Groundwater Compliance Monitoring Plan

Former Planters Hotel
Sunnyside, Washington

Prepared for:

Port of Sunnyside

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The material and data in this plan were prepared under the supervision and direction of the undersigned.

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Abbreviations

bgs	below ground surface
CMP	compliance monitoring plan
COC	chemical of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CUL	cleanup level
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
GeoEngineers	GeoEngineers, Inc.
IDW	investigation-derived waste
LCS	laboratory control sample
LNAPL	light nonaqueous-phase liquid
MFA	Maul Foster & Alongi, Inc.
MS	matrix spike
MSD	matrix spike duplicate
MTCA	Model Toxics Control Act
NWTPH	Northwest Total Petroleum Hydrocarbons
PAH	polycyclic aromatic hydrocarbon
PLSA	PLSA Engineering & Surveying
POC	point of compliance
the Port	Port of Sunnyside
the Property	400 S Sixth Street in Sunnyside, Washington
QA	quality assurance
QC	quality control
SIM	selected ion monitoring
SOP	standard operating procedure
TPH	total petroleum hydrocarbons
UST	underground storage tank
VOC	volatile organic compound
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation

1 Introduction

Maul Foster & Alongi, Inc. (MFA), prepared this compliance monitoring plan (CMP) on behalf of the Port of Sunnyside (the Port) for the former Planters Hotel site located at 400 S Sixth Street in Sunnyside, Washington (the Property) (Figure 1-1). The Property is listed with the Washington State Department of Ecology (Ecology) under Facility Site ID 8639 and Cleanup Site ID 12922.

This CMP was developed in accordance with the compliance monitoring requirements as put forth in the Washington State Model Toxics Control Act (MTCA) (Washington Administrative Code [WAC] 173-340-410).

1.1 Purpose

The Property is currently enrolled in Ecology's Voluntary Cleanup Program (CE0534). The Port received funding to support cleanup actions at the Property through the Brownfields Revolving Loan Fund administered by the Washington State Department of Commerce with funding from the U.S. Environmental Protection Agency (EPA). Cleanup actions were performed at the Property from November 28 to December 17, 2022 (MFA 2023). The cleanup action included removal of soil exceeding MTCA Method A cleanup levels (CULs) for unrestricted land use and placement of a bioremediation product in the base of the excavation to reduce remaining concentrations in groundwater. This CMP was developed to guide groundwater compliance monitoring activities at the Property to demonstrate that CULs have been met following the completed cleanup action.

The CMP offers guidance on procedures for monitoring well installation, groundwater sampling, and management of investigation-derived waste (IDW). The CMP outlines procedures for collecting, analyzing, evaluating, and reporting groundwater monitoring data, including quality assurance (QA) procedures for field activities, sampling QA and quality control (QC) procedures, and data validation protocols.

The objectives of the CMP are to:

- Identify groundwater monitoring well locations for the compliance monitoring network.
- Describe the cleanup standards for the Property (CULs and points of compliance).
- Provide guidelines and criteria for groundwater monitoring at the Property, including criteria for screening against CULs and monitoring frequency.
- Outline procedures for installation and decommissioning of monitoring wells at the Property.
- Define requirements for terminating the groundwater monitoring program.

2 Background

2.1 Property Description and History

The Property is in section 25, township 10 north, range 22 east of the Willamette Meridian in Sunnyside, Washington (Figure 1-1). The Property comprises 0.31 acres and is located at the southeast corner of S Sixth Street and Decatur Avenue (Yakima County tax lots 22102524512 and 22102524511) (Figure 2-1).

The Property contains an unoccupied 3,152-square foot commercial building constructed in 1971 (Figure 2-1). The most recent building occupant was a Kentucky Fried Chicken restaurant franchise. The Planters Hotel occupied the Property from the early 1900s to the late 1960s; the hotel used two underground storage tanks (USTs) at the location shown in Figure 2-1. The USTs were decommissioned by removal in 2015. Current redevelopment plans for the Property include renovation of the existing commercial building into a pizza shop.

2.2 Geology and Hydrogeology

The topography of the Property is generally level and lies at an elevation of approximately 747 feet above mean sea level. Subsurface soil on the Property consists of silt with sand and occasional gravel, sand with silt, and silt to approximately 16 feet below ground surface (bgs). In 2019, groundwater was encountered at the Property between 6.5 and 12 feet bgs (GeoEngineers 2019).

Groundwater flow direction at the Property has not been confirmed. Therefore, a review of groundwater flow direction measured at monitoring wells at adjacent sites, spatial distribution of previous chemical detections, and an assessment of nearby surface water bodies was completed to determine an anticipated groundwater flow direction at the Property. The nearest surface water is Snipes Mountain Lateral, an irrigation canal flowing approximately 0.30 miles southwest of the Property. The Yakima River flows approximately 6 miles south of the Property. Based on topography, spatial distribution of previous chemical detections, flow direction measured at nearby sites, and surface water features, the direction of groundwater flow at the Property is inferred to be south-southwest.

2.3 2021 Environmental Investigation

In 2015, two USTs associated with the former hotel were removed from the Property (PLSA 2015). Analysis of soil samples collected from the bottom of the UST excavation detected diesel- and heavy-oil-range total petroleum hydrocarbons (TPH), total naphthalenes, and polycyclic aromatic hydrocarbons (PAHs) at concentrations greater than the MTCA CULs. Analysis of reconnaissance groundwater samples collected from borings in the UST excavation exhibited diesel exceedances of the MTCA CUL, total naphthalenes and PAHs detections below MTCA CULs, and no detections of heavy oil or carcinogenic PAHs (cPAHs).

In April and May 2021, MFA performed a subsurface investigation at the Property (MFA 2021a,b). Ten borings were advanced to a maximum depth of 20 feet bgs using direct-push drilling to assess the nature and extent of UST-related contamination (Figure 2-2). Soil and groundwater samples were collected from each boring location and sent for laboratory analysis. Samples were analyzed for the following:

- Gasoline-range hydrocarbons by Northwest Total Petroleum Hydrocarbons (NWTPH)-Gx
- Diesel- and lube-oil-range hydrocarbons by NWTPH-Dx
- Volatile organic compounds (VOCs) by EPA Method 8260D
- 1,2-dibromomethane and vinyl chloride by EPA Method 8260 selected ion monitoring (SIM)
- PAHs by EPA Method 8270E-SIM

Data were screened against MTCA Method A CULs. Where MTCA Method A CULs were unavailable, MTCA Method B CULs were used. In soil samples, TPH and VOCs were detected above MTCA CULs at boring GP03 and PAHs were detected above MTCA CULs at borings GP02 and GP03.

2.4 2022 Remedial Action

On November 28, 2022, MFA commenced soil excavation and management activities near the former USTs at the Property (MFA 2023). Impacted soils were excavated from 4 to 11 feet bgs. Soil confirmation sampling from one east sidewall location (ESW-2A) exceeded CULs for diesel-, oil-range hydrocarbons and cPAHs (Figure 2-2). Overexcavation along the eastern sidewall was technically infeasible due to the presence of underground utilities, an adjacent power line, and the Property boundary. Soil confirmation sampling from one north sidewall location (NSW-1A) exceeded CULs for cPAHs (Figure 2-2). Overexcavation along the northern sidewall was technically infeasible due to the lack of additional shoring and constraints associated with inclement weather.

A total of 312 tons of contaminated soil was removed from the Property. Following excavation, 800 pounds of Regenesis advanced oxygen releasing compound was applied in the base of the excavation. The excavation was backfilled with soil from the clean overburden stockpile and clean imported gravel borrow and then restored to original grade with clean imported gravel.

2.5 Residual Contamination

The following chemicals of concern (COCs) were identified for groundwater at the Property in the *Engineering Design Report* based on previous investigation data (MFA 2022):

- Diesel- and oil-range hydrocarbons (heavy oils)
- Gasoline-range hydrocarbons (soil only)
- PAHs
- VOCs (soil only)

Soil with COC concentrations above MTCA Method A CULs were excavated and disposed of off site during the remedial action performed in 2022 (MFA 2023). However, as described in Section 2.4, overexcavation along portions of the northern and eastern sidewalls was technically infeasible. Confirmation soil sampling identified the presence of the following COCs at concentrations above MTCA Method A CULs for unrestricted land use in the northern (NSW-1A) and eastern sidewalls (ESW-2A):

- cPAHs
- Diesel- and oil-range hydrocarbons (heavy oils) (only ESW-2A)

Bioremediation (application of 800 pounds of Regenesis advanced oxygen releasing compound) product was applied to the backfill of the excavation.

3 Monitoring Program

This section describes the groundwater monitoring program including identification of the monitoring well network, stages of monitoring, sampling and analysis program, and decision-making process for continuation or cessation of monitoring in each well or the need for implementation of contingent actions.

3.1 Monitoring Objectives

The primary groundwater monitoring objectives are:

- Assess the effectiveness of the 2022 remedial action.
- Evaluate groundwater quality conditions.
- Evaluate groundwater compliance with MTCA Method A CULs.
- Evaluate COC concentration trends of the dissolved-phase plume:
  - Determine whether COC concentrations are declining, stabilizing, or increasing.
  - Determine whether the lateral extent of contamination is stable or migrating.

