or flush-mount, as appropriate, as described in Step 12 above. During well installation, record construction details and tabulate materials used in field notebook as well as appropriate field forms.
5. After completing the well installation, lock the well, clean the area, and dispose of materials in accordance with the procedures outlined in Section 8 below.

Driven Well Point Installation

Well points will be installed by pushing or driving using a drilling rig or direct-push rig, or hand-driven where possible. The well point construction materials will consist of a 1- to 2-inch-diameter threaded steel casing with either 0.010- or 0.020-inch slotted stainless steel screen. The screen length will vary depending on the hydrogeologic conditions of the site. The casings will be joined together with threaded couplings and the terminal end will consist of a steel well point. Because they are driven or pushed to the desired depth, well points do not have annular backfill materials such as sand pack or grout.

8 WASTE MANAGEMENT

Investigation-derived wastes (IDW), including soil cuttings and excess drilling fluids (if used), decontamination liquids, and disposable materials (well material packages, PPE, etc.), will be placed in clearly labeled, appropriate containers, or managed as otherwise specified in the Work Plan (or equivalent), FSP, and/or IDW management guidance document.

9 DATA RECORDING AND MANAGEMENT

Drilling activities should be documented on appropriate field/log forms as well as in a proper field notebook and/or PDA. Additionally, all documents (and photographs) should be scanned and electronically filed in the appropriate project directory for easy access. Pertinent information will include personnel present on site, times of arrival and departure, significant weather conditions, timing of well installation activities, soil descriptions, well construction specifications (screen and riser material and diameter, sump length, screen length and slot size, riser length, sand pack type), and quantities of materials used. In addition, the locations of newly-installed wells will be documented photographically or in a site sketch. If appropriate, a measuring wheel or engineer's tape will be used to determine approximate distances between important site features.

The well location, ground surface elevation, and inner and outer casing elevations will be surveyed using the method specified in the site Work Plan (or equivalent). Generally, a local baseline control will be set up. This local baseline control can then be tied into the appropriate vertical and horizontal datum, such as the National Geodetic Vertical Datum of 1929 or 1988 and the State Plane Coordinate System. At a minimum, the elevation of the top of the inner casing used for water-level measurements should be measured to the nearest 0.01 foot. Elevations will be established in relation to the National Geodetic Vertical Datum of 1929. A permanent mark will be placed on top of the inner casing to mark the point for water-level measurements.

10 QUALITY ASSURANCE

All drilling equipment and associated tools (including augers, drill rods, sampling equipment, wrenches, and any other equipment or tools) that may have come in contact with soil will be cleaned in accordance with the procedures outlined in the appropriate SOP. Well materials will also be cleaned prior to well installation.

11 REFERENCES

American Society for Testing Materials (ASTM) D5092 - *Standard Practice for Design and Installation of Ground Water Monitoring Wells*. American Society for Testing Materials. West Conshohocken, Pennsylvania.

American Society of Testing and Materials (ASTM) D1586 - *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils*. American Society for Testing Materials. West Conshohocken, Pennsylvania.

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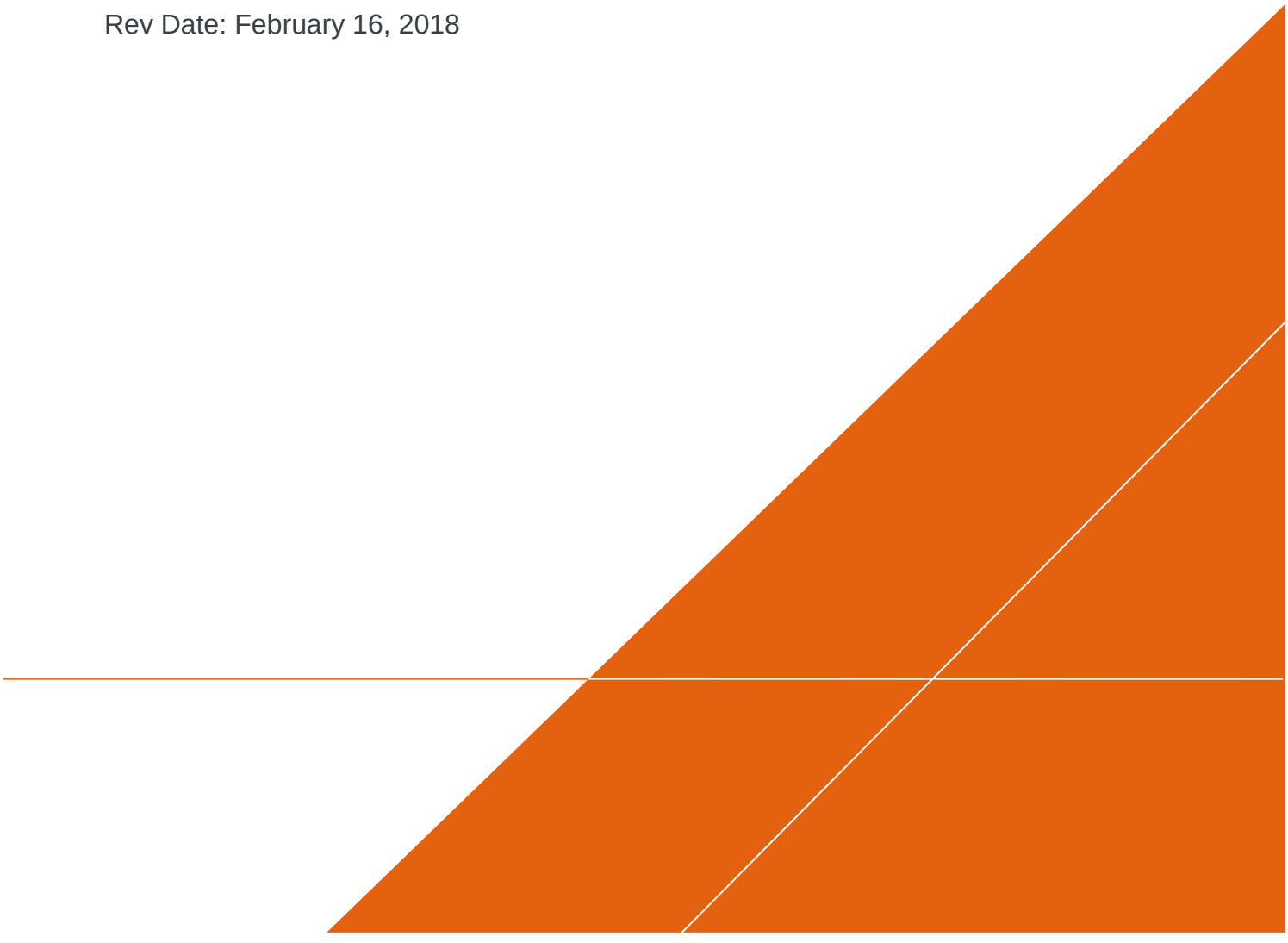
TGI - SOIL DESCRIPTION

Rev: #2

Rev Date: February 16, 2018



VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	May 20, 2008	17	Original SOP	Joe Quinnan Joel Hunt
1	September 2016	15	Updated to TGI	Nick Welty Patrick Curry
2	February 16, 2018	15	Updated descriptions, attachments and references in text	Nick Welty Patrick Curry

APPROVAL SIGNATURES

Prepared by:		June 30, 2017
	Patrick Curry, PG	Date:
Technical Expert Reviewed by:		June 30, 2017
	Nicklaus Welty, PG	Date:

1 INTRODUCTION

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2 SCOPE AND APPLICATION

This Arcadis Technical Guidance Instruction (TGI) describes proper soil description procedures. This TGI should be followed for unconsolidated material unless there is an established client-required specific procedure or regulatory-required specific procedure. In cases where there is a required specific procedure, it should be followed and should be referenced and/or provided as an appendix to reports that include soil classifications and/or boring logs. When following a required non-Arcadis procedure, additional information required by this TGI should be included in field notes with client approval.

This TGI has been developed to emphasize field observation and documentation of details required to:

- make hydrostratigraphic interpretations guided by depositional environment/geologic settings;
- provide information needed to understand the distribution of constituents of concern; properly design wells, piezometers, and/or additional field investigations; and develop appropriate remedial strategies.

This TGI incorporates elements from various standard systems such as ASTM D2488-06, Unified Soil Classification System, Burmister and Wentworth. However, none of these standard systems focus specifically on contaminant hydrogeology and remedial design. Therefore, although each of these

systems contain valuable guidance and information related to correct descriptions, strict application of these systems can omit information critical to our clients and the projects that we perform.

This TGI does not address details of health and safety; drilling method selection; boring log preparation; sample collection; or laboratory analysis. Refer to other Arcadis procedure, guidance, and instructional documents, the project work plans including the quality assurance project plan, sampling plan, and health and safety plan (HASP), as appropriate.

3 PERSONNEL QUALIFICATIONS

Soil descriptions should only be performed by Arcadis personnel or authorized sub-contractors with a degree in geology or a geology-related discipline. Field personnel will complete training on the Arcadis soil description TGI in the office and/or in the field under the guidance of an experienced field geologist with at least 2 years of prior experience applying the Arcadis soil description method.

4 EQUIPMENT LIST

The following equipment should be taken to the field to facilitate soil descriptions:

- field book, field forms or PDA to record soil descriptions;
- field book for supplemental notes;
- this TGI for Soil Descriptions and any project-specific procedure, guidance, and/or instructional documents (if required);
- field card showing Wentworth scale;
- Munsell® soil color chart;
- tape measure divided into tenths of a foot;
- stainless steel knife or spatula;
- hand lens;
- water squirt bottle;
- jar with lid;
- personal protective equipment (PPE), as required by the HASP; and
- digital camera

5 CAUTIONS

Drilling and drilling-related hazards including subsurface utilities are discussed in other procedure documents and site-specific HASPs and are not discussed herein.

Soil samples may contain hazardous substances that can result in exposure to persons describing soils. Routes for exposure may include dermal contact, inhalation and ingestion. Refer to the project specific HASP for guidance in these situations.

6 HEALTH AND SAFETY CONSIDERATIONS

Field activities associated with soil sampling and description will be performed in accordance with a site-specific HASP, a copy of which will be present on site during such activities. Know what hazardous substances may be present in the soil and understand their hazards. Always avoid the temptation to touch soils with bare hands, detect odors by placing soils close to your nose, or tasting soils.

7 PROCEDURE

1. Select the appropriate sampling method to obtain representative samples in accordance with the selected sub-surface exploration method, e.g. split-spoon or Shelby sample for hollow-stem drilling, acetate sleeves for direct push, bagged core for sonic drilling, etc.
2. Proceed with field activities in required sequence. Although completion of soil descriptions is often not the first activity after opening sampler, identification of stratigraphic changes is often necessary to select appropriate intervals for field screening and/or selection of laboratory samples.
3. Set up boring log field sheet.
    - Drillers in both the US and Canada generally work in feet due to equipment specifications. Use the Arcadis standard boring log form (**Attachment A**).
    - The preferred boring log includes a graphic log of the principal soil component to support quick visual evaluation of grain size. The purpose of the graphic log is to quickly assess relative soil permeability. Note, for poorly sorted soils (e.g. glacial till), the principal component may not correlate to permeability of the sample. In this case, the geologist should use best judgement to graph overall soil type consistent with relative soil permeability. For example, for a dense sand/silt/clay till, the graphic log would reflect the silt/clay, rather than sand.
    - Record depths along the left-hand side at a standard scale to aid in the use of this tool. See an example completed boring log (**Attachment B**).
4. Examine each soil core (this is different than examining each sample selected for laboratory analysis), and record the following for each stratum:
    - depth interval;
    - principal component with descriptors, as appropriate;
    - amount and identification of minor component(s) with descriptors as appropriate;
    - moisture;
    - consistency/density;
    - color; and
    - additional description or comments (recorded as notes).
5. At the end of the boring, record the amount of drilling fluid used (if applicable) and the total depth logged.

The above is described more fully below.

DEPTH

To measure and record the depth below ground surface (bgs) of top and bottom of each stratum, the following information should be recorded.

1. Measured depth to the top and bottom of sampled interval. Use starting depth of sample based upon measured tool length information and the length of sample interval.
2. Length of sample recovered, not including slough (material that has fallen into hole from previous interval), expressed as fraction with length of recovered sample as numerator over length of sampled interval as denominator (e.g. 14/24 for 14 inches recovered from 24-inch sampling interval that had 2 inches of slough discarded).
3. Thickness of each stratum measured sequentially from the top of recovery to the bottom of recovery.
4. Any observations of sample condition or drilling activity that would help identify whether there was loss from the top of the sampling interval, loss from the bottom of the sampling interval, or compression of the sampling interval. Examples: 14/24, gravel in nose of spoon; or 10/18 bottom 6 inches of spoon empty.

DETERMINATION OF COMPONENTS

Obtain a representative sample of soil from a single stratum. If multiple strata are present in a single sample interval, each stratum should be described separately. More specifically, if the sample is from a 2-foot long split-spoon where strata of coarse sand, fine sand and clay are present, then the resultant description should be of the three individual strata unless a combined description can clearly describe the interbedded nature of the three strata. Example: Fine Sand with interbedded lenses of Silt and Clay, ranging between 1 and 3 inches thick.

Identify principal component and express volume estimates for minor components on logs using the following standard modifiers.

Modifier	Percent of Total Sample (by volume)
and	36 - 50
some	21 - 35
little	10 - 20
trace	<10

Determination of components is based on using the Udden-Wentworth particle size classification (see below) and measurement of the average grain size diameter. Each size grade or class differs from the next larger grade or class by a constant ratio of ½. Due to visual limitations, the finer classifications of Wentworth's scale cannot be distinguished in the field and the subgroups are not included. Visual determinations in the field should be made carefully by comparing the sample to the Soil Description Field Guide (**Attachment C**) that shows Udden-Wentworth scale or by measuring with a ruler. Use of field sieves is encouraged to assist in estimating percentage of coarse grain sizes. Settling test or wash method (Appendix X4 of ASTM D2488) is encouraged for determining presence and estimating percentage of clay and silt. Note that "gravel" is not an Udden-Wentworth size class.