3.2 Point of Compliance

The point of compliance (POC) is the point or points where the groundwater CUL must be attained for a site to comply with the cleanup standards. The standard POC is groundwater throughout the Property from the uppermost level of the saturated zone extending vertically to the lowest potentially impacted depth. Groundwater CULs shall be attained in all groundwater from the POC to the outer boundary of the hazardous-substance plume.

3.3 Groundwater Monitoring Network

To meet the groundwater monitoring requirements defined in WAC 173-340-410, quarterly groundwater monitoring activities will be conducted at the Property for the first year of compliance monitoring.

Groundwater monitoring will be conducted at three proposed monitoring wells: MW-1 through MW-3 (Figure 3-1). The monitoring wells are positioned upgradient of, within, and downgradient of the excavation area to evaluate the effectiveness of the 2022 remedial action and monitor groundwater quality.

3.4 Sampling and Analysis

Groundwater monitoring will include measuring water levels and water quality parameters (e.g., dissolved oxygen, pH, temperature, specific conductance, and oxygen reduction potential); assessing the presence of light nonaqueous-phase liquid (LNAPL) and measuring its thickness (if present); and collection and analysis of groundwater samples for COC analysis. Groundwater sampling will be conducted according to the methods and protocols outlined in this CMP.

Groundwater samples will be analyzed for the following:

- Diesel- and oil-range hydrocarbons (heavy oils) by NWTPH-Dx
- PAHs by EPA Method 8270E-SIM

The following activities will be conducted during each groundwater monitoring event:

- Water level measurements in each monitoring well for evaluating hydraulic gradient trends
- Groundwater sample collection from each monitoring well for evaluating compliance with CULs
- Analysis of COC concentration trends relative to the associated CULs

4 Access and Site Preparation

4.1 Access

MFA personnel will be on the Property during compliance monitoring events. Work activities that generate loud noises will generally be confined to the hours between 7 a.m. and 7 p.m. MFA will coordinate with the Port before beginning work at the Property.

4.2 Site Preparation

Before any subsurface field activities (e.g., monitoring well installation) begin at the Property public and private utility-locating services will be used to check for underground utilities and pipes near each proposed well or boring location (see standard operating procedure [SOP] 18 in the appendix). MFA will coordinate fieldwork with the Port to define locations of possible on-site utilities, piping, and other subsurface obstructions.

5 Groundwater Assessment

Proposed monitoring wells are shown in Figure 3-1. It is anticipated that monitoring wells will be installed using a direct-push drill rig (i.e., Geoprobe) in accordance with the well installation details below. Subsurface soils will be logged and screened for volatiles using a photoionization detector during well installation. If refusal is met before the desired well depth is reached (e.g., significant debris, cobbles, or bedrock are encountered), locations may be adjusted in the field, or a different drilling technology may be considered.

5.1 Monitoring Well Installation

Monitoring wells will be constructed according to the Washington State well construction standards (WAC 173-160, Minimum Standards for Construction and Maintenance of Wells) (see SOP 11 in the appendix) as described below:

- Monitoring wells will be constructed with 2-inch-diameter polyvinyl chloride or stainless steel riser pipes and screened sections consisting of 0.101-inch machine slots. The monitoring wells may be constructed with prepacked well screen with 10 x 20 washed silica sand or by placing materials downhole, following WAC 173-160.
- Additional filter pack may be placed around the prepacked screen, if used. The additional filter pack will consist of graded 10 x 20 washed silica sand and will extend a maximum of 1 foot below the bottom of the screen and 3 feet above the top of the screen. A weighted line will be used to monitor the level of the filter pack during installation. The filter pack may be surged during installation.
- Bentonite grout or chips hydrated with potable water (e.g., 0.75-inch minus) will be used to seal the annulus above the filter pack. A weighted line will be used to measure the top of the bentonite chips as they are poured into place.
- At least 24 hours after well installation, the well will be developed by surging, bailing, or pumping to remove sediment that may have accumulated during installation and to improve the hydraulic connection with the water-bearing zone (see SOP 12 in the appendix).
- Water quality field parameters such as specific conductance, pH, temperature, and turbidity will be measured during well development, as deemed appropriate. The wells will be developed until the turbidity measurements are 10 nephelometric turbidity units or less, or until there is no noticeable decrease in turbidity. To the extent practical, water quality field parameters will be considered stable with the specific conductance is within 10 percent of the previous reading, pH is within 0.1 standard unit of the previous reading, and temperature is within 0.1 degree Celsius of the previous reading.
- Development methods, purge volumes, and water quality parameters will be recorded on well development field forms.

During monitoring well installation, soil logging (see SOP 02 in the appendix) will be performed by, or directly under the supervision of, a geologist or hydrogeologist licensed in the State of Washington.

Through previous investigations, soil characterization at the Property is considered complete and soil samples will not be collected for COC analysis. Boring logs will include information such as the project name and location, the name of the drilling contractor, the drilling method, the sampling method, sample depths, blow counts (if applicable) a description of soil encountered, and screened intervals. Soils will be described using ASTM International Standard D2488-00, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). The information will be recorded on MFA boring logs.

5.2 Groundwater Elevations

Depth to groundwater (and LNAPL or free product, if present) will be recorded to the nearest 0.01 foot, using an interface probe and/or an electronic water level indicator, from the designated measuring point (i.e., the top of the well casing on the north side) (see SOP 13 in the appendix). The measuring point will be physically marked so that readings are measured from the same reference point during each monitoring event, and the measuring point elevation will be surveyed. If LNAPL is present, an LNAPL thickness measurement will be taken and recorded. Groundwater elevations at wells with LNAPL (if any) will be corrected to compensate for the effect of differing densities between LNAPL and water. The total well depth will also be measured. The water level indicator will be decontaminated between wells in accordance with the procedures in Section 5.5.

5.3 Monitoring Well Decommissioning

If wells are decommissioned, they will be filled with bentonite grout or chips hydrated with potable water, in accordance with WAC 173-160.

5.4 Surveying

Field staff will navigate to well locations using a handheld global position unit (e.g., Trimble) with submeter accuracy. The location and measuring point elevation of newly installed monitoring wells will be surveyed by a licensed surveyor.

5.5 Equipment Cleaning and Decontamination

5.5.1 Drilling Equipment

Drilling equipment will be decontaminated before installation of each monitoring well. Decontamination fluids will be transferred to Washington State Department of Transportation (WSDOT)-approved drums and will be managed as IDW as described in Section 5.6.

5.5.2 Sampling Equipment

Non-disposable sampling equipment and reusable materials will be decontaminated prior to sample collection and between sampling locations (see SOP 01 in the appendix). Decontamination will consist of the following:

- Tap-water rinse (may consist of an equivalent high-pressure or hot-water rinse) such that visible soil is removed by scrubbing
- Nonphosphate detergent wash, consisting of a diluted mixture of Liqui-Nox (or equivalent) and tap water
- Distilled water rinse
- Methanol solution (one-to-one solution of methanol with distilled water) rinse
- Distilled water rinse

All decontamination fluids will be transferred to WSDOT-approved drums and treated as IDW as described in Section 5.6.

5.6 Management of Investigation-Derived Waste

IDW may include soil cuttings, purged groundwater, decontamination fluids (see Section 5.5.2), sampling debris, and personal protective equipment. The IDW will be segregated into solids, liquids, and sampling debris (e.g., personal protective equipment, tubing, bailers). IDW will be stored in a designated area on the Property in WSDOT-approved drums.

IDW drums will be labeled with their contents, the approximate volume of material, the date of collection, and the origin of the material. Drums will be sealed, secured, and transferred to a designated area on the Property before characterization. Analytical data from groundwater sampling may be used to characterize the IDW generated during drilling and monitoring well sampling.

6 Groundwater Sampling

6.1 Monitoring Well Groundwater Sampling

If a peristaltic pump is used, groundwater will be purged at the EPA-approved low-flow purge rate (e.g., 0.1 to 0.5 liter per minute). Groundwater samples will be collected from the middle of the screened interval or, if the water level is below the top of the screen, from the middle of the water column (see SOP 09 in the appendix). New, disposable tubing will be used at each monitoring well location.

Before groundwater sample collection, the water level will be measured and a minimum of one well volume will be purged. Samples will be collected after selected water quality parameters (e.g., temperature, specific conductance, pH, and turbidity) have stabilized for three successive readings. If the well runs dry during purging, a sample can be collected once the well recharges a sufficient volume of water. During purging, flow rates, water levels, and water quality parameters will be recorded on a field sampling data sheet. Groundwater samples will be collected directly into laboratory-supplied containers specific to the analyses required.

6.2 Nomenclature

Groundwater samples will be labeled to include the following information:

- A prefix describing the sampling location
- GW (to indicate a groundwater sample matrix)
- The date of collection (formatted MMDDYY)

For example, a groundwater sample collected from monitoring well MW1 on July 27, 2024, would be labeled MW1-GW-072724.

For duplicate groundwater samples, “DUP” will replace the location identification number. The sample will have the same sample time as the primary sample. A duplicate sample of the abovementioned sample would appear as MWDUP-GW-072724.

7 Analytical Methods

7.1 Chemicals of Interest

Heavy oils (diesel- and oil-range hydrocarbons) and PAHs are identified as the COCs in groundwater at the Property. All samples submitted for laboratory analysis will be analyzed on a standard turnaround time.

7.2 Laboratory Test Methods and Reporting Limits

In accordance with the QA/QC requirements set forth in this CMP, an Ecology-accredited laboratory will perform the following analyses on groundwater samples (see the table):

- Diesel- and oil-range hydrocarbons by NWTPH-Dx
- PAHs by EPA Method 8270E-SIM

The requested method reporting limits and method detection limits will be consistent with MTCA CULs (where practicable).

7.3 Instrumentation

7.3.1 Field Instrumentation

Field instruments will be used during the investigations. The following field equipment may require calibration before use and periodically during sampling activities:

- Water quality meter (with pH, conductivity, and dissolved-oxygen meters)
- Turbidity meter

Field instrument calibration and preventative maintenance will follow the manufacturers’ guidelines, and deviations from the established guidelines will be documented.

7.3.1.1 Field Calibration

Generally, field instruments should be calibrated daily before work begins. Field personnel may decide to calibrate more than once a day if inconsistent or unusual readings occur, or if conditions warrant more frequent calibration. Calibration activities should be recorded in field notebooks. The following procedures will be followed to ensure that field instruments are properly calibrated and remain operable:

- Operation, maintenance, and calibration will be performed in accordance with the instrument manufacturers’ specifications.

- Standards used to calibrate field instruments will meet the minimum requirements for source and purity recommended in the equipment operation manual. Standards will be checked for expiration dates that may be printed on the bottle. Standards that have expired should not be used.
- Acceptable criteria for calibration will be based on the limits set in the operations manual.
- Users of the equipment should be trained in the proper calibration and operation of the instrument.
- Operation and maintenance manuals for each field instrument should be available to people using the equipment.
- Field instruments will be inspected before they are taken to the Property.
- Calibration procedures (including items such as time, standards used, and calibration results) should be recorded in a field notebook. The information should be available if problems are encountered.

7.3.1.2 Preventative Maintenance

Preventative maintenance of field instruments and equipment will follow the operations manuals. A schedule of preventative-maintenance activities should be followed to minimize downtime and ensure the accuracy of measurement systems.

7.3.2 Laboratory Instrumentation

Laboratory instrument calibration and preventative maintenance of laboratory equipment will be the responsibility of the laboratory. The preventative-maintenance approach for specific equipment should follow the manufacturers' specifications, good laboratory practices, and industry-standard techniques.

7.4 Sample Handling and Custody

Field sampling personnel will be responsible for the collection, labeling, description, documentation, handling, packaging, storage, and shipping of investigative samples obtained in the field. Proper sample handling and custody procedures are required in order to retain sample integrity from collection in the field through laboratory analysis and data reporting. Sample nomenclature is described in Section 6.2.

7.4.1 Sample Handling

Groundwater samples will be collected in laboratory-supplied containers with appropriate preservation per analytical method requirements. Immediately following collection, groundwater samples will be transferred to iced coolers and stored at approximately 4 degrees Celsius.

All samples will be stored and transported to the analytical laboratory in iced coolers. Samples will be submitted to the analytical laboratory to allow for analysis within the applicable holding times.

Analytical methods, sample container, preservation, and holding time requirements for the primary COCs are listed in the table.

7.4.2 Sample Custody

Sample custody will be tracked using a chain-of-custody form, which will be filled out with the appropriate sample and analytical information immediately after samples are collected. Sample custody procedures will be used to document the history of samples from the time of sample collection through shipment, analysis, and disposal. Samples and sample documentation will be maintained in the physical possession of authorized field personnel or under control in a secure location.

The following items will be recorded on the chain-of-custody form:

- Project name
- Project number
- MFA project manager
- Sampler name(s)
- Sample number, date and time collected, media, number of bottles submitted
- Requested analyses for each sample
- Type of data package required
- Turnaround requirements
- Signature, printed name, and organization name of persons having custody of samples, and date and time of transfer
- Additional instructions or considerations that would affect analysis (nonaqueous layers, archiving, etc.)

Persons in possession of the samples will be required to sign and date the chain-of-custody form whenever samples are transferred between individuals or organizations. The laboratory will implement its in-house custody procedures, which begin when sample custody is transferred to laboratory personnel.

If samples are shipped via air or ground transportation (by a third party), the following custody procedures will be followed:

- The chain-of-custody form will be signed and dated when custody is relinquished to the carrier.
- The signed chain-of-custody form(s) will be packed in shipping containers with the samples, and a custody seal will be placed on the container.
- The shipping documentation will be used by the laboratory to document sample receipt.

At the analytical laboratory, a designated sample custodian will accept custody of the samples and will verify that the chain-of-custody form matches the samples received.

7.5 Field Quality Control Samples

The field QC samples will be used to assess the accuracy and precision of the field sample collection and handling activities.

7.5.1 Equipment Rinsate Blanks

It is not anticipated that nondisposable equipment will be used at the Property during compliance monitoring. However, if nondedicated field equipment is used during sampling, equipment rinsate blanks will be used to assess whether decontamination procedures are sufficient. If equipment rinsate blanks are collected, at least one equipment rinsate blank will be collected for each sampling event or for every 20 samples collected. If more than 20 samples are collected with the same equipment, or if high concentrations of contaminants are encountered, additional equipment rinsate blanks will be collected, as warranted. Collection of equipment rinsate blanks consists of passing deionized/distilled water through or over sampling equipment. Equipment rinsate blank results will be evaluated during data validation.

7.5.2 Field Duplicates

Field duplicates are collected to measure sampling and laboratory precision. One field duplicate sample will be collected per 20 samples; a minimum of one field duplicate will be collected. Field duplicate results will be evaluated during data validation.

7.5.3 Temperature Blanks

Temperature blanks are prepared by the laboratory, using analyte-free water. The laboratory uses temperature blanks to record the temperature of each cooler used to transport samples from the field to the laboratory. Each cooler containing samples that require temperature preservation will contain a temperature blank. The laboratory will verify that the temperature blank measurement is within the acceptable range specific to the analytical method.

7.5.4 Trip Blanks

A trip blank monitors the potential for sample contamination during sample collection and transport. A trip blank consists of reagent-grade water in a new sample container, which is prepared at the same time as the sample containers. The trip blank will accompany the samples throughout collection, shipment, and storage. If VOCs are analyzed in groundwater, at least one trip blank will be included with each cooler in which samples for VOC analyses are stored.

7.6 Laboratory Quality Control Samples

The laboratory QC samples will be used to assess the accuracy and precision of the laboratory analysis. Each category of laboratory QA/QC will be performed by the laboratory at the required frequency, as applicable, based on analytical method guidelines and sample matrix.

7.6.1 Calibration Verification

Instruments will initially be calibrated at the start of the project or sample run, as required, and when any ongoing calibration does not meet control criteria. The number of points used in the initial calibration is defined in the analytical method. Calibration will be continued as specified in the analytical method to track instrument performance. If a continuing calibration does not meet control limits, analysis of project samples will be suspended until the source of the control failure is either eliminated or reduced to within control specifications. Any project samples analyzed while the instrument was outside control limits will be reanalyzed.

7.6.2 Method Blanks

Method blanks are prepared using analyte-free (reagent) water and are processed with the same methodology (e.g., extraction, digestion) as the associated investigative samples. Method blanks are used to document contamination resulting from the laboratory's analytical process. A method blank will be prepared and analyzed per 20 samples (or fewer) for every analytical batch.

The method blank results are used to verify that reagents and preparation do not impart unacceptable bias to the investigative sample results. The presence of analytes in the method blank sample will be evaluated against method-specific thresholds. If analytes are present in the method blank above the method-specific threshold, corrective action will be taken to eliminate the source of contamination before proceeding with analysis. Investigative samples from an analytical batch associated with method blank detections will be evaluated and qualified as appropriate by the data validator.

7.6.3 Laboratory Control Samples

Laboratory control samples (LCSs) are prepared by spiking laboratory-certified, reagent-grade water with the analytes of interest or a certified reference material that has been prepared and analyzed. The result for percent recovery of the LCS is a data quality indicator of the accuracy of the analytical method and laboratory performance.

An LCS will be prepared and analyzed per 20 samples (or fewer) for every analytical batch. Investigative samples from an analytical batch associated with LCS results outside laboratory acceptance limits will be evaluated and qualified as appropriate by the data validator.

7.6.4 Laboratory Duplicate Samples

Laboratory duplicate samples are prepared by the laboratory by splitting an investigative sample into two separate aliquots and performing separate sample preparation and analysis on each aliquot. The results for relative percent difference of the primary investigative sample and the respective laboratory duplicate sample are used to measure precision in the analytical method and laboratory performance. For nonaqueous matrices, sample heterogeneity may affect the measured precision for the laboratory duplicate sample.