Udden-Wenworth Scale Modified Arcadis, 2008			
Size Class	Millimeters	Inches	Standard Sieve #
Boulder	256 – 4096	10.08+	
Large cobble	128 - 256	5.04 -10.08	
Small cobble	64 - 128	2.52 – 5.04	
Very large pebble	32 – 64	0.16 - 2.52	
Large pebble	16 – 32	0.63 – 1.26	
Medium pebble	8 – 16	0.31 – 0.63	
Small pebble	4 – 8	0.16 – 0.31	No. 5 +
Granule	2 – 4	0.08 – 0.16	No.5 – No.10
Very coarse sand	1 -2	0.04 – 0.08	No.10 – No.18
Coarse sand	½ - 1	0.02 – 0.04	No.18 - No.35
Medium sand	¼ - ½	0.01 – 0.02	No.35 - No.60
Fine sand	1/8 -¼	0.005 – 0.1	No.60 - No.120
Very fine sand	1/16 – 1/8	0.002 – 0.005	No. 120 – No. 230
Silt (subgroups not included)	1/256 – 1/16	0.0002 – 0.002	Not applicable (analyze by pipette or hydrometer)
Clay (subgroups not included	1/2048 – 1/256	.00002 – 0.0002	

Identify components as follows. Remove particles greater than very large pebbles (64-mm diameter) from the soil sample. Record the volume estimate of the greater than very large pebbles. Examine the sample fraction of very large pebbles and smaller particles and estimate the volume percentage of the pebbles, granules, sand, silt and clay. Use the jar method, visual method, and/or wash method (Appendix X4 of ASTM D2488) to estimate the volume percentages of each category.

Determination of actual dry weight of each Udden-Wentworth fraction requires laboratory grain-size analysis using sieve sizes corresponding to Udden-Wentworth fractions and is highly recommended to determine grain-size distributions for each hydrostratigraphic unit.

Lab or field sieve analysis is advisable to characterize the variability and facies trends within each hydrostratigraphic unit. Field sieve-analysis can be performed on selected samples to estimate dry weight fraction of each category using ASTM D2488 Standard Practice for Classification of Soils for Engineering Purposes as guidance, but replace required sieve sizes with the following Udden-Wentworth set: U.S. Standard sieve mesh sizes 6; 12; 20; 40; 70; 140; and 270 to retain pebbles; granules; very coarse sand; coarse sand; medium sand; fine sand; and very fine sand, respectively.

PRINCIPAL COMPONENT

The principal component is the size fraction or range of size fractions containing the majority of the volume. Examples: the principal component in a sample that contained 55% pebbles would be “Pebbles”; or the principal component in a sample that was 20% fine sand, 30% medium sand and 25% coarse sand would be “Sand, fine to coarse” or for a sample that was 40% silt and 45% clay the principal component would be “Clay and Silt”. Shade the boxes on the graphic log (**Attachment A**) up to and including the box with the principal component. The purpose of the graphical log is to provide a relative estimate of permeability. As noted above, for poorly sorted soils such as glacial till, the principal component may not correlate to permeability of the sample. In this case, the geologist should use best judgement to graph overall soil type consistent with relative soil permeability.

Include appropriate descriptors with the principal component. These descriptors vary for different particle sizes as follows.

Angularity – Describe the angularity for very coarse sand and larger particles in accordance with the table below (ASTM D-2488-06). Figures showing examples of angularity are available in ASTM D-2488-06 and the Arcadis Soil Description Field Guide.

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Sub-angular	Particles are similar to angular description but have rounded edges.
Sub-rounded	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.

Plasticity – Describe the plasticity for silt and clay based on observations made during the following test method (ASTM D-2488-06).

- As in the dilatancy test below, select enough material to mold into a ball about ½ inch (12 mm) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.
- Shape the test specimen into an elongated pat and roll by hand on a smooth surface or between the palms into a thread about 1/8 inch (3 mm) in diameter. If the sample is too wet to roll easily, it should be spread into a thin layer and allowed to lose some water by evaporation. Fold the sample threads and reroll repeatedly until the thread crumbles at a diameter of about 1/8 inch. The thread will crumble when the soil is near the plastic limit.

Description	Criteria
Non-plastic	A 1/8-inch (3 mm) thread cannot be rolled at any water content.
Low	The thread can barely be rolled, and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

Dilatancy – Describe the dilatancy for silt and silt-sand mixtures using the following field test method (ASTM D-2488-06).

- From the specimen select enough material to mold into a ball about ½ inch (12 mm) in diameter. Mold the material adding water if necessary, until it has a soft, but not sticky, consistency.
- Smooth the ball in the palm of one hand with a small spatula.
- Shake horizontally, striking the side of the hand vigorously with the other hand several times.
- Note the reaction of water appearing on the surface of the soil.
- Squeeze the sample by closing the hand or pinching the soil between the fingers, and not the reaction as none, slow, or rapid in accordance with the table below. The reaction is the speed with which water appears while shaking and disappears while squeezing.

Description	Criteria
None	No visible change in the specimen.
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

Note that silt and silt-sand mixtures will be non-plastic and display dilatancy. Clay mixtures will have some degree of plasticity but do not typically react to dilatancy testing. Therefore, the tests outlined above can be used to differentiate between silt dominated and clay dominated soils.

MINOR COMPONENT(S)

The minor component(s) are the size fraction(s) containing less than 50% volume. Example: the identified components are estimated to be 60% medium sand to granules, 25% silt and clay; 15 % pebbles – there are two identified minor components: silt and clay; and pebbles.

Include a standard modifier to indicate percentage of minor components (see Table on Page 6) and the same descriptors that would be used for a principal component. Plasticity should be provided as a descriptor for clay and clay mixtures. Dilatancy should be provided for silt and silt mixtures. Angularity should be provided as a descriptor for pebbles and coarse sand. For the example above, the minor constituents with modifiers could be: some silt and clay, low plasticity; little medium to large pebbles, sub-round.

SORTING

Sorting is the opposite of grading, which is a commonly used term in the USCS or ASTM methods to describe the uniformity of the particle size distribution in a sample. Well-sorted samples are poorly graded and poorly sorted samples are well graded. Arcadis prefers the use of sorting for particle size distributions and grading to describe particle size distribution trends in the vertical profile of a sample or hydrostratigraphic unit because of the relationship between sorting and the energy of the depositional process. For soils with sand-sized or larger particles, sorting should be determined as follows:

Well sorted – the range of particle sizes is limited (e.g. the sample is comprised of predominantly one or two grain sizes).

Poorly sorted – a wide range of particle sizes are present.

You can also use sieve analysis to estimate sorting from a sedimentological perspective; sorting is the statistical equivalent of standard deviation. Smaller standard deviations correspond to higher degree of sorting (see Remediation Hydraulics, 2008).

MOISTURE

Moisture content should be described for every sample since increases or decreases in water content is critical information. Moisture should be described in accordance with the table below (percentages should not be used unless determined in the laboratory).

Description	Criteria
Dry	Absence of moisture, dry to touch, dusty.
Moist	Damp but no visible water.
Wet (Saturated)	Visible free water, soil is usually below the water table.

CONSISTENCY or DENSITY

This can be determined by standard penetration test (SPT) blow counts (ASTM D-1586) or field tests in accordance with the tables below. When drilling with hollow-stem augers and split-spoon sampling, the SPT blow counts and N-value is used to estimate density. The N-value is the blows per foot for the 6" to 18" interval. Example: for 24-inch spoon, recorded blows per 6-inch interval are: 4/6/9/22. Since the second interval is 6" to12", the third interval is 12" to 18", the N value is 6+9, or 15. Fifty blow counts for less than 6 inches is considered refusal. In recent years, more common drilling methods include rotary-sonic or direct push. When blow counts are not available, density is determined using a thumb test. Note however, the thumb test only applies to fine-grained soils.

Fine-grained soil – Consistency

Description	Criteria
Very soft	N-value < 2 or easily penetrated several inches by thumb.
Soft	N-value 2-4 or easily penetrated one inch by thumb.
Medium stiff	N-value 9-15 or indented about ¼ inch by thumb with great effort.
Very stiff	N-value 16-30 or readily indented by thumb nail.
Hard	N-value > than 30 or indented by thumbnail with difficulty

Coarse-grained soil – Density

Description	Criteria
Very loose	N-value 1- 4
Loose	N-value 5-10
Medium dense	N-value 11-30
Dense	N-value 31- 50
Very dense	N-value >50

COLOR

Color should be described using simple basic terminology and modifiers based on the Munsell system. Munsell alpha-numeric codes are required for all samples. If the sample contains layers or patches of varying colors this should be noted and all representative colors should be described. The colors should be described for moist samples. If the sample is dry it should be wetted prior to comparing the sample to the Munsell chart.

ADDITIONAL COMMENTS (NOTES)

Additional comments should be made where observed and should be presented as notes with reference to a specific depth interval(s) to which they apply. Some of the significant information that may be observed includes the following.

- Odor - You should not make an effort to smell samples by placing near your nose since this can result in unnecessary exposure to hazardous materials. However, odors should be noted if they are detected during the normal sampling procedures. Odors should be based upon descriptors such as those used in NIOSH “Pocket Guide to Chemical Hazards”, e.g. “pungent” or “sweet” and should not indicate specific chemicals such as “phenol-like” odor or “BTEX” odor.
- Structure
- Bedding planes (laminated, banded, geologic contacts).
- Presence of roots, root holes, organic material, man-made materials, minerals, etc.
- Mineralogy
- Cementation
- NAPL presence/characteristics, including sheen (based on client-specific guidance).
- Reaction with HCl - typically only used for special soil conditions, such as caliche environments.
- Origin, if known (Lacustrine; Fill; etc.).

EXAMPLE DESCRIPTIONS

51.4 to 54.0’ CLAY, some silt, medium to high plasticity; trace small to large pebbles, sub-round to sub-angular up to 2” diameter; moist, stiff, dark grayish brown (10 YR 4/2) NOTE: Lacustrine; laminated 0.1 to 0.2” thick, laminations brownish yellow (10 YR 4/3).

32.5 to 38.0’ SAND, medium to very coarse, sub-round to sub-angular; little granule and pebble, trace silt; poorly sorted, wet, grayish brown (10 YR 5/2).

Unlike the first example where a density of cohesive soils could be estimated, this rotary-sonic sand and pebble sample was disturbed during drilling (due to vibrations in a loose sand and pebble matrix) so no density description could be provided. Neither sample had noticeable odor so odor comments were not included.

The standard generic description order is presented below.

- Depth
- Principal Components
  - Angularity for very coarse sand and larger particles
  - Plasticity for silt and clay
  - Dilatancy for silt and silt-sand mixtures
- Minor Components
- Sorting
- Moisture
- Consistency or Density
- Color
- Additional Comments

8 WASTE MANAGEMENT

Project-specific requirements should be identified and followed. The following procedures, or similar waste management procedures are generally required.

Water generated during cleaning procedures will be collected and contained onsite in appropriate containers for future analysis and appropriate disposal. PPE (such as gloves, disposable clothing, and other disposable equipment) resulting from personnel cleaning procedures and soil sampling/handling activities will be placed in plastic bags. These bags will be transferred into appropriately labeled 55-gallon drums or a covered roll-off box for appropriate disposal.

Soil materials will be placed in sealed 55-gallon steel drums or covered roll-off boxes and stored in a secured area. Once full, the material will be analyzed to determine the appropriate disposal method.

9 DATA RECORDING AND MANAGEMENT

Upon collection of soil samples, the soil sample should be logged on a standard boring log and/or in the field log book depending on Data Quality Objectives (DQOs) for the task/project. The preferred standard boring log is presented below and is included as **Attachment A**.

The general scheme for soil logging entries is presented above; however, depending on task/project DQOs, specific logging entries that are not applicable to task/project goals may be omitted at the project manager's discretion. In any case, use of a consistent logging procedure is required.

Completed logs and/or logbook will be maintained in the task/project field records file. Digital photographs of typical soil types observed at the site and any unusual features should be obtained whenever possible. All photographs should include a ruler or common object for scale. Photo location, depth and orientation must be recorded in the daily log or log book and a label showing this information in the photo is useful.

10 QUALITY ASSURANCE

Soil descriptions should be completed only by appropriately trained personnel. Descriptions should be reviewed by an experienced field geologist for content, format and consistency. Edited boring logs should be reviewed by the original author to assure that content has not changed.

11 REFERENCES

Arcadis Soil Description Field Guide, 2008.

Munsell® Color Chart – available from Forestry Suppliers, Inc.- Item 77341 "Munsell® Color Soil Color Charts.

Field Gauge Card that Shows Udden-Wentworth scale – available from Forestry Suppliers, Inc. – Item 77332 "Sand Grain Sizing Folder."

ASTM D-1586, Test Method for Penetration Test and Split-Barrel Sampling of Soils.

ASTM D-2488-00, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)

United States Bureau of Reclamation. Engineering Geology Field Manual. United States Department of Interior, Bureau of Reclamation. http://www.usbr.gov/pmts/geology/fieldmap.htm.

Petrology of Sedimentary Rocks, Robert L. Folk, 1980, p. 1-48.

NIOSH Pocket Guide to Chemical Hazards.

Remediation Hydraulics, Fred C. Payne, Joseph A. Quinnan, and Scott T. Potter, 2008, p 59-63.