When required by the analytical method, a laboratory duplicate will be prepared and analyzed per 20 samples (or fewer) for every analytical batch. Investigative samples associated with laboratory duplicate results outside laboratory acceptance limits will be evaluated and qualified as appropriate by the data validator.

7.6.5 Matrix Spike Samples

Matrix spike (MS) and matrix spike duplicate (MSD) are prepared by spiking investigative samples with known amounts of analytes before extraction and preparation and analysis. The recoveries for the MS and MSD samples will be used to assess matrix effects and the accuracy and precision in the analytical method by measuring how well the analytical method recovers the target compounds in the investigative matrices.

When required by the analytical method, an MS and MSD set will be prepared and analyzed per 20 samples (or fewer) for every analytical batch. Project samples may be designated for MS and MSD analysis on the chain-of-custody form. Investigative samples associated with MS and MSD results outside laboratory acceptance limits will be evaluated and qualified as appropriate by the data validator.

7.6.6 Surrogate Spikes

Surrogate spiking consists of adding reference compounds to samples before preparation of the samples for organic analysis. Surrogate compound spiking is used to assess method accuracy on a sample-specific basis. Surrogate compounds will be added to samples in accordance with the analytical method requirements. Surrogate spike percent recovery acceptance limits are determined by the analytical method. The surrogate spike percent recovery results will be reported by the laboratory and samples with surrogate results outside laboratory acceptance limits will be evaluated and qualified as appropriate by the data validator.

7.7 Data Management and Data Validation

7.7.1 Data Management

7.7.1.1 Field Data

Field data may be recorded in a bound logbook or on paper or electronic field data sheets. Hard copies of all field data will be scanned and saved electronically. Field data collected on paper or electronic field data sheets may be imported into an EQuIS database. In the event that field data are entered by hand into an electronic format before they are imported into EQuIS, the data will be entered and reviewed for data entry errors by separate qualified individuals (i.e., individuals not involved in the original manual entry).

Daily internal QC checks will be performed for field activities. Checks will consist of reviewing field notes and field activity memoranda to confirm that the specified measurements, calibrations, and procedures are being followed. The need for corrective action will be assessed on an ongoing basis, in consultation with the project manager.

7.7.1.2 Laboratory Data

The laboratory will provide analytical data packages that include the following:

- Transmittal cover letter
- Case narrative
- Chain-of-custody form
- Analytical results
- Surrogate recoveries
- Method blank results
- LCS results
- Laboratory duplicate results

- MS and MSD results

Laboratory analytical data will also be provided to MFA as electronic data deliverables, which will be imported directly into an EQuIS database used for data storage. Validated laboratory results will be exported and provided as part of the final report for each project. Validated laboratory data will also be uploaded to Ecology's Environmental Information Management System database.

Data may be reduced to summarize particular data sets and to aid interpretation of the results. Statistical analyses may also be applied to results. Data reduction QC checks will be performed on hand-entered data, calculations, and data graphically displayed.

7.7.2 Data Validation

Validation of the analytical data produced under this CMP will be performed by an MFA chemist, independent of the analytical laboratory generating the data reports. The validator will evaluate the laboratory data for precision, completeness, accuracy, and compliance with the analytical methods. The validator will review data according to applicable sections of EPA guidelines for data review (EPA 2020) and appropriate laboratory- and method-specific guidelines (EPA 1986).

Data qualifiers, as defined by EPA, are used to classify sample data according to their conformance to QC requirements. Common qualifiers are listed below:

- J—Estimated, qualitatively correct but quantitatively suspect.
- R—Rejected, data not suitable for any purpose. The analyte may or may not be present in the sample.
- U—Not detected at a specified reporting or detection limit.

The following information will be reviewed during data evaluation, where applicable:

- Sampling nomenclature
- Sampling dates
- Requested analyses
- Chain-of-custody documentation
- Sample preservation
- Holding times
- Method blanks
- LCS results
- Laboratory duplicate results
- MS and MSD results
- Surrogate recoveries
- Field QC samples
- Method reporting limits
- Additional comments or difficulties reported by the laboratory

- Overall assessment

The results of the data evaluation review will be summarized for each data package in a data validation memorandum. QC criteria not defined in the guidelines for evaluating analytical data are adopted, where appropriate, from the analytical method. Data qualifiers will be assigned to sample results based on EPA guidelines, as applicable, and the reasons for sample qualification will be stated in the data validation memorandum.

8 Reporting

Groundwater monitoring reports will be prepared in accordance with Ecology requirements (WAC 173-340-840[5]). Monitoring reports will provide a description of field activities, sampling methodologies, analytical data, analytical laboratory reports and associated chain-of-custody forms, field measurements of groundwater quality parameters and water levels, a discussion of analytical data trends over time, a comparison of analytical results to selected MTCA CULs, and data validation memoranda. Any deviations from this CMP will be explained in the groundwater monitoring report. Final, validated data will be uploaded to Ecology's Environmental Information Management System database within 30 days of receipt.

9 Schedule

The groundwater monitoring activities outlined in this CMP will begin October 2023 and will continue for four consecutive quarters. The CMP, sampling frequency, and sampling schedule will be reevaluated after completion of four quarterly groundwater monitoring events.

References

EPA. 1986. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.* EPA publication SW-846. 3rd ed. U.S. Environmental Protection Agency. Final updates I (1993), II (1995), IIA (1994), IIB (1995), III (1997), IIIA (1999), IIIB (2005), IV (2008), V (2015), VI phase I (2017), VI phase II (2018), VI phase III (2019), VII phase I (2019), and VII phase II (2020).

EPA. 2020. *National Functional Guidelines for Organic Superfund Methods Data Review.* EPA 540-R-20-005. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation: Washington, DC. November.

GeoEngineers. 2019. *Soil and Groundwater Assessment, Former Don Copp Site, 400 South 6th Street, Sunnyside, Washington.* Prepared for Washington State Department of Ecology. GeoEngineers, Inc. June 26.

MFA. 2021a. Dana Domenighini and David Weatherby, LG, Maul Foster & Alongi, Inc. *Former Planters Hotel Site, 400 S Sixth Street, Sunnyside, Washington: Supplemental Subsurface Investigation.* Letter to Jay Hester, Port of Sunnyside. June 15.

MFA. 2021b. *Final Site Investigation Report, Former Planters Hotel Site, 400 S Sixth Street, Sunnyside, Washington.* Prepared for the Port of Sunnyside. Maul Foster & Alongi, Inc.: Portland, OR. June 30.

MFA. 2022. *Engineering Design Report, Former Planters Hotel Site, Sunnyside, Washington.* Prepared for the Port of Sunnyside. Maul Foster & Alongi, Inc.: Vancouver, WA. August 31.

MFA. 2023. *Draft Cleanup Action Completion Report, Former Planters Hotel, Sunnyside, Washington.* Prepared for the Port of Sunnyside. Maul Foster & Alongi, Inc.: Vancouver, WA. July 6.

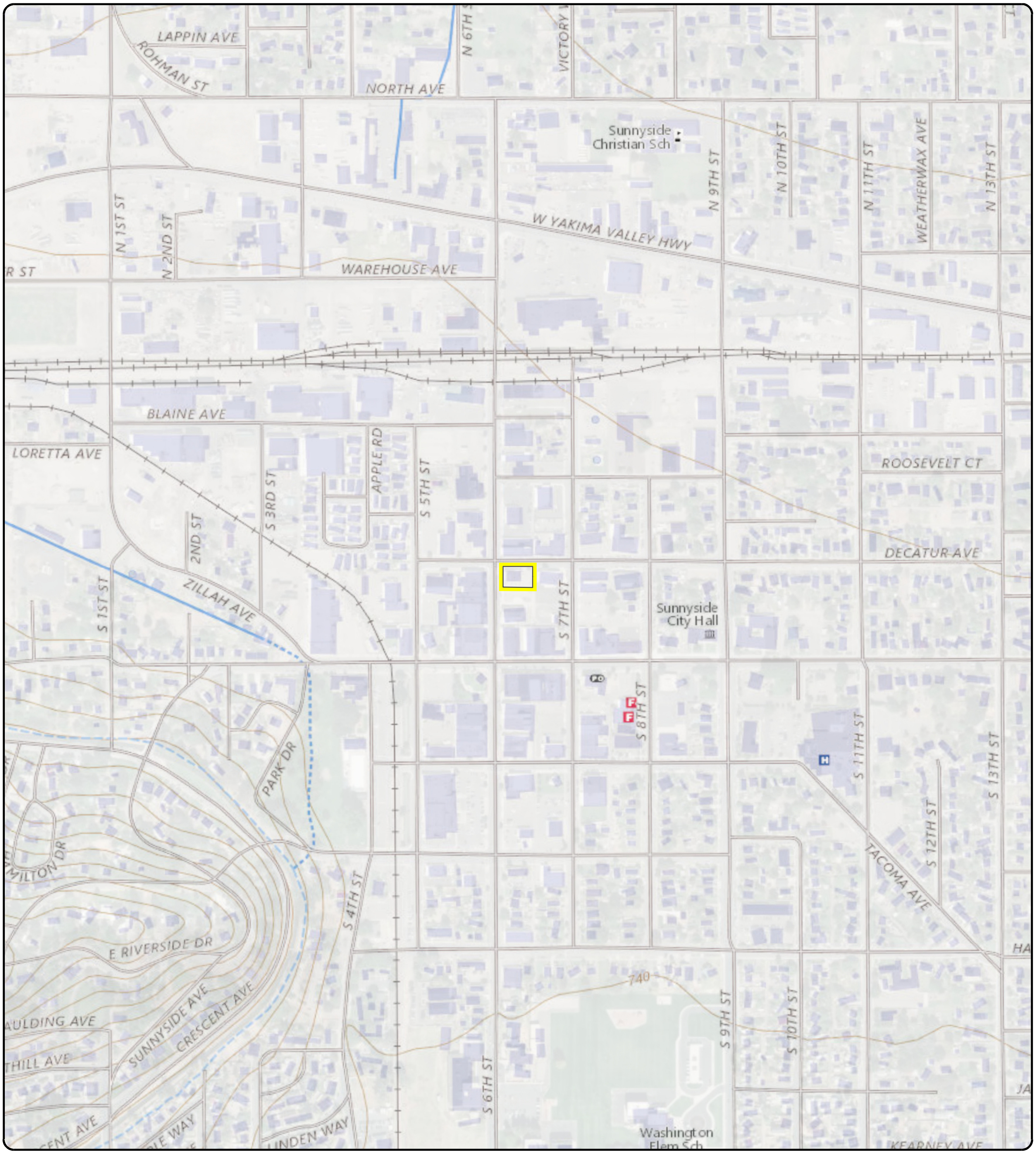
PLSA. 2015. *Underground Storage Tank Decommissioning—Site Assessment Report.* Prepared for Ken Leingang Excavating, Yakima, Washington. PLSA Engineering & Surveying. August 3.