ATTACHMENT A

Arcadis Standard Soil Boring Log Form

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SOIL BORING LOG

Boring/Well ______________ Project ____ Page ___ of ___

Site Location ____ Drilling Started ____________________

Total Depth Drilled ________ Feet Hole Diameter ________ inches Drilling Completed ____________________

Type of Sample or Coring Device ____________ Length and Diameter of Coring Device ____________________ Sampling Interval ________ feet

Drilling Method ____________ Drilling Fluid Used ____________

Drilling Contractor ______________________________ Driller ____________________

Prepared By ______________________________ Helper ____________________

Core Recovery (feet)	PID Reading (ppm)	Sample Depth (ft bgs)	MUD		SAND					GRAVEL				Udden-Wentworth Description: principal components, (angularity, plasticity, dilatency); minor components, (angularity, plasticity, dilatency); sorting, moisture content, consistency/density, color, additional comments
			clay	silt	very fine	fine	medium	coarse	very coarse	granular	pebble	cobble	boulder	

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SOIL BORING LOG (CONT'D)

Boring/Well ______________________ Prepared By ______________________ Page ____ of ____

Core Recovery (feet)	PID Reading (ppm)	Sample Depth (ft bgs)	MUD		SAND					GRAVEL				Udden-Wentworth Description: principal components, (angularity, plasticity, dilatency); minor components, (angularity, plasticity, dilatency); sorting, moisture content, consistency/density, color, addtl. Comments
			clay	silt	very fine	fine	medium	coarse	very coarse	granular	pebble	cobble	boulder	

ATTACHMENT B

Example of Completed Arcadis Soil Boring Log

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SOIL BORING LOG

Boring/Well SB-01 Project Example Page 1 of 1

Site Location Anytown, North America Drilling Started 6/26/17

Total Depth Drilled 20 Feet Hole Diameter 4.5 inches Drilling Completed 6/26/17

Type of Sample or Coring Device Continuous Length and Diameter of Coring Device 5', 2.25" macrocore Sampling Interval 5 feet

Drilling Method Geoprobe Drilling Fluid Used NA

Drilling Contractor Fibertec Driller Ryan Brown

Prepared By A. DeGrandis Helper Grant Berger

Core Recovery (feet)	PID Reading (ppm)	Sample Depth (ft bgs)	MUD: clay	MUD: silt	SAND: very fine	SAND: fine	SAND: medium	SAND: coarse	SAND: very coarse	GRAVEL: granular	GRAVEL: pebble	GRAVEL: cobble	GRAVEL: boulder	Udden-Wentworth Description: principal components, (angularity, plasticity, dilatency); minor components, (angularity, plasticity, dilatency); sorting, moisture content, consistency/density, color, additional comments
	0.3	1	X	X	X	X	X							(0.0-4.0) SAND, fine to medium, sub-rounded; little granules to small pebbles, sub-rounded to sub-angular; trace silt; poorly sorted, dry to moist, dark grayish brown (10YR 4/2).
60" (HA)	0.1	2	X	X	X	X	X							
	0.0	3	X	X	X	X	X							
	0.0	4	X	X	X	X	X							
↓	1.4	5	X	X										NOTE: Ablation till.
	1.7	6	X	X										
	0.9	7	X	X										(4.0-10.0) SILT, non-plastic, rapid dilatancy; dry to moist, soft to medium stiff, gray (10YR 5/1).
52"	1.2	8	X	X										
	0.6	9	X	X										
↓	0.2	10	X	X										
	0.0	11	X	X	X	X	X							(10.0-15.5) SAND, fine, sub-rounded; trace silt; well sorted, moist to wet, pale brown (10YR 6/3).
	0.0	12	X	X	X	X	X							
60"	0.1	13	X	X	X	X	X							
	0.0	14	X	X	X	X	X							
↓	0.0	15	X	X	X	X	X							NOTE: wet at 12.0'
	0.2	16	X	X	X	X	X							
	0.0	17	X	X										(15.5-20.0) CLAY, high plasticity, no dilatancy; little silt; moist, soft to medium stiff, light gray (10YR 7/1) to dark gray (10YR 4/1).
58"	0.0	18	X	X										
	0.0	19	X	X										
↓	0.0	20	X	X										NOTE: Lacustrine, minor 0.1-0.25" lamination.
														End of boring - 20.0'

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ATTACHMENT C

Arcadis Soil Description Field Guide

SOIL DESCRIPTION FIELD GUIDE (JUNE 30, 2017; REV. 2.0)

ARCADIS Design & Consultancy for natural and built assets

FINE-GRAINED SOILS

Description	Criteria
	Descriptor - Plasticity
Nonplastic	A 1/8-inch (3mm) thread cannot be rolled at any moisture content.
Low	Thread can barely be rolled, and lump cannot be formed when drier than plastic limit.
Medium	Takes considerable time and rolling to reach plastic limit. Thread cannot be rolled after reaching plastic limit. Lump crumbles when drier than plastic limit.
High	Thread is easy to roll and quickly reaches plastic limit. Thread can be rerolled several times after reaching plastic limit. Lump can be formed without crumbling when drier than plastic limit.
	Descriptor - Dilatancy
No Dilatancy	No visible change when shaken or squeezed.
Slow	Water appears slowly on the surface of soil during shaking and does not disappear or disappears slowly when squeezed.
Rapid	Water appears quickly on surface of soil during shaking and disappears quickly when squeezed.
Minor Components with Descriptors	
	Moisture
Dry	Absence of moisture, dry to touch, dusty.
Moist	Damp but no visible water.
Wet	Visible free water; soil is usually below the water table. (Saturated)
	Consistency
Very soft	N-value < 2 or easily penetrated several inches by thumb.
Soft	N-value 2-4 or easily penetrated 1 inch by thumb.
Medium stiff	N-value 5-8 or indented about 1/2 inch by thumb with great effort.
Stiff	N-value 9-15 or indented about 1/4 inch by thumb with great effort.
Very stiff	N-value 16-30 or readily indented by thumb nail.
Hard	N-value > than 30 or indented by thumbnail with difficulty.
Color using Munsell	
Geologic Origin (if known)	
Other	

EXAMPLE OF SOIL DESCRIPTION AND PHOTO

10-15 feet CLAY, medium to high plasticity; trace silt; trace small to very large pebbles, subround to subangular up to 2" diameter; moist, stiff, dark grayish brown (10YR 4/2). NOTE: Lacustrine; laminated 0.1 to 0.2" thick, laminations brownish yellow (10YR 4/3).

DESCRIPTION ORDER

Depth Interval
Principal Components with Descriptors
Minor Components with Descriptors
Sorting
Field Moisture Condition
Density/Consistency
Color using Munsell
Geologic Origin (if known)
Other descriptions as NOTES:
- Odor
- Stratigraphy
- Structure
- Sphericity
- Cementation
- Reaction to acid

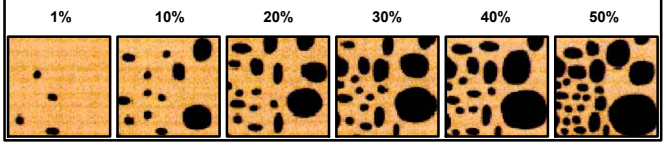
MINOR COMPONENTS % MODIFIERS

Modifier	Percent of Total Sample (by volume)
and	36 - 50
some	21 - 35
little	10 - 20
trace	<10

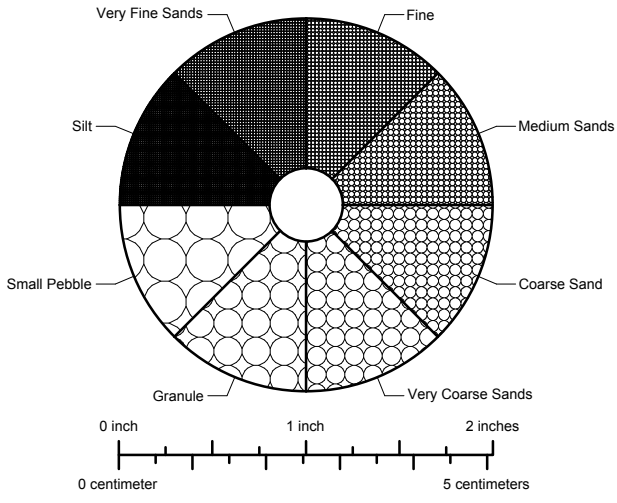
UDDEN-WENTWORTH SCALE

Fraction	Sieve Size	Grain Size	Approximate Scale
Boulder		256 - 4096 mm	Larger than volleyball
Large Cobble		128 - 256 mm	Softball to volleyball
Small Cobble		64 - 128 mm	Pool ball to softball
Very Large Pebble		32 - 64 mm	Pinball to pool ball
Large Pebble		16 - 32 mm	Dime size to pinball
Medium Pebble		8 - 16 mm	Pencil eraser to dime size
Small Pebble	No. 5+	4 - 8 mm	Pea size to pencil eraser
Granule	No. 10 - 5	2 - 4 mm	Rock salt to pea size
Very Coarse Sand	No. 18 - 10	1 - 2 mm	See field gauge card
Coarse Sand	No. 35 -18	0.5 - 1 mm	See field gauge card
Medium Sand	No. 60 - 35	0.25 - 0.5 mm	See field gauge card
Fine Sand	No. 120 - 60	0.125 - 0.25 mm	See field gauge card
Very Fine Sand	No. 230 - 120	0.0625 - 0.125 mm	See field gauge card
Silt and Clay. See SOP for description of fines	Not Applicable	<0.0625 mm	Analyze by pipette or hydrometer

PARTICLE PERCENT COMPOSITION ESTIMATION



GRAPH FOR DETERMINING SIZE OF PARTICLES



FOR COARSE-GRAINED SOILS

Description	Criteria
	Descriptor - Angularity
Angular	Particles have sharp edges and relatively planar sides withunpolished surfaces.
Subangular	Particles are similar to angular but have rounded edges.
Subround	Particles have nearly planar sides but have well-roundedcorners and edges.
Round	Particles have smoothly curved sides and no edges.
Minor Components with Descriptors	
	Sorting Cu= d60/d10
Well Sorted	Near uniform grain-size distribution Cu= 1 to 3.
Poorly Sorted	Wide range of grain size Cu= 4 to 6.
	Moisture
Dry	Absence of moisture, dry to touch, dusty.
Moist	Damp but no visible water.
Wet	Visible free water; soil is usually below the water table. (Saturated)
	Density
Very loose	N-value 1 - 4
Loose	N-value 5 - 10
Medium Dense	N-value 11 - 30
Dense	N-value 31 - 50
Very dense	N-value >50
Color using Munsell	
Geologic Origin (if known)	
Other	
	Cementation
Weak Cementation	Crumbles or breaks with handling or little finger pressure.
Moderate Cementation	Crumbles or breaks with considerable finger pressure.
Strong Cementation	Will not crumble with finger pressure.
	Reaction with Dilute HCl Solution (10%)
No Reaction	No visible reaction.
Weak Reaction	Some reaction, with bubbles forming slowly.
Strong Reaction	Violent reaction, with bubbles forming immediately.

EXAMPLE OF SOIL DESCRIPTION AND PHOTO

10 -15 feet SAND, medium to very coarse; little granules to medium pebbles, subround to subangular; trace silt; poorly sorted, wet, grayish brown (10YR5/2).

ON THE ORIGINAL DRAWING.
USE TO VERIFY FIGURE
REPRODUCTION SCALE

SOIL DESCRIPTION FIELD GUIDE (JUNE 30, 2017; REV. 2.0)

ARCADIS Design & Consultancy for natural and built assets

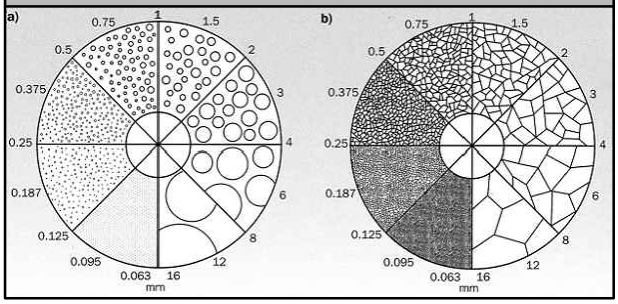
VARIATIONS IN SOIL STRATIGRAPHY

Term	Thickness of Configuration
Parting	0 - to 1/16-inch thickness.
Seam	1/16 - to 1/2-inch thickness.
Layer	1/2 - to 12-inch thickness.
Stratum	> 12-inch thickness.
Pocket	Small erratic deposit, usually less than 1 foot in size.
Varved Clay	Alternating seams or layers of sand, silt, and clay (laminated).
Occasional	≤ 1 foot thick.
Frequent	> 1 foot thick.

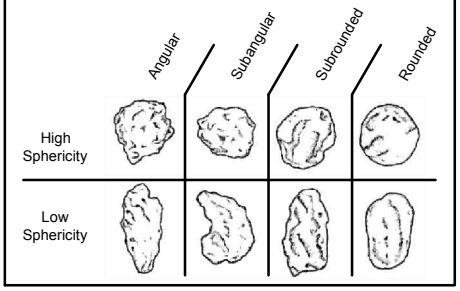
SOIL STRUCTURE DESCRIPTIONS

Term	Description
Homogeneous	Same color and appearance throughout.
Laminated	Alternating layers < 1/4 inch thick.
Stratified	Alternating layers ≥ 1/4 inch thick.
Lensed	Inclusions of small pockets of different materials, such as lenses of sand scattered through a mass of clay; note thickness.
Blocky	Cohesive soil can be broken down into small angular lumps, which resist further breakdown.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear to be polished or glossy, sometimes striated.