Limitations

The services undertaken in completing this plan were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This plan is solely for the use and information of our client unless otherwise noted. Any reliance on this plan by a third party is at such party's sole risk.

Opinions and recommendations contained in this plan apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this plan.

Figures



Notes
U.S. Geological Survey (2020) 7.5-minute topographic quadrangle: Sunnyside.
Township10 North, Range 22 East, Section 25.

Data Sources
Property boundary obtained from Yakima County GIS.

Legend

Property Boundary

Figure 1-1
Property Location
Former Planters Hotel Site
400 S Sixth Street
Sunnyside, Washington

0 400 800
Feet

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Print Date: 7/19/2023
Reviewed by: jhansen
Produced By: sturner
Project: M0346.11.006

Figure 2-1
Property Features

Former Planters Hotel Site
400 S Sixth Street
Sunnyside, Washington

Legend

- Former UST Excavation
- Property Boundary
- Tax Lot

Notes
All locations are approximate.
UST = underground storage tank.

0 10 20
Feet

Data Sources
Aerial photograph obtained from Esri;
tax lot data obtained from Yakima County.

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Project: M0346.11.006 Produced By: sturner Reviewed by: jhansen Print Date: 8/15/2023 Path: X:\0346_11\006\Fig2_1_Property_Overview.mxd

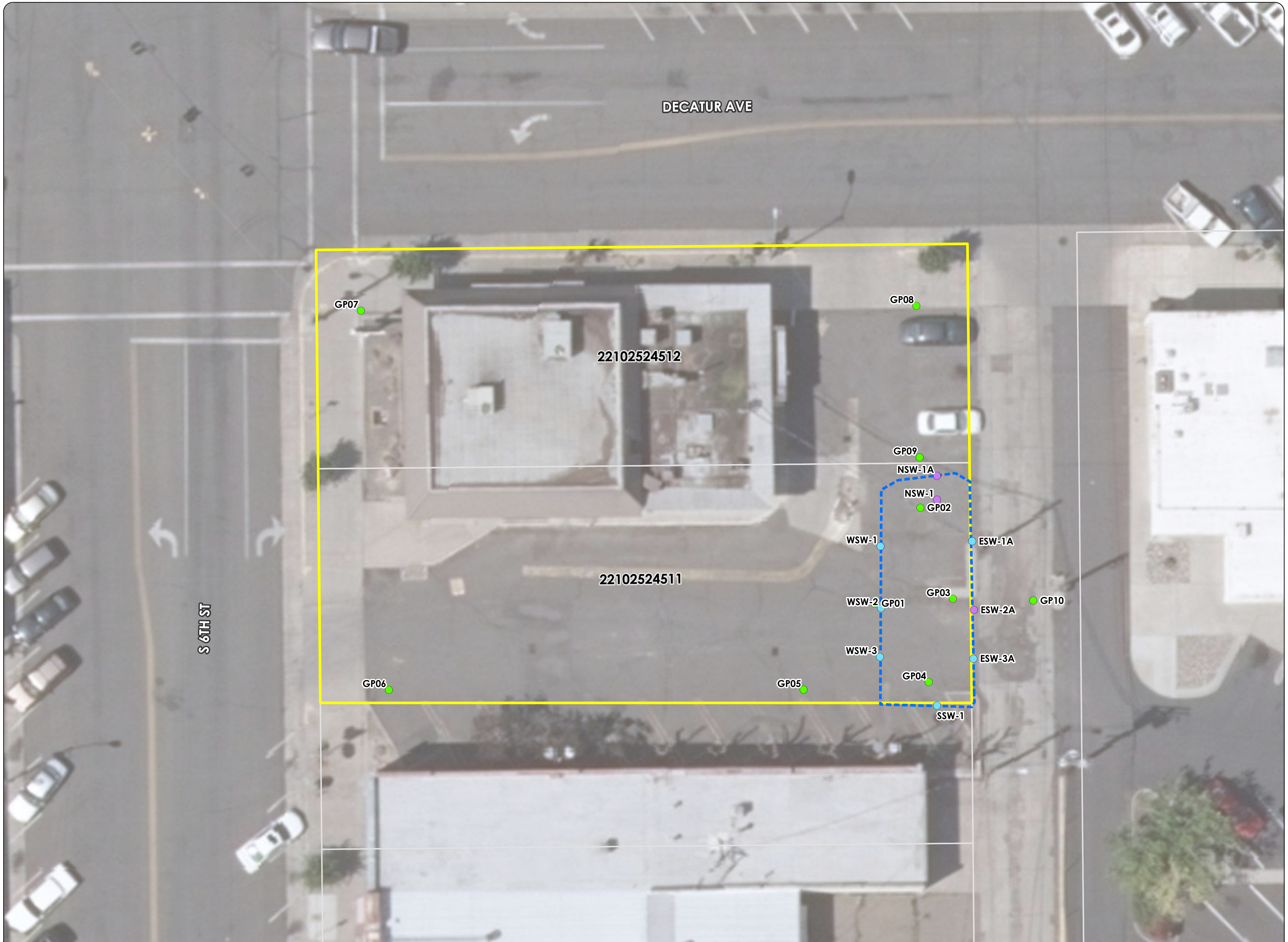

Figure 2-2
Previous Sample Locations

Former Planters Hotel Site
400 S Sixth Street
Sunnyside, Washington

Legend

- Boring (April and May 2021)
- Clean Confirmation Sample (November 2022)
- Confirmation Sample Above MTCA CULs (November 2022)
- Former UST Excavation
- Property Boundary
- Tax Lot

Notes
CUL = cleanup level.
MTCA = Model Toxics Control Act.
UST = underground storage tank.

0 10 20
Feet

Data Sources
Aerial photograph obtained from Esri;
tax lot data obtained from Yakima County.

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Reviewed by: jhansen
Produced By: sturner
Project: M0346.11.006

Figure 3-1
Proposed Monitoring Wells

Former Planters Hotel Site
400 S Sixth Street
Sunnyside, Washington

Legend

- Proposed Monitoring Well
- Boring (April and May 2021)
- Confirmation Sample Above MTCA CULs (November 2022)
- Inferred Groundwater Flow Direction
- Former UST Excavation
- Property Boundary
- Tax Lot

Notes

Only borings and confirmation sample locations with chemical concentrations above MTCA CULs are shown.
CUL = cleanup level.
MTCA = Model Toxics Control Act.
UST = underground storage tank.

0 10 20
Feet

Data Sources

Aerial photograph obtained from Esri;
tax lot data obtained from Yakima County.

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Path: X:\0346_11\006\Fig_3_1_Proposed_Monitoring_Well_Locations.mxd
Print Date: 8/17/2023
Reviewed by: jhansen
Produced By: sturner
Project: M0346.11.006

Table

Table
Container Requirements, Preservation, and Holding Times
Groundwater Compliance Monitoring Plan
Former Planters Hotel, Sunnyside, Washington

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Matrix	Method	Parameters	Sample Container[(a)]	Preservation (store at 4°C)	Holding Time[(b)]
Groundwater	EPA 8270E/8270E-SIM	PAHs	1-L amber glass bottle	None	7 days
	NWTPH-Dx	Diesel- and oil-range hydrocarbons		HCl to pH < 2	14 days

Notes

°C = degrees Celsius.

EPA = U.S. Environmental Protection Agency.

HCl = hydrochloric acid.