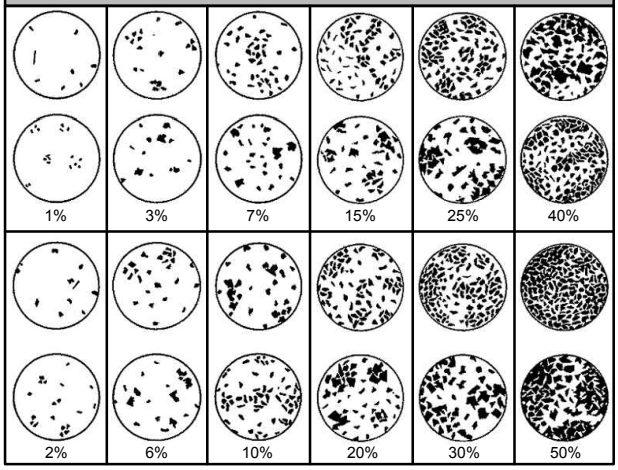
GRAPH FOR DETERMINING SIZE OF PARTICLES



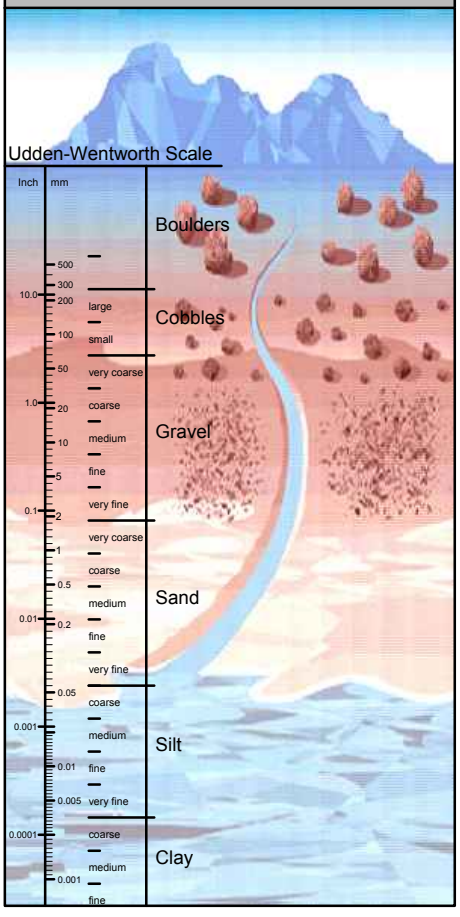
ANGULARITY CHART



PARTICLE PERCENT COMPOSITION ESTIMATION



SORTING



SETTLING TABLE (SILT/CLAY)

Diameter of Particle (mm)	<0.625	<0.031	<0.016	<0.008	<0.004	<0.002	<0.0005
Depth of Withdrawal (cm)	10	10	10	10	5	5	3
Time of Withdrawal	hr:min:sec	hr:min:sec	hr:min:sec	hr:min:sec	hr:min:sec	hr:min:sec	hr:min:sec
Temperature (Celsius)							
20	00:00:29	00:01:55	00:07:40	00:30:40	00:61:19	04:05:00	37:21:00
21	00:00:28	00:01:52	00:07:29	00:29:58	00:59:50	04:00:00	
22	00:00:27	00:01:50	00:07:18	00:29:13	00:58:22	03:54:00	
23	00:00:27	00:01:47	00:07:08	00:28:34	00:57:05	03:48:00	
24	00:00:26	00:01:45	00:06:58	00:27:52	00:55:41	03:43:00	33:56:00
25	00:00:25	00:01:42	00:06:48	00:27:14	00:54:25	03:38:00	
26	00:00:25	00:01:40	00:06:39	00:26:38	00:53:12	03:33:00	
27	00:00:24	00:01:38	00:06:31	00:26:02	00:52:02	03:28:00	
28	00:00:24	00:01:35	00:06:22	00:25:28	00:50:52	03:24:00	31:00:00
29	00:00:23	00:01:33	00:06:13	00:24:53	00:49:42	03:10:00	
30	00:00:23	00:01:31	00:06:06	00:24:22	00:48:42	03:05:00	

10 inches
9 inches
8 inches
7 inches
6 inches
5 inches
4 inches
3 inches
2 inches
1 inch
1/10in

0 mm
10 mm
20 mm
30 mm
40 mm
50 mm
60 mm
70 mm
80 mm
90 mm
100 mm
110 mm
120 mm
130 mm
140 mm
150 mm
160 mm
170 mm
180 mm
190 mm
200 mm
210 mm
220 mm
230 mm
240 mm
250 mm

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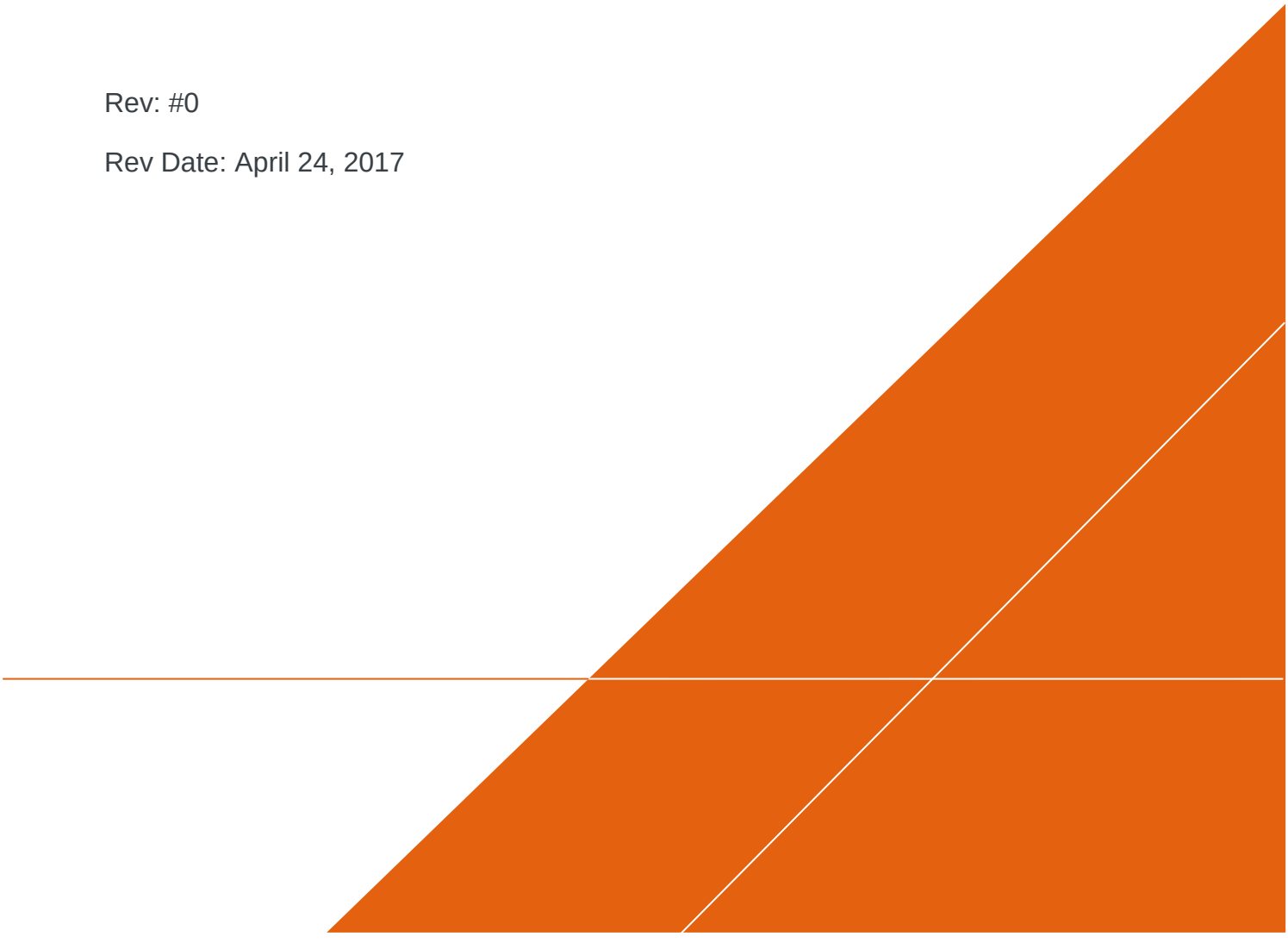
TECHNICAL GUIDANCE INSTRUCTION - MONITORING WELL DEVELOPMENT

Rev: #0

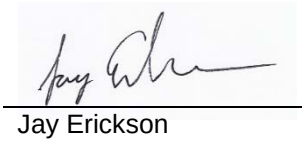
Rev Date: April 24, 2017



VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	4/24/2017	All	Re-written as TGI	Marc Killingstad

APPROVAL SIGNATURES

Prepared by:		4/24/2017
	Jay Erickson	Date:
Technical Expert Reviewed by:		4/24/2017
	Marc Killingstad	Date:

1 INTRODUCTION

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In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

This Technical Guidance Instruction (TGI) covers the development of screened wells used for obtaining representative groundwater information and samples from granular aquifers (i.e., monitoring wells). Note that this TGI only applies to monitoring well development and not remediation (injection/extraction) well development.

The purposes of Monitoring Well Development are:

1. Repair damage to the borehole wall from drilling that can include clogging, smearing or compaction of aquifer materials;
2. Remove fine grained sediment from the formation and filter pack that may result in high turbidity levels in groundwater samples;
3. To re-sort formation and filter pack material adjacent to the well screen;

4. To recover any drilling fluids (if used) that may affect the permeability of the formation and filter pack or alter the water quality around the well; and
5. To optimize the well efficiency and hydraulic communication between the well screen and the formation.

Successful monitoring well development is dependent on the following:

1. Hydrostratigraphy – Permeable formations containing primarily sand and gravel are more easily developed due to lower percentages of silt and clay material. Water in permeable formations can be moved in and out of the screen and/or through the formation easier than in less permeable deposits
2. Well Diameter – Development tooling including brushes, surge blocks, pumps and jetting tools are more readily available for wells 4 inches in diameter and greater.
3. Well Design – Wells with filter packs and screens designed to match the formation through the analysis of formation sieve samples are easier to develop. An important aspect to well design is to minimize the size of the annular space between the formation and well screen. Adequate room must be allowed for the proper installation of well materials, but not too large as to prevent/reduce communication with the surrounding formation.
4. Drilling Methods – Different drilling methods result in varying amount of borehole damage and, therefore, impact the degree to which development will be successful.

Well development methods for monitoring wells include the following:

1. Bailing – use of a bailer to remove water and sediment from the well casing. This technique does little to remove fines from the filter pack and may lead to bridging of sediment since the flow in only in one direction, toward the well screen.
2. Pumping/overpumping – use of a pump to remove water and sediment from the well casing, overpumping involves pumping the well at a rate that exceeds the design capacity of the well. Similar to bailing, this technique does little to remove fines from the filter pack and may lead to bridging of sediment since the flow in only in one direction, toward the well screen. Small diameter monitoring wells have the additional constraint on pump size and flow rates.
3. Backwashing (rawhiding) – consists of starting and stopping a pump intermittently to produce rapid pressure changes in a well. This method can produce better results than pumping alone since the procedure involves movement of the water in and out of the screen and formation. However, in many cases the surging action is not rigorous enough to fully develop the well.
4. Surging/swabbing – use of a mechanical surge block or swabbing tool to operate like a piston with an up and down motion. The downstroke causes a backwash action that breaks up bridged sediment and the upstroke pulls the dislodged sediment into the well. This method works well for small and large diameter wells. Care should be taken on the downstroke so as not to force fines back into the formation, frequent pumping/purging during surging help to keep fines out of the well. Double surge blocks are recommended.
5. Jetting – use of a tool fitted with nozzles that direct streams of water horizontally into well screens at high velocity. Due to the size of the tooling, this method is better suited for wells 4 inch in diameter and larger. The method is also more effective with wire-wrapped/continuous slot screens due to the

increased open area. Jetting requires specialized equipment and concurrent pumping to prevent reintroducing fines into the filter pack. Additionally, jetting requires subsequent surging to remove fines dislodged in the filter pack and formation.

For most situations, gentle surging coupled with bailing or pumping to remove dislodged materials is recommended.

Well development for properly designed and constructed monitoring wells may begin after the annular seal materials have been installed and allowed to cure, since these wells are designed to retain 90-99% of the filter pack material. This cure time is typically at least 24 to 48 hours after the sealing materials have been installed.

This TGI is meant to provide a general guide for proper monitoring well development. A site-specific field implementation plan for well installation and development detailing the specific methods and tools should be developed to provide site-specific instruction and guidance.

3 PERSONNEL QUALIFICATIONS

Monitoring well development activities will be performed by persons who have been trained in proper well development procedures under the guidance of an experienced field geologist, engineer, or technician.

4 EQUIPMENT LIST

Required equipment depends on the selected method and should be detailed in the site-specific field implementation plan. However, the following are typically required.

- Health and safety equipment, as required by the site Health and Safety Plan (HASP):
- Cleaning equipment
- Field notebook and/or personal digital assistant (PDA)
- Monitoring well keys
- Water level indicator
- Field parameter meter (YSI)
- Well Development Logs
- Well construction logs/diagrams
- Weighted tape (measure depth)
- Turbidity meter
- Camera
- Watch/timing device.

5 CAUTIONS

Where surging is performed to assist in removing fine-grained material from the sand pack, surging must be performed in a gentle manner. Excessive suction could promote fine-grained sediment entry into the outside of the sand pack from the formation.

Avoid using development fluids or materials that could impact groundwater or soil quality, or could be incompatible with the subsurface conditions.

In some cases, it may be necessary to add potable water to a well to allow surging and development, especially for new monitoring wells installed in low permeability formations. Before adding potable water to a well, the Certified Project Manager (CPM) and/or Project Hydrogeologist must be notified and the CPM shall make the decision regarding the appropriateness and applicability of adding potable water to a well during well development procedures. If potable water is to be added to a well as part of development, the potable water source should be sampled and analyzed for constituents of concern, and the results evaluated by the CPM prior to adding the potable water to the well. If potable water is added to a well for development purposes, at the end of development the well will be purged dry to remove the potable water, or if the well no longer goes dry then the well will be purged to remove at least three times the volume of potable water that was added.

6 HEALTH AND SAFETY CONSIDERATIONS

Field activities associated with monitoring well development will be performed in accordance with a site-specific HASP, a copy of which will be present on site during such activities.

7 PROCEDURE

As indicated above, for most monitoring wells, gentle surging coupled with bailing or pumping to remove dislodged sediment is recommended.

1 Ensure sufficient time has passed to allow for proper curing of the well seal.

2 Don appropriate PPE (as required by the site-specific HASP).

3 Place plastic sheeting around the well.

4 Clean all equipment entering each monitoring well, except for new, disposable materials that have not been previously used.

5 Open the well cover while standing upwind of the well, remove well cap. Insert PID probe approximately 4 to 6 inches into the casing or the well headspace and cover with gloved hand. Record the PID reading in the field notebook. If the well headspace reading is less than 5 PID units, proceed; if the headspace reading is greater than 5 PID units, screen the air within the breathing zone. If the PID reading in the breathing zone is below 5 PID units, proceed. If the PID reading is above 5 PID units, move upwind from well for 5 minutes to allow the volatiles to dissipate. Repeat the breathing zone test. If the reading is still above 5 PID units, don the appropriate respiratory protection in accordance with the requirements of the HASP. Record all PID readings.

6 Obtain an initial measurement of the depth to water and the total well depth from the reference point at the top of the well casing. Record these measurements in the field log book. It is recommended to use a weighted tape for the total well depth measurement.

7 The depth to the bottom of the well should be sounded and then compared to the completion form or construction diagram for the well. Any discrepancies should be reported immediately to the CPM and/or Project Hydrogeologist. If sand or sediment is present inside the well, it should first be removed by bailing. Do not insert bailers, pumps, or surge blocks into the well if obstructions, parting of the casing, or other damage to the well is suspected. Instead report the conditions to the CPM and/or Project Hydrogeologist and obtain approval to continue or cease well development activities.

8 Lower a double surge block into the screened portion of the well. Starting from the bottom of the screen using 2 foot throws, gently raise and lower the surge block to force water in and out of the screen slots and sand pack. Continue surging for 15 to 30 minutes.