L = liter.

NWTPH = Northwest Total Petroleum Hydrocarbons.

PAH = polycyclic aromatic hydrocarbons.

SIM = selected ion monitoring.

[(a)]Recommended volume. Volume may vary per laboratory.

[(b)]Time by which the sample is to be analyzed or extracted, as dictated by the analytical method. The extraction holding time begins once the sample has been extracted. The laboratory is responsible for testing extracts within the method-specified extraction holding times.

Appendix

Standard Operating Procedures

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STANDARD OPERATING PROCEDURE

Decontamination of Field Equipment

SOP Number: 1
Date: 3/9/2021
Revision Number: 0.1

SCOPE AND APPLICATION

This standard operating procedure (SOP) describes the decontamination procedure for field equipment that may come in contact with contaminated media and that Maul Foster & Alongi, Inc. (MFA) staff may reuse at multiple sample locations or sites. Decontamination is performed to reduce the potential for cross-contamination of samples that will be collected with multiuse equipment and that will undergo physical or chemical analyses. Other equipment that is multiuse—not used specifically for sample collection (e.g., water level meter, pump used for well development)—also requires decontamination. Finally, decontamination is necessary to minimize the potential for MFA staff's exposure to chemicals.

Typically, decontamination is not necessary for field equipment that is disposable and intended to be used only once (e.g., disposable bailer). Additionally, this SOP does not apply to equipment used by subcontractors, such as drilling equipment. However, MFA staff should confirm that subcontractors are implementing appropriate decontamination procedures to minimize the potential for cross-contamination of samples or MFA staff's exposure to chemicals.

EQUIPMENT AND MATERIALS REQUIRED

The following materials are necessary for this procedure:

- Nonphosphate detergent solution (e.g., Alconox, Liquinox)
- Distilled and potable water
- Personal protective equipment (as specified in the site-specific health and safety plan)
- Buckets to contain rinsate, brushes, paper towels

Depending on the site conditions and the types of contaminants that may be present, the use of other decontamination materials, such as deionized water, methanol, hexane, or isopropyl alcohol, may be necessary. The need for other materials should be determined prior to fieldwork. The decontamination procedures using other materials should be described in a site-specific sampling and analysis plan (SAP).

METHODOLOGY

When the site-specific SAP specifies additional or different requirements for decontamination, it takes precedence over this SOP. In the absence of a SAP, the following procedures shall be used.

General Sampling Procedure:

1. Rinse the equipment with potable water to remove visible soil, petroleum sheen, or contamination.
2. Scrub the equipment with a brush and solution of distilled water and nonphosphate detergent.
3. Rinse the equipment with distilled water.
4. Allow equipment to air dry, or dry it with paper towels.
5. At all times, ensure that the decontaminated equipment is stored so as to prevent it from becoming contaminated while not in use. Depending on the size of the equipment, it can be wrapped with new aluminum foil or placed in a new plastic bag.

Rinsate Storage:

All fluids resulting from equipment decontamination shall initially be contained in a bucket and then transferred to a Department of Transportation-approved container (e.g., 55-gallon drum) stored on site at a location that does not interfere with on-site activities (e.g., vehicle traffic, pedestrian areas). Place a label on each container and include the following information:

- The date on which fluids were placed in the container
- Contents (e.g., "water from equipment decontamination")
- Contact information, including MFA staff or client phone number

Note that labels on containers exposed to sunlight or precipitation are prone to fading. Use a waterproof, indelible ink pen (e.g., Sharpie®) whenever possible. In the field notebook, keep a detailed inventory of all containers, including the number of containers, the approximate quantity of liquids generated, and a description of the source of the fluids. Provide this information to the MFA project manager. For future reference, take photographs of (1) each drum label, (2) the drum(s), and (3) the drum storage vicinity on site.

Note that some clients and site owners have specific requirements for labeling and storage of containers. The requirements should be determined in advance of the fieldwork.

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STANDARD OPERATING PROCEDURE

Lithologic Logging

SOP Number: 2
Date: 3/9/2021
Revision Number: 0.1

SCOPE AND APPLICATION

This standard operating procedure (SOP) describes the methods for observing and documenting the physical characteristics of unconsolidated geologic materials (soil and sediment) encountered during field investigations. If a Maul Foster & Alongi, Inc. (MFA) project requires hard rock drilling and description of rock core or cuttings, procedures for describing rock should be specified in a project-specific sampling and analysis plan (SAP).

EQUIPMENT AND MATERIALS REQUIRED

The following materials are necessary for this procedure:

- Blank field forms (e.g., boring logs) for documenting observations
- Dry-erase board
- Camera
- Munsell soil color chart (where required)
- MFA field logging checklist

METHODOLOGY

When the project-specific SAP specifies additional or different requirements for lithologic logging, it takes precedence over this SOP. In the absence of a SAP, the procedures in this SOP shall be used. MFA uses a combination of the Unified Soil Classification System (USCS) and the ASTM International method D2487 for describing and classifying soil and sediment by visual and manual examination. Before beginning fieldwork, verify with the project manager the logging standard to be used.

Logging Process:

The objective of lithologic logging is to document the physical characteristics of soil and sediment encountered and the changes in characteristics with depth. Typically, changes with depth will define the strata encountered. Therefore, each stratum encountered should be identified and the following characteristics described in the order given:

- Depth interval of each stratum to the nearest tenth of a foot below ground surface
- USCS classification Group Name and Symbol
- Color, using the Munsell color chart
- Grain-size distribution, as percentages of fines (silt and clay combined), sand, and gravel
- Percentages of larger gravels (cobbles and boulders) if present.
- Consistency when the content of fines is 50 percent or greater
- Density when the combined percentage of sand and gravel is 50 percent or greater
- Sand and gravel grain shapes
- Chemical odors, if noticeable
- Structures, if present (e.g., laminae, pores)
- Presence of organic matter (e.g., roots, leaves, twigs, wood fragments)
- Moisture content as “dry,” “moist,” or “wet”
- If possible, a description of the origin of each stratum (e.g., fill, alluvium)

SCOPE AND APPLICATION

This standard operating procedure (SOP) describes use of the low-flow sampling method for collection of reconnaissance groundwater samples from borings and groundwater samples from monitoring wells. The method uses low pumping rates during purging and sample collection to minimize water-level drawdown and hydraulic stress at the well-aquifer interface.

EQUIPMENT AND MATERIALS REQUIRED

The following materials are necessary for this procedure:

- Personal protective equipment (as specified in the health and safety plan)
- Water quality meter (e.g., Oakton, YSI Inc. multiparameter meter)
- Turbidity meter
- Water-level meter
- Peristaltic pump and tubing
- Laboratory-supplied sample containers
- Laboratory chain-of-custody form and cooler with ice
- Filter if dissolved analyses will be performed
- Well construction logs documenting the screen depth and interval for all wells to be sampled
- Equipment decontamination supplies if sampling equipment will be reused between sample locations (see SOP 1 for equipment decontamination procedures)
- 5-gallon buckets with lids
- Department of Transportation-approved storage containers (e.g., drums, totes)
- Groundwater field sampling datasheet and notebook

METHODOLOGY

When the project-specific sampling and analysis plan (SAP) provides additional or different requirements for low-flow groundwater sampling, it takes precedence over this SOP. In the absence of a SAP, the procedures in this SOP shall be used.

General Sampling Procedure:

Water Level Measurement

- Water-level measurement procedures are described in detail in SOP 13.
- Open the well cap to allow the water level to equilibrate (approximately ten minutes).
- Measure the water level in the well, using an electronic water-level meter to the nearest 0.01 foot to determine the depth to groundwater below the top of the well casing.
- If light nonaqueous-phase liquid (LNAPL)is present (typically indicated by a dark, oily sheen on the top of the water level meter), discuss with the MFA project manager how to proceed.

Purging

- If the water level is above the top of the well screen, place the end of the sample tubing in the middle of the well screen interval. If the water level is below the top of the screen, place the end of the sample tubing at the midpoint between the water level and the bottom of the well screen.
- Typical low-flow sampling pumping rates range from 0.1 to 0.5 liters per minute, depending on the hydrogeologic characteristics at the site. The objective of the rate selected is to minimize excessive drawdown (<0.3 feet) of the water level.
- Measure water quality parameters (dissolved oxygen, pH, electrical conductivity, turbidity, and temperature) using a flow-through cell connected to the discharge end of the peristaltic pump tubing. Purging will be considered complete when the water quality parameters stabilize per the following for three consecutive readings taken over 3-minute intervals (consistent with EPA guidance)[1]:

  Dissolved Oxygen (10% for values greater than 0.5 mg/L, if three Dissolved Oxygen values are less than 0.5 mg/L, consider the values as stabilized),
  Specific Conductance (3%),
  Temperature (3%),
  pH (± 0.1 unit),
  Oxidation/Reduction Potential (±10 millivolts).

- Document the purge procedures, including pumping rates, water quality parameter measurements, and the water level during purging, on the groundwater field sampling datasheet.
- Place purge water in Department of Transportation-approved containers (e.g., 55-gallon drum) stored on site. See SOP 1 for drum storage, labeling, and documentation procedures.

Sample Collection

- Following the purging process, collect groundwater samples in laboratory-supplied containers.
- Confirm the laboratory analytical methods and sample container requirement with the MFA project manager or project chemist. If analysis for gasoline-range petroleum hydrocarbons or volatile organic compounds (VOCs) is proposed, fill the sample containers for gasoline and VOC analysis before filling sample containers for other analytical methods. Sample containers for gasoline and VOC analysis shall be filled to capacity without overfilling and capped so that no headspace or air bubbles remain in the container.

Low Yield (Alternate Method)

- If drawdown of the water table cannot be avoided by reducing the pumping rate, and the well goes dry during purging, discontinue pumping and water quality parameter measurements.
- Collect the groundwater sample after the water level above the well bottom recovers to 90 percent of the prepurge water level. For example, if the water level was 10 feet above the well bottom before purging, begin sampling when the water level has recovered to 9 feet or more above the well bottom.
- If the water column volume is insufficient to meet the sample volume requirement, allow the water level to again recover to 90 percent before continuing sampling. Repeat this procedure until all sample containers are filled.

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[1] EPA. 2017. Low stress (low flow) purging and sampling procedure for the collection of groundwater samples from monitoring wells. September 19.

SCOPE AND APPLICATION

This standard operating procedure (SOP) describes the use of conventional machine slotted polyvinyl chloride (PVC) or prepacked well screens to install monitoring wells. The screen permits water to enter the well from the saturated aquifer, prevents soil from entering the well, and serves structurally to support the aquifer material. The slot size of the well screen is typically based on selection of the filter pack material. Monitoring wells must be designed and installed to ensure that low-turbidity groundwater samples, groundwater levels, and hydraulic conductivity data that are representative of conditions in the aquifer can be obtained.

EQUIPMENT AND MATERIALS REQUIRED

The following materials are necessary for this procedure:

- Drill rig and operator provided by a subcontractor to MFA. Ensure that the subcontractor is licensed to perform the well installations.
- Personal protective equipment (as specified in the health and safety plan).
- Water-level meter.
- Monitoring well construction log and notebook.

METHODOLOGY

When the project-specific sampling and analysis plan (SAP) provides additional or different requirements for well installation, it takes precedence over this SOP. In the absence of a SAP, the procedures in this SOP shall be used.

The drilling contractor will be responsible for conforming to all applicable local and state regulations for well construction.

The proposed well construction should be provided to the driller in advance so that (1) the driller can confirm that the proposed construction is consistent with state regulations, and (2) the driller comes to the project site with sufficient materials for the well construction.

General Procedure:

Drilling and Well Construction. This SOP assumes that a boring has already been drilled and is ready for well installation. See SOPs 7 and 8 for drilling procedures. If the boring was advanced to a depth below the targeted well screen interval, backfill the boring with cement-bentonite slurry or bentonite chips so that the boring bottom is at a depth about 2 feet below the lower screen interval depth. Well construction will include flush-threaded Schedule 40 PVC casing and conventional PVC well screen or stainless steel mesh prepacked well screen, placed at the bottom of the boring.

Filter Pack. Clean silica sand pack will be placed between the boring wall and the PVC screen/riser (i.e., the annulus) from the bottom of the well to approximately 1 to 2 feet above the screened interval. The filter pack should have greater hydraulic conductivity than the surrounding formation so that water can be drawn into the well. Before installation of the seal, the well may be surged using a surge block or similar technique to consolidate the filter pack and eliminate voids. Measure and document the depth to the sand filter pack before setting the seal.

Seal. A bentonite seal 1 to 2 feet thick will be placed above the sand. The bentonite will be hydrated and allowed to sit for a minimum of 30 minutes for proper hydration and sealing. Measure and document the depth to the top of the seal before placing grout.

Grout. Cement-bentonite slurry or bentonite chips (hydrated after installation) will be placed above the bentonite seal following proper hydration of the seal. The cement-bentonite slurry will be placed to within 1 foot of the ground surface.

Surface Seal and Monument. A concrete surface seal will secure a flush-mounted, traffic-rated monument, or a bollard-protected stickup monument. Flush-mounted surface monuments will be completed slightly above grade to prevent ponding of water on the monument lid. A locking cap and lock will secure the top of the well casing in a surface monument. Tamper-resistant bolts (e.g., pentagonal) may be used to secure the lid of a flush-mounted monument. The lid of a stickup monument should be secured with a lock.

The well constructor shall permanently affix a well identification label to the wellhead. In addition, the well number should be marked on the well (e.g., punched into monument ring, written on the well casing/cap with permanent marker). A v-notch is typically cut into the north side of the PVC riser for use as a survey point and for water level measurements.

Documentation. The field representative will produce the following documentation during the well installation:

- Length of well components, including blank casing, well screen, and sump (if included).
- Preinstallation boring depth below ground surface (bgs).
- Depth bgs to top and bottom of screen.
- Depth bgs to top of filter pack and seal.
- Types, brands, and amounts of materials (sand, bentonite, grout) used.
- Decontamination procedures followed, if needed (see SOP 1 for equipment decontamination procedures).
- If potable water was placed into the boring or well during installation, document the total volume of water placed; this information will be needed for well development (see SOP 12).
- Any deviation from standard procedures or any problems encountered during the installation activities.

SCOPE AND APPLICATION

This standard operating procedure (SOP) describes the methods for developing new monitoring well installations. New wells should be developed no sooner than a period of 24 hours after the grout seal has been placed; longer periods of 48 to 72 hours may be necessary, depending on applicable local or state regulations. The objective of well development is to ensure that low-turbidity groundwater samples, groundwater levels, and hydraulic conductivity data representative of conditions in the aquifer can be obtained from the well. This SOP is also applicable to the redevelopment of existing monitoring wells.

EQUIPMENT AND MATERIALS REQUIRED

The following materials are necessary for this procedure:

- Personal protective equipment (as specified in the health and safety plan)
- Well purge equipment (e.g., Waterra Pump, bailer, and peristaltic pump)
- Water-quality meter (e.g., Oakton and turbidity meter)
- Water-level meter
- Well construction logs for all wells to be developed
- Equipment decontamination supplies if sampling equipment will be reused between sample locations (see SOP 1 for equipment decontamination procedures)
- Five-gallon buckets with lids
- Department of Transportation-approved storage containers (e.g., drums, totes)
- Well development log and notebook

METHODOLOGY

When the project-specific sampling and analysis plan (SAP) provides additional or different requirements for well development, it takes precedence over this SOP. In the absence of a SAP, the procedures in this SOP shall be used.

Owing to the potential for hazardous substances in groundwater, well development requires consideration of the work area and equipment setup, health and safety procedures, use of appropriate personal protective equipment, procedures for equipment decontamination, and disposal of expendable development supplies. Confirm all procedures in advance with the MFA project manager and the MFA health and safety professional.

1. Cut a segment of plastic sheeting to an approximate 10-foot-by-10-foot dimension. Cut a hole in the center of the sheeting and place the sheeting over the well so that the well monument can be accessed through the hole and the sheeting lies flat on the ground. The sheeting defines the work area for well development. All equipment that may come in contact with groundwater should remain in this work area until it has been decontaminated or containerized for disposal.
2. Measure the depth to water and the total depth of the well before development. Confirm that the entire screen length is below the water level; if it is not, contact the MFA project manager to discuss potential modification of the well-development procedures.
3. Subtract the depth to water from the total well depth to determine the height of the column of groundwater present in the well casing. Multiply the height by the gallon-per-foot value in the table

below, corresponding to the diameter of the well being developed, to calculate the volume of water in the well casing. Record the readings and casing volume on the well development log.

Casing Diameter (inches)	Volume (gallons per foot)
1	0.04
2	0.17
3	0.37
4	0.65
5	1.02
6	1.46

4. Surge groundwater through the entire well screen interval with a weighted bailer or Waterra pump with tubing equipped with surge block. Begin surging at the top of the well screen by vigorously moving the bailer or surge block in approximately 1-foot vertical increments. Gradually increase the surge depth until the entre screen interval has been surged. The surge time for each 1-foot increment will depend on type of drilling, lithology, and well completion details. Generally, there should be at least one minute of surging across each increment.

5. After surging the well screen, purge groundwater from the well into buckets at a higher purging rate than the expected purging rate of groundwater sampling. Ideally, purging will be completed using a method that does not continue to surge the well (i.e., peristaltic or submersible pump). If a Waterra pump is used, remove the surge block from the tubing and set the tubing intake above the well screen for purging. Measure the water level during the purging process and adjust the pumping rate to maintain a water level above the top of the screen interval if possible. Document the volume of water removed.

6. When the volume of water purged equals the casing volume, use the water-quality meter to measure the temperature, pH, conductivity, and turbidity of the purge water. Repeat the measurements for each casing volume removed. Note that a YSI water-quality meter or similar meters should not be used in highly turbid water, per the manufacturer's recommendation.