9 Lower a bottom-loading bailer, submersible pump, or inertia pump tubing with check valve to the bottom of the well and gently bounce on the bottom of the well to collect/remove accumulated sediment, if any. Remove and empty the bailer, if used. Repeat until the bailed/pumped water is free of excessive sediment and contact at the bottom of the well feels solid. Alternatively, measurement of the well depth with a weighted tape can be used to verify that sediment and/or silt has been removed to the extent practicable, based on a comparison with the well installation log or previous measurement of total well depth.

10 After surging the well for a minimum of two cycles and removing excess accumulated sediment from the bottom of the well, re-measure the depth-to-water and the total well depth from the reference point at the top of the well casing. Record these measurements in the field log book.

11 Remove formation water by pumping/bailing. Where pumping is used, measure and record the pre-pumping water level. Operate the pump at a relatively constant rate. Measure the pumping rate using a calibrated container and stop watch, and record the pumping rate in the field log book. Measure and record the water level in the well at least once every 5 minutes during pumping. Note any relevant observations in terms of water color, visual level of turbidity, sheen, odors, etc. Pump or bail until termination criteria specified in the Site-Specific Field Implementation plan are reached. Note: the project-specific field implementation plan may also specify a maximum turbidity requirement for completion of development. Unless otherwise specified the maximum turbidity should be 50 NTUs or less. Record the total volume of water purged from the well.

12 While developing, take periodic water level measurements (at least one every five minutes) to determine if drawdown is occurring and record the measurements on the Well Development Log.

13 While developing, calculate the rate at which water is being removed from the well. Record the volume on the Well Development Log.

14 While developing, water is also periodically collected directly from the well or bailer discharge and readings taken of the indicator parameters: pH, specific conductance, and temperature. Development is considered complete when the indicator parameters have stabilized (i.e., three consecutive pH, specific conductance, and temperature readings are within tolerances specified in the project work plans or within 10% if not otherwise specified), the extracted water is clear and free

of fine sediment and most importantly, when acceptable volume of water has been removed and/or a sufficient amount of surging has been performed.

15 In certain instances, for slow recharging wells, the parameters may not stabilize. In this case, well development is considered complete when minimal amounts of fine-grained sediments are recovered and acceptable volume of water has been removed.

16 If the well goes dry, stop pumping or bailing. Note the time that the well went dry. After allowing the well to recover, note the time and depth to water. Resume pumping or bailing when sufficient water has recharged the well.

17 Contain all development water in appropriate containers.

18 When complete, secure the lid back on the well.

19 Place disposable materials in plastic bags for appropriate disposal and decontaminate reusable, downhole pump components and/or bailer

8 WASTE MANAGEMENT

Materials generated during monitoring well installation and development will be placed in appropriate labeled containers and disposed of as described in the Work Plan/Field Implementation Plan or Field Sampling Plan.

9 DATA RECORDING AND MANAGEMENT

All well development activities should be documented on appropriate log forms as well as in a proper field notebook and/or PDA. Additionally, all documents (and photographs) should be scanned and electronically filed in the appropriate project directory for easy access. Pertinent information will include personnel present on site; times of arrival and departure; significant weather conditions; timing of well development activities; development method(s); observations of purge water color, turbidity, odor, sheen, etc.; purge rate; and water levels before, during, and after pumping.

10 QUALITY ASSURANCE

All reused, non-disposable, downhole well development equipment should be cleaned in accordance with the procedures outlined in the project documents.

11 REFERENCES

American Society for Testing Materials (ASTM), Designation D5521-05. *Standard Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers*. American Society for Testing Materials. West Conshohocken, Pennsylvania.

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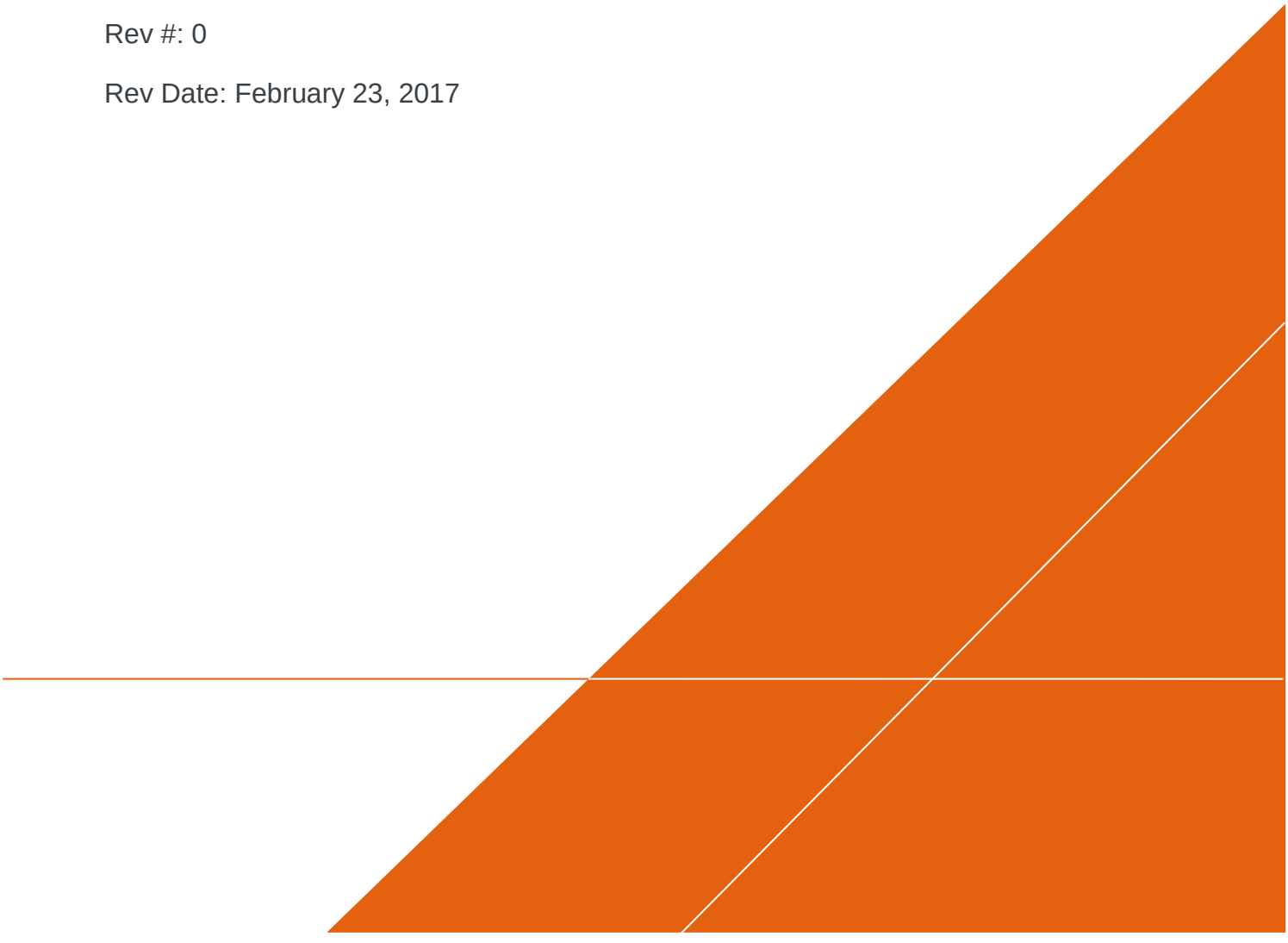
TGI - INVESTIGATION-DERIVED WASTE HANDLING AND STORAGE

Rev #: 0

Rev Date: February 23, 2017



VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	February 23, 2017	ALL	Conversion from SOP to TGI	Ryan Mattson / Peter Frederick

APPROVAL SIGNATURES

Prepared by:		02/23/2017
	Derrick Maurer	Date:
Technical Expert Reviewed by:		02/23/2017
	Ryan Mattson (Technical Expert)	Date:

1 INTRODUCTION

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2 SCOPE AND APPLICATION

The objective of this Technical Guidance Instruction (TGI) is to describe the procedures to manage investigation-derived wastes (IDW), both hazardous and nonhazardous, generated during site activities, which may include, but are not limited to: drilling, trenching/excavation, construction, demolition, monitoring well sampling, soil sampling, decontamination and remediation. For the purposes of this TGI, IDW is considered to be discarded materials which are defined as solid waste by United States Environmental Protection Agency (EPA) standard 40 CFR § 261.2 (which may include liquids, solids, or sludges). IDW may include soil, groundwater, drilling fluids, decontamination liquids, as well as contaminated personal protective equipment (PPE), sorbent materials, construction and demolition debris, and disposable sampling materials. Hazardous or uncharacterized IDW will be collected and staged at the point of generation. Quantities small enough to be containerized in 55-gallon drums will be taken to a designated temporary onsite storage area (discussed in further detail under Drum Storage) pending characterization and disposal. IDW materials will be characterized using process knowledge and appropriate laboratory analyses to determine the waste classification and evaluate proper safe handling and disposal methods.

This TGI describes the necessary equipment, field procedures, materials, regulatory references, and documentation procedures necessary for proper handling and storage of IDW up to the time it is properly transported from the project site and disposed. The procedures included in this TGI for handling and temporary storage of IDW are based on the EPA's guidance document *Guide to Management of Investigation Derived Wastes* (USEPA, 1992). IDW is assumed to be contaminated with the site constituents of concern (COCs) until analytical evidence indicates otherwise. IDW will be managed to ensure the protection of human health and the environment and will comply with all applicable or relevant and appropriate requirements (ARAR). Although not comprehensive, the following laws and regulations on Hazardous Waste Management should be considered as potential ARAR. It is the Arcadis Certified Project Manager (CPM) and/or designated Technical Expert to determine which laws and regulations, at all levels of government, are applicable to each project site and activity falling under this TGI.

Federal Laws and Regulations

- Resource Conservation and Recovery Act (RCRA) 42 USC § 6901-6987.
- Federal Hazardous Waste Regulations 40 CFR § 260-265

Department of Transportation (DOT) Hazardous Materials Transportation 49 CFR

Occupational Safety and Health Administration (OSHA) Regulations 29 CFR

State Laws and Regulations

- To be determined based on location of site and location of treatment, storage, and/or disposal facility (TSDF) to be utilized.

Regional, County, Municipal, and Local Regulations

- To be determined based on location of site and location of treatment, storage, and/or disposal facility (TSDF) to be utilized.

Initial Storage

Pending characterization, IDW will be temporarily stored appropriately within each area of contamination (AOC). Under RCRA, "storage" is defined as the "holding of hazardous waste for a temporary period, at the end of which the hazardous waste is treated, disposed of, or stored elsewhere" (40 CFR § 260.10). The onsite waste staging area will be in a secure and controlled area. Uncharacterized wastes are considered potentially hazardous wastes and must be stored in DOT approved packaging. Liquid wastes must be stored in DOT approved closed head drums or other approved containers (e.g., portable tank containers) that are compatible with the type of material stored therein. Solid materials must be stored in DOT approved open head drums where practicable. Larger quantities of solid IDW can be containerized in bulk containers (such as in a roll-off box). Soil from large excavation projects may be managed in stockpiles with within the AOC and does not need to be containerized until exiting the AOC.

Characterization

Waste characterization can either be based on generator knowledge, such as using historical process knowledge and safety data sheets (SDS), or can be based upon characterization sampling analytical results. IDW typically is not characterized using SDS as it is a mixture of aged chemicals and environmental media. Historical process knowledge should be used to determine if the IDW is a listed hazardous waste (40 CFR § 261.31-33). If the IDW is not a listed hazardous waste, waste

characterization can be completed by laboratory analysis of representative samples of the IDW. The laboratory used for waste characterization analysis must have the appropriate state and federal accreditations and may be required to be pre-approved by the Client. IDW will be classified as RCRA hazardous or non-regulated under RCRA based on the waste characterization determination.

If IDW is characterized as RCRA hazardous waste, RCRA and DOT requirements must be followed for packaging, labeling, transporting, storing, and record keeping as described in 40 CFR § 262 and 49 CFR § 171-178. Waste material classified as RCRA nonhazardous may be handled and disposed of as nonhazardous waste in accordance with applicable federal, state, and local regulations.

Storage Time Limitations

Containerized hazardous wastes can be temporarily stored for a maximum of 90 calendar days from the accumulation start date for a large quantity generator or a maximum of 180 calendar days from the accumulation start date for a small quantity generator. Wastes classified as nonhazardous may be handled and disposed of as nonhazardous waste and are not subject to storage time limitations.

This is TGI may be modified by the CPM and/or Technical Expert for a specific project or client program, as required, dependent upon client requirements, site conditions, equipment limitations, or limitations imposed by the procedure. The resulting procedure employed to execute the work will be documented in the project work plans or reports. If changes to the sampling procedures are required due to unanticipated field conditions, the changes will be discussed with the CPM and/or Technical Expert as soon as practicable, and if approved to be performed, be documented.

3 PERSONNEL QUALIFICATIONS

Arcadis field sampling personnel will have current regulatory- and Arcadis-required health and safety training including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and cardiopulmonary resuscitation (CPR), as needed. Personnel handling and packaging hazardous waste and performing hazardous waste characterizations must have RCRA hazardous waste management training per 40 CFR § 264.16.

Although not common practice, in certain situations Arcadis personnel may sign waste profiles and/or waste manifests on a case by case basis for clients, provided the appropriate agreement is in place between Arcadis and the client documenting that Arcadis is not the generator, but is acting as an authorized representative of the generator. Arcadis personnel who sign waste profiles and/or waste manifests will have both current RCRA hazardous waste management training per 40 CFR § 264.16 and current DOT hazardous materials transportation training per 49 CFR § 172.704. Arcadis field personnel will also comply with client-specific training. In addition, Arcadis field sampling personnel will be knowledgeable in the relevant processes, procedures, and Technical Guidance Instructions (TGIs) and possess the demonstrated required skills and experience necessary to successfully complete the desired field work. The project health and safety plan (HASP) and other documents will identify other training requirements or access control requirements.