7. After the removal of five casing volumes, review the stability of the water quality meter readings. The well will be considered developed if the water quality readings have stabilized for three consecutive casing volumes for the following:
   pH (± 0.1 unit),
   Specific Conductance (3%),
   Turbidity (10% for values greater than 5 NTU; if three Turbidity values are less than 5 NTU, consider the values as stabilized),

8. If the water-quality readings stabilize before a total of ten casing volumes are removed, development is complete. If the water-quality readings do not stabilize, well development will be consider complete after ten casing volumes have been removed.

9. If the water level cannot be maintained above the well screen or the well pumps dry during purging, contact the MFA project manager for further instructions.

10. If potable water was placed into the boring during drilling or into the well during installation, remove that volume of water and then begin purging as described in step 5.

SCOPE AND APPLICATION

This standard operating procedure (SOP) describes the methods for obtaining groundwater level measurements and light nonaqueous-phase liquid (LNAPL) measurements from monitoring wells. Measurement may be collected as an independent event or in conjunction with groundwater sampling or sampling of removed LNAPL.

EQUIPMENT AND MATERIALS REQUIRED

The following materials are necessary for this procedure:

- Personal protective equipment (as specified in the health and safety plan)
- Equipment decontamination supplies if equipment will be reused between well locations (see SOP 1 for equipment decontamination procedures)
- Field notebook
- Water-level meter or oil/water interface probe if water levels and LNAPL levels will be measured
- Bailers or tape/paste to confirm LNAPL detections if required; see SOP 10 for procedures for managing LNAPL when removing LNAPL from a well

METHODOLOGY

When the project-specific sampling and analysis plan (SAP) provides additional or different requirements for water-level and LNAPL measurements, it takes precedence over this SOP. In the absence of a SAP, the procedures in this SOP shall be used.

General Sampling Procedure:

Review well construction details and historical groundwater and LNAPL levels and thicknesses if available.

During groundwater sampling events, measurements should be collected before, during, and after purging and sampling. During purging and low-flow sampling, water-level measurements are conducted to ensure that drawdown is not occurring. Low-flow sampling methods are described in SOP 9. The following procedures should be followed when collecting groundwater-level and LNAPL measurements from wells.

Water Level Measurement

1. Test the water-level meter to ensure proper instrument response. This can be accomplished by immersing the probe tip in a small container of water.
2. Open the well cover and cap and allow the water level to equilibrate with atmospheric pressure for several minutes so that a static water level is attained. Audible air movement into or out of the well upon loosening of the well cap is an indication that the water level is not in equilibrium with atmospheric pressure.
3. Locate the measurement reference point at the top of the well casing. Typically, this is a small notch in the casing or a point marked with a pen. If no measure point is present, measure the water level from the north side of the casing and note the result in the field notebook.
4. Lower the water-level meter probe into the well casing until the probe signal indicates that water has been contacted.

5. Observe the depth-to-water (DTW) reading from the measurement reference point at the top of the well casing to the nearest 0.01 foot. Over the course of about a minute, raise and re-lower the probe and observe the resulting DTW reading. If the reading remains unchanged to within 0.01 foot, this is an indication that the water level has equilibrated with atmospheric pressure; the reading can then be recorded in the field notebook as the static water level reading. If the reading changes, allow more time for the water level to become static.
6. If the work scope or SAP requires measurement of the depth-to-bottom (DTB), lower the probe to the bottom of the well and record the DTB reading from the reference point to the nearest 0.01 foot.
7. Remove the probe and decontaminate the probe and the portion of the probe tape inserted into the well casing.

Water Level and LNAPL Measurement

1. Repeat above steps 1 through 7.
2. Lower the interface probe into the well casing until the probe signal indicates that LNAPL has been contacted. Typically, the interface probe will signal by a repeating beep when LNAPL is present. A steady signal indicates that LNAPL is absent and that the probe is recording the DTW.
3. Observe the LNAPL reading as described in step 5 above until a static reading to the nearest 0.01 foot is achieved, and record the reading in the field notebook.
4. Lower the probe until a steady signal indicates that water has been contacted. Observe the water-level reading as described in step 5 above to confirm a static water level, and record the reading in the field notebook.
5. If LNAPL is detected in a well with no prior history of LNAPL presence, or the LNAPL thickness is greater than in prior observations, verify the presence and thickness using an alternative technique (e.g., bailer, tape, and water/petroleum colorimetric paste). See SOP 10 for procedures for managing LNAPL when removing LNAPL from a well.
6. Remove the interface probe and decontaminate the probe and the portion of the probe tape inserted into the well casing.

SCOPE AND APPLICATION

This standard operating procedure (SOP) describes the practices for locating underground utilities. Refer to the MFA health and safety plan (HASP) for additional information regarding communication procedures to be followed when an inadvertent utility strike occurs, as well as regarding methods for mitigating hazards during a utility strike.

EQUIPMENT AND MATERIALS REQUIRED

The following materials are necessary for this procedure:

- Personal protective equipment (as specified in the HASP)
- Marking materials (e.g., marking paint, stakes, flags)
- Field documentation materials

METHODOLOGY

When the project-specific sampling and analysis plan (SAP) specifies additional or different requirements for underground utility locates, it takes precedence over this SOP. In the absence of a SAP, the procedures in this SOP shall be used.

Before Conducting Utility Locates:

- Ensure that the locate will be conducted reasonably soon before the excavation work begins, e.g., within 48 hours. There may be project-specific conditions, e.g., weather and/or ground features that could cause markings to fade, which would require scheduling of the excavation work sooner than 48 hours after the locate.
- Clearly define the boundary of the work and the locations of all proposed excavations. Prepare a map of the project area showing the excavation locations.
- Interview site managers/property owners and obtain plans or drawings, if available, showing on-site utilities.
- For project work that will not take place in the public right-of-way, ensure that the public rights-of-way nearest to the project are identified and communicated during the one-call notification.
- Identify the township and range of the project area. This information can be easily attained by a quick email to MFA's GIS Exchange.
- If feasible, conduct a site visit to identify site conditions that could cause fading or disruption of marking paint. Such conditions could include gravel or ground sensitive to erosion and high traffic.
- Check the weather forecast to assess the potential for snow or rain to make marking utilities difficult or cause the markings to fade.

One-Call Utility Notification:

- If possible, initiate the one-call utility notification at least one week before the proposed work begins.
- Include a map or GPS coordinates when submitting the notification.
- Before conducting any excavation activities, confirm with each public utility that the utility locate has been completed.

- On remote or complicated sites, consider meeting public locators on site.
- Document the one-call ticket number and results in the project files.
- Provide the one-call ticket number to subcontractors who will be doing the excavations.

Private Utility Locate:

- Conduct the private utility locate only after confirmation that the public utility locate has been completed and all public utilities have been marked and the results reviewed by MFA staff who will be overseeing the excavations.
- Meet the private locator on site and participate in the entire private utility locate. Be engaged in the process, ask questions, and take time to walk the site thoroughly with the locator.
- Bring a copy of the one-call utility ticket and results of the one-call utility locater to check against the utility markings on the ground.
- If possible, have a site/property representative knowledgeable of on-site utilities participate in the private utility locate.
- If paint alone may not suffice to ensure clear marking of utilities, add vertical markers such as stakes or flags.
- Visually assess the area of the proposed excavation(s) to identify features potentially indicative of buried utilities. Have the private utility locator examine each feature identified below to assess the presence of buried utilities.
  - Examine adjacent public rights-of-way where public utilities have been marked for evidence of utilities that may extend onto the project site.
  - Identify nearby light poles, telephone poles, electrical utility poles, or other overhead utility poles with wires or conductors that run from the overhead utility, down the pole, and into the ground.
  - Identify the location of gas meters, water meters, or other aboveground junction boxes for evidence of utilities extending from these features into the ground.
  - Examine asphalt and concrete ground surfaces for discontinuities in the surface indicative of utility installations. Discontinuities may include recent patches of asphalt or concrete inlaid within older concrete or asphalt surfaces.
  - Identify manholes and catch basins indicative of buried storm or sanitary sewer pipes. Open manholes to examine the orientation of associated pipes to assess whether the utilities may be present near proposed excavations.
  - Identify tank ports and vent pipes.
  - Identify irrigation systems and associated features such as valve boxes and controllers.
  - Identify any other signs indicating the presence of buried utilities.
  - Be wary of utility marks that suddenly begin or dead end.

Preparing to Perform Subsurface Activities after a Locate:

- Ensure that the markings are still visible when the work begins.
- Adjust locations, as needed, to avoid identified utilities, or use alternative methods such as nonmechanical excavation means (i.e., manual excavation or air-knifing) to a minimum depth of 5 feet.

Table
APWA UNIFORM COLOR CODE

	WHITE—Proposed Excavation
	PINK—Temporary Survey Markings
	RED—Electric Power Lines, Cables, Conduit and Lighting Cables
	YELLOW—Gas, Oil, Steam, Petroleum or Gaseous Materials
	ORANGE—Communication, Alarm or Signal Lines, Cables or Conduit
	BLUE—Potable Water
	PURPLE—Reclaimed Water, Irrigation and Slurry Lines
	GREEN—Sewers and Drain Lines
Source: Uniform Color Codes, ANSI Standard Z535.1. American Public Works Association. Revised 1999.	