4 EQUIPMENT LIST

The Following Materials, as required, will be available for IDW handling and Storage:

- Appropriate personal protective equipment as specified in the Site Health and Safety Plan (HASP)
- DOT approved containers
- Hammer
- Leather gloves
- Drum dolly
- Appropriate drum labels (outdoor waterproof self-adhesive)
- Portable tank container
- Appropriate labeling, packing, chain-of-custody forms, and shipping materials as determined by the CPM and/or Technical Expert.
- Indelible ink and/or permanent marking pens
- Plastic sheeting
- Appropriate sample containers, labels, and forms
- Stainless-steel bucket auger
- Stainless steel spatula or knife
- Stainless steel hand spade
- Stainless steel scoop
- Digital camera
- Field logbook

5 CAUTIONS

Filled drums can be very heavy, become unbalanced, or spill its contents. Therefore, use appropriate moving techniques and equipment for safe handling. Similar media (e.g. soils with other soils; or liquids with other liquids) will be stored in the same drums to aid in sample analysis and disposal. Drum lids must be secured to prevent rainwater from entering the drums and leakage during movement. Drums containing solid material may not contain any free liquids. Waste containers stored for extended periods of time may be subject to deterioration. Drum Over Packs may be used as secondary containment. All drums must be visually inspected for condition to ensure that they are in good condition without visible evidence of rusting, holes, breakage, etc., to prevent potential leakage and facilitate subsequent disposal. All drum lids must be verified as having a properly functioning secured lid prior to use.

6 HEALTH AND SAFETY CONSIDERATIONS

Click here and enter text] As determined by the site's known and suspected hazards, appropriate PPE must be worn by all field personnel within the designated work area. Exposure air monitoring may be required during certain field activities as required in the Site Health and Safety Plan. If soil excavation in areas with potentially hazardous contaminants is possible, contingency plans will be developed to address the potential for encountering gross contamination or non-aqueous phase liquids. All excavation

activities shall be in compliance with OSHA standard 29 CFR 1926.651 Excavations, and any other applicable regulations.

Arcadis field personnel and subcontractors will be trained in and perform their work in compliance with all applicable federal, state, and local health and safety regulations as well as Arcadis' HASP and applicable Client health and safety requirements.

7 PROCEDURE

Specific waste temporary storage and handling procedures to be used are dependent upon the type of generated waste, including type of media (e.g. soils or free liquids) and constituents of concern. For this reason, IDW can be stored in a secure location onsite in separate 55-gallon storage drums, where solids can be stockpiled onsite (if nonhazardous) and purge water may be stored in portable tank containers. Waste materials such as broken sample bottles or equipment containers and wrappings will be stored in 55-gallon drums unless they were not in contact with sample media.

Management of IDW

Minimization of IDW should be considered by the project team during all phases of the project. Site managers may want to consider techniques such as replacing solvent based cleaners with aqueous-based cleaners for decontamination of equipment, reuse of equipment (where it can be properly decontaminated), limitation of traffic between exclusion and support zones, and drilling methods and sampling techniques that minimize the generation of waste. Alternative drilling and subsurface sampling methods may include the use of small diameter boreholes, as well as borehole testing methods such as a core penetrometer or direct push technique instead of coring.

Drum Storage

Drums containing hazardous waste will be stored in accordance with the requirements of 40 CFR 265 Subpart I (for containers) and 265 Subpart DD (for containment buildings). All 55-gallon drums will be stored at a secure, centralized onsite location that is readily accessible for vehicular pick-up. Drums confirmed as, or assumed to contain hazardous waste will be stored over an impervious surface provided with secondary spill containment. The storage location will, for drums containing liquid, have a containment system that can contain at least the larger of 10% of the aggregate volume of staged materials or 100% of the volume of the largest container. Drums will be closed during storage and be in good condition in accordance with the Guide to Management of Investigation-Derived Wastes (USEPA, 1992).

Hazardous Waste Determination

Waste material must be characterized to determine if it meets any of the federal definitions of hazardous waste as required by 40 CFR § 262.11. If the waste does not meet any of the federal definitions, it must then be established if any state-specific or local-specific hazardous waste criteria exist/apply.

Generator Status

Once hazardous waste determination has been made, the generator status will be determined. Large quantity generators (LQG) are generators who generate more than 1,000 kilograms of hazardous waste in a calendar month. Small quantity generators (SQG) of hazardous waste are generators who generate

greater than 100 kilograms but less than 1,000 kilograms of hazardous waste in a calendar month. Conditionally exempt small quantity generators (CESQG) are generators who generate less than 100 kilograms of hazardous waste per month. Please note that a generator status may change from month to month and that a notice of this change is usually required by the generator's state agency.

Accumulation Time for Hazardous Waste

A LQG may accumulate hazardous waste on site for 90 calendar days or less without a permit and without having interim status, provided that such accumulation is in compliance with requirements in 40 CFR § 262.34. A SQG may accumulate hazardous waste on site for 180 calendar days or less without a permit or without having interim status, subject to the requirements of 40 CFR § 262.34(d). CESQG requirements are found in 40 CFR § 261.5. NOTE: The CESQG and SQG provisions of 40 CFR § 261.5, 262.20(e), 262.42(b) and 262.44 may not be recognized by some states (e.g., California and Rhode Island). State-specific and local-specific regulations must be reviewed and understood prior to the generation of hazardous waste.

Satellite Accumulation of Hazardous Waste Satellite accumulation (SAA) will mean the accumulation of as much as fifty-five (55) gallons of hazardous waste, or the accumulation of as much as one quart of acutely hazardous waste, in containers at or near any point of generation where the waste initially accumulates, which is under the control of the operator of the process generating the waste, without a permit or interim status and without complying with the requirements of 40 CFR § 262.34(a) and without any storage time limit, provided that the generator complies with 40 CFR § 262.34(c)(1)(i).

Once more than 55 gallons of hazardous waste accumulates in SAA, the generator has three days to move this waste into storage.

Storage recommendations for hazardous waste include:

- Ignitable Hazardous wastes must be >50 feet from the property line per 40 CFR § 265.176 (LQG generators only).
- Hazardous waste must be stored on a concrete slab (asphalt is acceptable if there are no free liquids in the waste) per 40 CFR § 265.176.
- Drainage must be directed away from the accumulation area.
- Area must be properly vented.
- Area must be secure.

Drum/Container Labeling

Drums will be labeled on both the side and lid of the drum using a permanent marking pen. Old drum labels must be removed to the extent possible, descriptions crossed out should any information remain, and new labels affixed on top of the old labels. Other containers used to store various types of waste (e.g., polyethylene tanks, roll-off boxes, end-dump trailers, etc.) will be labeled with an appropriate "Waste Container" or "Testing in Progress" label pending characterization. Drums and containers will be labeled as follows:

- Appropriate waste characterization label (Pending Analysis, Hazardous, or Nonhazardous)
- Waste generator's name (e.g., client name)
- Project Name
- Name and telephone number of Arcadis project manager

- Composition of contents (e.g., used oil, acetone 40%, toluene 60%)
- Media (e.g., solid, liquid)
- Accumulation start date
- Drum number of total drums as reconciled with the Drum Inventory maintained in the field log book.

IDW containers will remain closed except when adding or removing waste. Immediately upon beginning to place waste into the drum/container, a “Waste Container” or “Pending Analysis” label will be filled out to include the information specified above, and affixed to the container. Once the contents of the container are identified as either non-hazardous or hazardous, the following additional labels will be applied.

- Containers with waste determined to be non-hazardous will be labeled with a green and white "Nonhazardous Waste" label over the "Waste Container" label.
- Containers with waste determined to be hazardous will be stored in an onsite storage area and will be labeled with the "Hazardous Waste" label and affixed over the "Waste Container" label.

The ACCUMULATION DATE for the hazardous waste is the date the waste is first placed in the container and is the same date as the date on the "Waste Container" label. DOT hazardous class labels must be applied to all hazardous waste containers for shipment offsite to an approved disposal or recycling facility. In addition, a DOT proper shipping name will be included on the hazardous waste label. The transporter should be equipped with the appropriate DOT placards. However, placarding or offering placards to the initial transporter is the responsibility of the generator per 40 CFR § 262.33.

Inspections and Documentation

All IDW will be documented as generated on a Drum Inventory Log maintained in the field log book. The Drum Inventory will record the generation date, type, quantity, matrix and origin (e.g., Boring-1, Test Pit 3, etc.) of materials in every drum, as well as a unique identification number for each drum. The drum inventory will be used during drum pickup to assist with labeling of drums. The drum storage area and any other areas of temporarily staged waste, such as soil/debris piles, will be inspected weekly. The weekly inspections will be recorded in the field notebook or on a Weekly Inspection Log. Digital photographs will be taken upon the initial generation and drumming/staging of waste, and final labeling after characterization to document compliance with labeling and storage protocols, and condition of the container. Evidence of damage, tampering or other discrepancy should be documented photographically.

Emergency Response and Notifications

Specific procedures for responding to site emergencies will be detailed in the HASP. If the generator is designated as a LQG, a Contingency Plan will need to be prepared to include emergency response and notification procedures per 40 CFR § 265 Subpart D. In the event of a fire, explosion, or other release which could threaten human health outside of the site or when Client or ARCADIS has knowledge of a spill that has reached surface water, Client or ARCADIS must immediately notify the National Response Center (800-424-8802) in accordance with 40 CFR § 262.34. Other notifications to state and/or other local regulatory agencies may also be necessary.

Drilling Soil Cuttings and Muds

Soil cuttings are solid to semi-solid soils generated during trenching activities, subsurface soil sampling, or installation of monitoring wells. Depending on the drilling method, drilling fluids known as "muds" may

be used to remove soil cuttings. Drilling fluids flushed from the borehole must be directed into a settling section of a mud pit. This allows reuse of the decanted fluids after removal of the settled sediments. Soil cuttings will be labeled and stored in 55-gallon drums with bolt-sealed lids.

Excavated Solids

Excavated solids may include, but are not limited to: soil, fill, and construction and demolition debris. Prior to permitted treatment or offsite disposal, potentially hazardous excavated solids may be temporarily stockpiled onsite as long as the stockpile remains in the same AOC from where it was excavated. Potentially hazardous excavated solids removed from the AOC must be immediately containerized in labeled drums or closable top roll-offs lined with 9-mil polyvinyl chloride (PVC) sheeting and are subject to LQG storage time limits. Nonhazardous excavated solids can be stockpiled either inside or outside of the AOC, do not have to be containerized and are not subject to hazardous waste regulations. Potentially hazardous excavated solids must not be mixed with nonhazardous excavated solids. All classes of excavated solid stockpiles should be maintained in a secure area onsite. At a minimum, the floor of the stockpile area will be covered with a 20-mil high density polyethylene liner that is supported by a foundation or at least a 60-mil high density polyethylene liner that is not supported by a foundation. The excavated material will not contain free liquids. The owner/operator will provide controls for windblown dispersion, run-on control, and precipitation runoff. The run-on control system will prevent flow onto the active portion of the pile during peak discharge from at least a 25-year storm and the run-off management system will collect and control at least the water volume resulting from a 24-hour, 25-year storm (USEPA, 1992). Additionally, the stockpile area will be inspected on a weekly basis and after storm events. Individual states may require that the stockpile be inspected/certified by a licensed professional engineer. Stockpiled material will be covered with a 6-mil polyvinyl chloride (PVC) liner or sprayed dust control product. The stockpile cover will be secured in place with appropriate material (concrete blocks, weights, etc.) to prevent the movement of the cover.

Decontamination Solutions

Decontamination solutions are generated during the decontamination of personal protective equipment and sampling equipment. Decontamination solutions may range from detergents, organic solvents and acids used to decontaminate small field sampling equipment to steam cleaning rinsate used to wash heavy field equipment. These solutions are to be labeled and stored in closed head drums compatible with the decontamination solution. Decontamination procedures, including personnel and field sampling equipment, must comply with applicable Arcadis procedural documents.

Disposable Equipment

Disposable equipment includes personal protective equipment (e.g., tyvek coveralls, gloves, booties and APR cartridges) and disposable sampling equipment such as trowels or disposable bailers. If the media sampled exhibits hazardous characteristics per results of waste characterization sampling, contaminated disposable equipment will also be disposed of as a hazardous waste. If compatible with the original IDW waste stream (i.e., the IDW is a solid and the disposal equipment is a solid), the disposable equipment can be combined with the IDW. If these materials are not compatible (i.e., the IDW is a liquid and the disposal equipment is a solid), the disposable equipment will be stored onsite in separate labeled 55-gallon drums. Uncontaminated or decontaminated disposable equipment can be considered nonhazardous waste.

Purge Water

Purge water includes groundwater generated during well development, groundwater sampling, or aquifer testing. The volume of groundwater generated will dictate the appropriate storage procedure. Monitoring well development and groundwater sampling may generate three well volumes of groundwater or more. This volume will be stored in labeled 55-gallon drums. Aquifer tests may generate significantly greater volumes of groundwater depending on the well yield and the duration of the test. Therefore, large-volume portable polyethylene tanks will be considered for temporary storage pending groundwater-waste characterization.

Purged Water Storage Tank Decontamination and Removal

The following procedures will be used for inspection, cleaning, and offsite removal of storage tanks used for temporary storage of purge water. These procedures are intended to be used for rented portable tanks such as Baker Tanks or Rain for Rent containers. Storage tanks will be made of inert plastic materials. The major steps for preparing a rented tank for return to a vendor include characterizing the purge water, disposing of the purge water, decontaminating the tank, final tank inspection, and mobilization. Decontamination and inspection procedures are described in further detail below.

- Tank Cleaning: Most vendors require that tanks be free of any visible sediment and water before returning, a professional cleaning service may be required. Each specific vendor should be consulted concerning specific requirements for returning tanks.
- Tank Inspection: After emptying the tank, purged water storage tanks should be inspected for debris, chemical staining, and physical damage. The vendors require that tanks be returned in the original condition (i.e., free of sediment, staining and no physical damage).

8 WASTE MANAGEMENT

Soil/Solids Characterization

Waste characterization will be conducted in accordance with waste hauler, waste handling facility, and local/state/federal requirements. In general, RCRA hazardous wastes are those solid wastes determined by a Toxicity Characteristic Leaching Procedure (TCLP) test or to contain levels of certain toxic metals, pesticides, or other organic chemicals above specific applicable regulatory agency thresholds. If the one or more of 40 toxic compounds listed in Table I of 40 CFR § 261.24 are detected in the sample at levels above the maximum unregulated concentrations, the waste must be characterized as a toxic hazardous waste. Wastes can also be considered “listed” hazardous waste depending on site-specific processes.

Composite soil samples will be collected at a frequency of one sample per 10 cubic yard basis for stockpiled soil or one per 55-gallon drum for containerized. A four-point composite sample will be collected per 10 cubic yards of stockpiled material and for each drum. Sample and composite frequencies may be adjusted in accordance with the waste handling facility’s requirements. Waste characterization samples may be analyzed for the TCLP volatile organic compounds (VOCs), TCLP semi-volatile organic compounds (SVOCs), TCLP RCRA metals, and polychlorinated biphenyls (PCBs), as well as reactivity and flammability (flashpoint). Additional samples may be collected and analyzed by the laboratory on a contingency basis. Site-specific constituents of concern including pesticides may require additional

sampling. Please note that state- or local-specific regulations may require a different or additional sampling approaches.

Wastewater Characterization

Waste characterization will be conducted in accordance with the requirements of the waste hauler, waste handling facility, and local/state/federal governments. In general, purge water should be analyzed by methods appropriate for the known contaminants, if any, that have been historically detected in the monitoring wells. Samples will be collected and analyzed in accordance with the requirements of the waste disposal facility. Wastewater characterization samples may be analyzed for TCLP volatile organic compounds (VOCs), TCLP semi-volatile organic compounds (SVOCs), TCLP RCRA metals, and polychlorinated biphenyls, as well as corrosivity (pH), reactivity and flammability (flashpoint). Additional samples may be collected and analyzed by the laboratory on a contingency basis. Site-specific constituents of concern including pesticides may require additional sampling. Please note that state- and/or local-specific regulations may require different or additional sampling approaches.

Sample Handling and Shipping

All samples will be appropriately labeled, packed, and shipped, and the chain-of-custody will be filled out in accordance with current Arcadis sample chain of custody, handling, packing, and shipping procedures and guidance instructions.

It should be noted that additional training is required for packaging and shipping of hazardous and/or dangerous materials. Please refer to the current Arcadis training requirements related to handling and shipping of samples, shipping determinations, and hazardous materials.

Preparing Waste Shipment Documentation (Hazardous and Nonhazardous)

Waste profiles will be prepared by the Arcadis CPM and forwarded, along with laboratory analytical data to the Client for approval/signature. The Client will then return the profile to Arcadis who will then forward to the waste removal contractor for preparation of a manifest. The manifest will be reviewed by Arcadis prior to forwarding to the Client for approval. Upon approval of the manifest, the Client will return the original signed manifest directly to the waste contractor or to the Arcadis CPM for forwarding to the waste contractor. Arcadis personnel may sign waste profiles and/or waste manifests on a case by case basis for clients, provided the appropriate agreement is in place between Arcadis and the client documenting that Arcadis is not the generator, but is acting as an authorized representative of the generator.

Final drum labeling and pickup will be supervised by an Arcadis representative who is trained and experienced with applicable waste labeling procedures. The Arcadis representative will have a copy of the drum inventory maintained in the field book and will reconcile the drum inventory with the profile numbers on the labels and on the manifest. Different profile numbers will be generated for different matrices or materials in the drums. For example, the profile number for drill cuttings will be different than the profile number for purge water. When there are multiple profiles it is critical that the proper label, with the profile number appropriate to a specific material be affixed to the proper drums. A copy of the Arcadis drum inventory will be provided to the waste transporter during drum pickup and to the facility receiving the waste.

9 DATA RECORDING AND MANAGEMENT

Waste characterization sample handling, packing, and shipping procedures will be documented in accordance with relevant Arcadis procedures and guidance instructions as well as applicable client and/or project requirements, such as a Quality Assurance Project Plan or Sampling and Analysis Plan. Copies of the chain-of-custody forms will be maintained in the project file. Arcadis should photograph or maintain a copy of any hazardous waste manifest signed on behalf of Client in the corresponding office DOT record file.

10 QUALITY ASSURANCE

The CPM or APM will review all field documentation once per week for errors or omissions as compared to applicable project requirements including but not limited to: the proposal/scope of work, QAPP, SAP, HASP, etc. Deficiencies will be noted, tracked, and resolved. Upon correction, they will be noted for project documentation.

11 REFERENCES

United States Environmental Protection Agency (USEPA). 1992. Guide to Management of Investigation-Derived Wastes. Office of Remedial and Emergency Response. Hazardous Site Control Division. January 1992.

ARCADIS Design & Consultancy for natural and built assets

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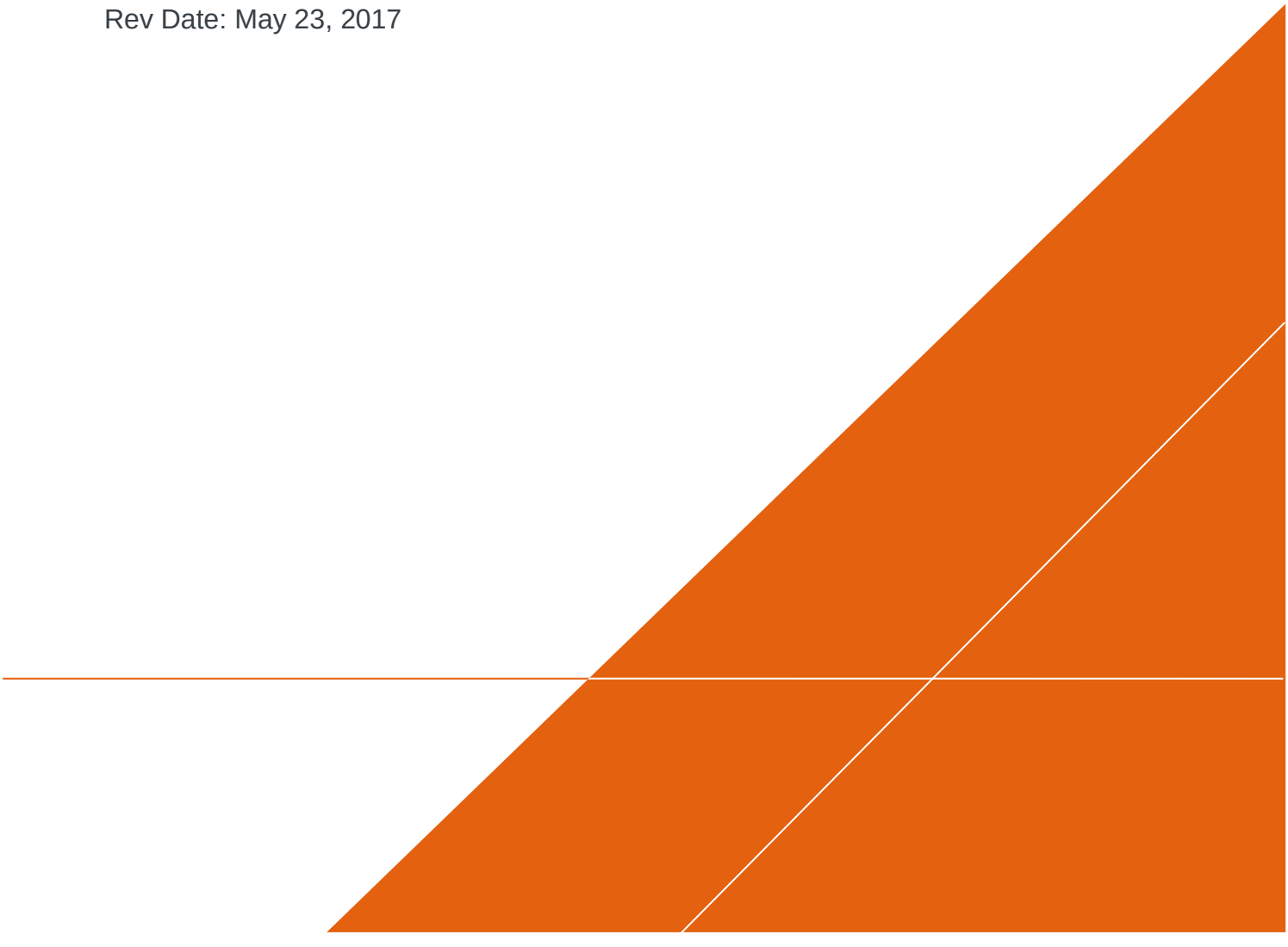
SOP - SAMPLE CHAIN OF CUSTODY

Rev: #1

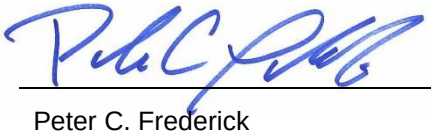
Rev Date: May 23, 2017



VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	April 19, 2017	All	Re-write to COC only	Richard Murphy
1	May 23, 2017	4	Add: Guidance on use of previous version of SOP.	Peter Frederick
		9	Add: Info on COCs for multiple shipping containers	
		7	Modify: Move letter i. to letter m. and change to “when appropriate”	

APPROVAL SIGNATURES

Prepared by:  05/23/2017

Peter C. Frederick Date:

Technical Expert Reviewed by:  05/23/2017

Richard J. Murphy Date:

1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) describes the general Chain of Custody (COC) procedures and guidance instructions for samples collected from project sites that are relinquished from Arcadis' possession.

COC is defined as the maintenance of an unbroken record of possession of an item from the time of its collection through some analytical or testing procedure. COC is typically documented by a written record of the collection, possession, and handling of samples collected from a project location. Each sample will be tracked by a documented record that efficiently documents the individuals who were responsible for the sample during each successive transfer of that sample to various recipients beyond Arcadis' possession. This information can be used to legally establish the integrity of the samples and therefore the analytical results derived from the samples. This information can be used in addition to other records and documentation regarding the samples, such as field forms, field logs, and photographs.

A sample is considered under custody if:

- It is in your possession; or
- It is in your view, after being in your possession; or
- It was in your possession and then you then locked it up to prevent tampering; or
- It is in a designated secure area.

Continued use of previous version of SOP:

Although not recommended, Arcadis program-, project-, and client-teams may be able to use the previous version of this SOP provided that it meets all of the quality expectations of Arcadis and client, and meets applicable regulatory requirements. It is up to the program, project, and/or client-team leader to determine whether it is appropriate to adopt the current SOP or to continue using the previous version.

However, all new work not associated with the previous version of this SOP must be performed with the current version of the SOP.

When adopting this new SOP, users of the previous versions must be aware that specific handling, packing, and shipping procedures and guidance has been removed and that those should be addressed within program or project plans (e.g. QAPPs, Work Plans, SAPs, etc.) or in a more detailed SOP or TGI specific to that sampling activity, whether related to media, constituent/analyte, client, state, etc.

In addition, adopting this new SOP will require users to refer to the Arcadis DOT Safety Program for procedures and guidance on the determination and handling, packing, and shipping of samples that are or may be considered hazardous materials.

3 PERSONNEL QUALIFICATIONS

Arcadis personnel performing work under the purview of this SOP will have received appropriate training and have field experience regarding the collection of samples from project locations. Arcadis personnel will have all other applicable and appropriate training relevant to the sampling work and project site.

4 EQUIPMENT LIST

The following list provides materials that may be required for each COC. Project reporting and documentation requirements must be reviewed with the CPM prior to execution of work. Additional materials, tools, equipment, etc. may be required, and project staff are required to verify with the CPM and/or Technical Expert what specific equipment is required to complete the COC.

- Indelible ink pen (preferably either black or blue ink);
- COC form https://thesourceus.arcadissource.com/TKI/Documents/COC%20Form.pdf (**Appendix A**) from either Arcadis, laboratory receiving and analyzing the samples, or other applicable and appropriate entity for the work performed;
- When appropriate, such as for litigation or expert testimony work, custody seals or tape.

5 CAUTIONS

One way in which the law tries to ensure the integrity of evidence is by requiring proof of the chain of custody by the party who is seeking to introduce a particular piece of evidence.

A proper chain of custody requires three types of affirmations: (1) affirmation that a sample is what it purports to be (for example, soil collected from a specified location and depth); (2) affirmation of continuous possession by each individual who has had possession of the sample from the time it is collected until the time it is analyzed or held by a laboratory; and (3) affirmation by each person who has had possession that sample remained in substantially the same condition and not contaminated or affected by outside influences from the moment one person took possession until the moment that person released the evidence into the custody of another (for example, affirmation that the sample was stored in a secure location where no one but the person in custody had access to it).

Proving chain of custody is necessary to "lay a foundation" for the samples in question, by showing the absence of alteration, substitution, or change of condition.

Ensure that appropriate sample containers with applicable preservatives, coolers, and packing material are planned for and provided at the site at the time of sample collection.

Understand the offsite transfer requirements of the samples for the facility at which samples are collected.

If overnight courier service is required schedule pick-up or know where the drop-off service center is located and the hours of operation.

An Arcadis employee appropriately trained at the correct level of internal hazardous materials/DOT (Department of Transportation) shipping must complete an Arcadis shipping determination to address applicable DOT and IATA (International Air Transport Association) shipping requirements. Review the applicable Arcadis procedures and guidance instructions for sample packaging, and labeling. Prior to using air transportation, confirm air shipment is acceptable under DOT and IATA regulations.

The person relinquishing possession of the samples or other member of the project team should contact the final recipient of the samples to confirm receipt and review any special provisions on the COC or questions that they may have.

6 HEALTH AND SAFETY CONSIDERATIONS

Follow the health and safety procedures outlined in the project/site Health and Safety Plan (HASP) as well as other applicable H&S requirements, such as:

- Arcadis Hazardous Material/DOT handling, packaging, and shipping training
- Project site-specific H&S training
- Client-specific H&S training
- Constituent-specific H&S training
- Media-specific H&S training

7 PROCEDURE

Collected samples must be uniquely identified, and properly documented, containerized, labeled with unique identifier, possessed in a secure manner during remainder of sampling event, packaged, and shipped to recipient laboratory.

Sample Identification

The method of sample identification depends on the type of measurement or analyses performed. In some cases, in-situ measurements of existing conditions and/or sample location must be made during sample collection. These data will be recorded directly on field forms, logbooks, or other project record data sheets used to permanently retain this information for the project file. Examples of location identification information includes: latitude/longitudinal measurements, compass directions, well number, building number, floor number, room name, or proximity to a site feature unique to the site. Examples of in-situ measurements are pH, temperature, conductivity, flow measurement, or physical condition of the media being sampled. Physical samples collected are identified by a unique identifying number or code on a sample tag or label. These physical samples are removed from the sample location and transported to a laboratory for analyses.

In some cases, before samples are placed into individual containers and labeled as individual samples, samples may be separated into portions depending upon the analytical methods and required duplicate or triplicate analyses to be performed.

When completing a COC for samples, personnel must complete the following:

1. Written COCs must be completed with indelible ink (preferably either black or blue colored ink).
2. Written COCs must be completed using legible printed writing, and not cursive writing.
3. All entry fields on the COC form must be completed. If information is not applicable for a specific entry field, personnel will either put “N/A” or use a strike-out line or dash like “----------“ to indicate no applicable information is needed for that field.
4. Use of quotation marks or lines/down arrows to represent repetitive/duplicative text in similar fields.
5. Regardless of the type or specific COC form, the following pertinent information must be provided on the COC form:
    a. Arcadis project number
    b. Arcadis project name
    c. Project location, including street address, city, state, building number, providing as much detail as appropriate
    d. Recipient laboratory contact and sample receiving shipping location information
    e. Entities’/persons’ contact information for who will be receiving analytical results
    f. Name of sampler, i.e. person collecting sample and relinquishing possession of samples to the next entity in the chain of custody
    g. Date of sample collection

h. If appropriate for the sample media, contaminant/constituent of concern, or analytical method, document time of sample collection using standard military time

i. Sample analytical method(s)

j. Turnaround time required for analyses and/or reporting

k. Instructions to laboratory regarding handling, timing, analyses, etc. as applicable and appropriate

l. Printed name and signature of the individual person who collected the samples and relinquishing possession of the samples

m. If appropriate or when documentation of the specific sample collection method will influence how the laboratory handles, prepares, or analyzes the samples, document the sample collection methodology used for collecting the samples (e.g. ASTM D5755)

6. The following additional specific information will be entered on the COC form, regardless of what type of COC is being used:

   a. Unique Sample Identifier – The sample identifier (ID) must be unique to the individual sample it is applied to. The information in which the sample ID conveys is determined by the CPM, Technical Expert, and/or other project team members in advance of sample collection so that sample identification is consistently applied for the project. The sample nomenclature may be dictated by a specific client, program, or project database and require unique identification for each sample collected for the project. Consult with the CPM and/or Technical Expert for additional information regarding sample identification.

      The sample ID could convey specific information regarding the sample to aid personnel in recognizing what the sample represents, or they may be arbitrary so as to facilitate the anonymity of the sample location, media, constituent of concern, project site, etc.

      Examples of unique identifiers include:

      1. Well locations, grid points, or soil boring identification numbers (e.g., MW-3, X-20, SB-30). When the depth interval is included, the complete sample ID would be “SB-30 (0.5-1.0) where the depth interval is in feet. Please note it is very important that the use of hyphens in sample names and depth units (i.e., feet or inches) remain consistent for all samples entered on the chain of custody form. DO NOT use the apostrophe or quotes in the sample ID.

      2. Sample names may also use the abbreviations “FB,” “TB,” and “DUP” as prefixes or suffixes to indicate that the sample is a field blank, trip blank, or field duplicate, respectively.

   b. List the date of sample collection. All indicated dates must be formatted using either mm/dd/yy (e.g., 03/07/09) or mm/dd/yyyy (e.g. 03/07/2009).

   c. When appropriate for the analytical procedure used, list the local time that the sample was collected. The time value should be presented using military format. For example, 3:15 P.M. should be entered as 15:15.

d. Samples should be indicated to be either “Grab” or “Composite”. Grab samples are collected from only one unique location at one specific point in time.

e. Composite samples are a group of individual samples that are combined for analysis in their totality. Composite samples need to be documented if they are either collected from a number of different locations over a broader area to be representative of the entire area being sampled, or if they are representative of a single location over an extended period of time.

f. If used, preservatives for the individual sample will be noted.

g. The requested analytical method(s) that the samples are being analyzed for must be indicated. As much detail, as necessary, should be presented to allow the analytical laboratory to properly analyze the samples. For example, polychlorinated biphenyl (PCB) analyses may be represented by entering “EPA Method 8082 – PCBs” or “EPA PLM 600-R93-116.” In cases where multiple analytical methods and/or analytical parameters are required for an individual sample, each method should be indicated for the sample (e.g., EPA 8082/8260/8270 or EPA PLM/400-point count).

h. If there are project-specific sample analytes to be reported, they should be specifically listed for each individual sample (e.g., 40 CFR 264 Appendix IX).

i. The total number of containers for each analytical method requested should be documented. This information may be included under the parameter or as a total for the sample.

j. When necessary, note which samples should be used for site specific matrix spikes.

k. Indicate special project-specific requirements pertinent to the handling, shipping, or analyses. These requirements may be on a per sample basis such as “extract and hold sample until notified,” or may be used to inform the laboratory of special reporting requirements for the entire sample delivery group (SDG).

l. Indicate turnaround time (TAT) required for samples on COC. If individual samples have differing TATs, the different TATs for each sample or groups of samples must be clearly indicated.

m. Provide contact name and phone number in the event that problems are encountered when samples are received at the laboratory. The person relinquishing possession of the samples or other member of the project team should contact the final recipient of the samples to confirm receipt and review any special provisions on the COC or questions that they may have.

n. If available, attach the Laboratory Task Order or Work Authorization forms.

o. The “Relinquished By” field must contain the signature of the Arcadis person who relinquished custody of the samples to the next entity in the chain of custody, which may be another person, the shipping courier, or the analytical laboratory.

p. Dates and times must be indicated using the following format:

    1) Date: either mm/dd/yy e.g., 01/01/17 OR mm/dd/yyyy e.g., 01/01/2017

    2) Time: use military format, e.g. 9:30 a.m. is 0930 and 9:30 p.m. is 2130

q. The “Received By” section is signed by sample courier or laboratory representative who received the samples from the sampler or it is signed upon laboratory receipt from the overnight courier service.

4. When more than one page of the COC form is required to complete the total number of samples, use as many sheets as necessary to accurately and clearly document the samples and information. Some COCs may have a standard first page/cover page, and subsequent pages may not contain all the detailed fields as the first page/cover page. Ensure that any subsequent pages convey all of the necessary and pertinent information for each individual sample as required in this procedure document.
5. Pages of the COC must retain a page count of the total number of pages; e.g., Page 1 of 3, Page 2 of 3, Page 3 of 3.
6. Upon completing the COC forms, forward the original signed COC with the sample package. Ensure that the original COC form is secured with the sample package so that it remains with the physical samples for the duration of transport and handling to its final destination and ensure that the COC form will not be become damaged or rendered unreadable due to sample breakage/leakage if stored inside the sample shipping container or outside influences if COC is stored in an outside plastic pouch to the container.
7. If you’ve collected enough samples that would require more than one container to ship them all to the same laboratory or location, then each separate/individual container that contains any number of samples must have a separate COC representing only those samples contained within that specific container. For example, if you have 3 total shipping containers for all of your samples, you must have a total of 3 separate, individual COCs for each of the 3 containers representing only those samples in their representative container. Thus, every container holding samples must have its own, individual COC.
8. If electronic chain of custody (eCOC) forms are utilized, ensure that the requirements of this procedure and guidance instructions are followed to the extent possible. Verify that proper signature and COC procedures are maintained with the CPM and/or Technical Expert when using eCOC.

8 WASTE MANAGEMENT

Not Applicable.

9 DATA RECORDING AND MANAGEMENT

The original signed COC shall be submitted with the samples. Copies of COC records will be transmitted to the CPM or designee at the end of each day unless otherwise directed by the CPM. The sampling team leader retains copies of the chain of custody forms for filing in the project file. Record retention shall be in accordance with client- and project-specific requirements and Arcadis policies, the most stringent will apply.

10 QUALITY ASSURANCE

COC forms will be legibly completed in accordance with this procedure and guidance instruction document, as well as other applicable and appropriate project documents such as Sampling and Analysis Plan (SAP), Quality Assurance Project Plan (QAPP), Work Plan, or other project guidance documents.

COC records will be reviewed by the CPM or their appropriate designee for completeness and accuracy to the applicable requirements. Non-conformances will be noted and corrected in a timely manner on the copies retained by Arcadis as well as contacting the ultimate receiving entity for correction to the originally signed COC in their possession.

11 REFERENCES

Arcadis Client Document Retention Guide

Arcadis Transportation Safety Program requirements, procedures, and guidance instructions

EPA Samplers' Guide – Contract Laboratory Program Guidance for Field Samplers, EPA document EPA-540-R014-013 October 2014

EPA Region III – *Sample Submission Procedures for the Office of Analytical Services and Quality Assurance (OASQA) Laboratory Branch* revision 13.0 January 29, 2014

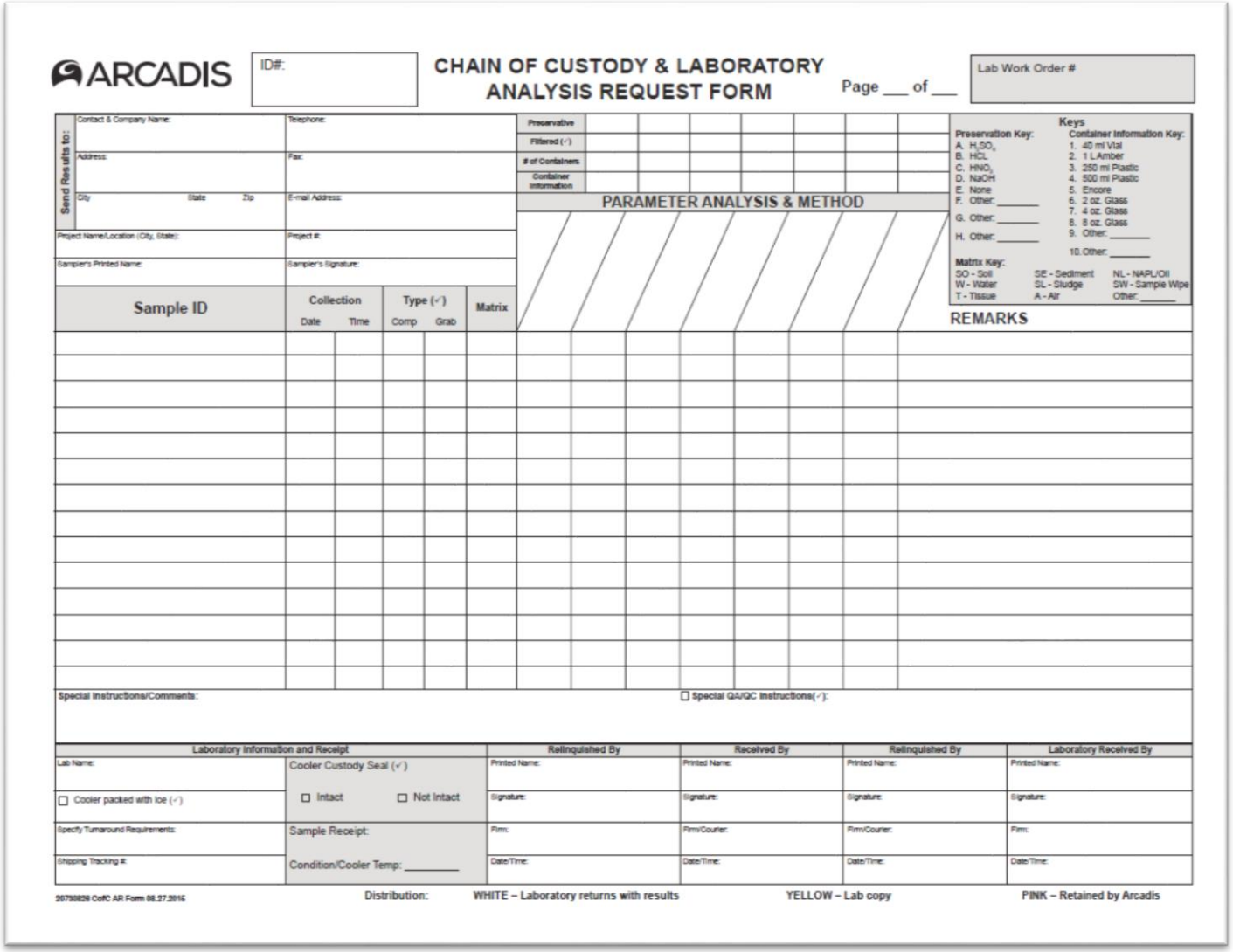
EPA Region I Office Environmental Measurement and Evaluation – *Standard Operating Procedures for Chain of Custody of Samples* revision 1 March 25, 2002

EPA Region IV Science and Ecosystem Support Division *Operating Procedure for Sample and Evidence Management* January 29, 2013

APPENDIX A

Chain of Custody Form

[click image below to access form]



ARCADIS

ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Page ___ of ___

Lab Work Order #

Send Results to:

Contact & Company Name: | Telephone:

Address: | Fax:

City | State | Zip | E-mail Address:

Project Name/Location (City, State): | Project #:

Sampler's Printed Name: | Sampler's Signature:

Sample ID	Collection Date	Collection Time	Type (✓) Comp	Type (✓) Grab	Matrix

Preservative | Filtered (✓) | # of Containers | Container Information

PARAMETER ANALYSIS & METHOD

REMARKS

Keys

Preservation Key:
A. H_2SO_4
B. HCL
C. HNO_3
D. NaOH
E. None
F. Other: _____
G. Other: _____
H. Other: _____

Container Information Key:
1. 40 ml Vial
2. 1 L Amber
3. 250 ml Plastic
4. 500 ml Plastic
5. Encore
6. 2 oz. Glass
7. 4 oz. Glass
8. 8 oz. Glass
9. Other: _____
10. Other: _____

Matrix Key:
SO - Soil | SE - Sediment | NL - NAPL/Oil
W - Water | SL - Sludge | SW - Sample Wipe
T - Tissue | A - Air | Other: _____

Special Instructions/Comments:

☐ Special QA/QC Instructions(✓):

Laboratory Information and Receipt		Relinquished By	Received By	Relinquished By	Laboratory Received By
Lab Name:	Cooler Custody Seal (✓)	Printed Name:	Printed Name:	Printed Name:	Printed Name:
☐ Cooler packed with Ice (✓)	☐ Intact ☐ Not Intact	Signature:	Signature:	Signature:	Signature:
Specify Turnaround Requirements:	Sample Receipt:	Firm:	Firm/Courier:	Firm/Courier:	Firm:
Shipping Tracking #:	Condition/Cooler Temp: _____	Date/Time:	Date/Time:	Date/Time:	Date/Time:

20730829 CofC AR Form 08.27.2015

Distribution: WHITE – Laboratory returns with results YELLOW – Lab copy PINK – Retained by Arcadis

APPENDIX A
Chain of Custody Form
[click image below to access form]

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