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WORK PLAN

DOWNGRADIENT GROUNDWATER ASSESSMENT SIMPLOT GROWERS SOLUTION MOXEE, WASHINGTON

by
Haley & Aldrich, Inc.
Spokane, Washington

for
J.R. Simplot Company
Pocatello, Idaho

File No. 202395-002
30 December 2022

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30 December 2022
File No. 202395-002

J.R. Simplot Company
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Attention: Molly Dimick, MBA
Environmental Engineer

Subject: Downgradient Groundwater Assessment Work Plan
Simplot Growers Solution
Moxee, Washington

Haley & Aldrich, Inc. (Haley & Aldrich) prepared this Downgradient Groundwater Assessment Work Plan (Work Plan) to guide field activities for downgradient well installation and subsequent groundwater monitoring at the Simplot Grower Solutions (SGS) facility, located at 7528 Postma Road in Moxee, Washington. This work plan includes: background information, a description of planned field work, a sampling plan, and an updated health and safety plan. We will provide a draft version of the Work Plan for J.R. Simplot's (Simplot's) review prior to generating a final version. We anticipate the Washington State Department of Ecology (Ecology) also will review the draft and provide comments that will be incorporated into the final document.

Sincerely yours,
HALEY & ALDRICH, INC.

Keylin A Huddleston
Project Geologist

Ward McDonald, L.G.
Project Geologist

John Haney, P.E.
Principal Environmental Engineer

Enclosures
Work Plan Downgradient Groundwater Assessment, Simplot Growers Solution

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SIGNATURE PAGE FOR

WORK PLAN
DOWNGRADIENT GROUNDWATER ASSESSMENT
SIMPLOT GROWERS SOLUTION
MOXEE, WASHINGTON

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1. Introduction

On behalf of the J.R. Simplot Company (Simplot), Haley & Aldrich, Inc. (Haley & Aldrich) has prepared this Downgradient Groundwater Assessment Work Plan (Work Plan) for the Simplot Grower Solutions (SGS) facility, located at 7528 Postma Road in Moxee, Washington (see "Vicinity Map", Figure 1). This Work Plan presents the goals, objectives, and planned activities for installing and sampling downgradient monitoring wells southwest of the SGS facility (subject property). Simplot owns and operates the subject property as a retail outlet for crop nutrition and crop protection products; these products are stored and sometimes blended on site. Previous assessment and groundwater monitoring activities have identified a plume of nitrates and sulfates in groundwater beneath the subject property that exceeds Washington State Department of Ecology (Ecology) cleanup levels. Ecology references the subject property as Site Number 84612438 and Simplot enrolled the subject property in Ecology's Voluntary Cleanup Program (VCP) in 2014 (VCP Number CE0419).

Haley & Aldrich conducted an upgradient groundwater data gap assessment at the subject property in March of 2022 to evaluate the potential for environmental impacts to the subject property from hydraulically upgradient nitrate and/or sulfate sources. Findings of the data gap assessment indicate that the sulfate plume beneath the subject property potentially originates from an off-site source east of the subject property (see SGS Groundwater Assessment, Haley & Aldrich 2022). Our review of previous assessment data also indicated that the downgradient sewer line that parallels the southwest property boundary could also be a source of nitrates to groundwater. Haley & Aldrich recommended installing monitoring wells hydraulically downgradient of the subject property near the sewer line and conducting seasonal groundwater monitoring to evaluate for this potential secondary source of nitrates.

The subject property background, geology and hydrogeology, summary of previous investigations, and goals and objectives for the project are summarized below.

2. Background

The subject property is approximately 3.74 acres and is bounded to the north by Postma Road, to the east by a card-lock fuel facility and agricultural land, to the south by Burlington Northern Santa Fe (BNSF) rail lines and Washington State Route No. 24 (SR 24), and to the west by the Moxee City Shops (a former sewage treatment plant with documented petroleum releases). According to the Yakima County Assessor, the first structure constructed on the subject property was in 1950; additional structures were added in the 1980s and 2000s. The subject property has an aboveground storage tank (AST) farm containing approximately 16 ASTs that are used to store retail agricultural products.

Generally, the land surrounding the subject property and north of SR 24 is a mixture of commercial operations and agricultural land; the land south of SR 24 is a mixture of residential and agricultural land. Aerial photographs and maps accessed from the Yakima County website also show several irrigation and drainage ditches located north and east of the subject property.

2.1 GEOLOGY AND HYDROGEOLOGY

The subject property is located within the Yakima River Basin in south central Washington. The local geology is comprised of high ridges of basalt thrusted upward by the tectonic event that created the Yakima Fold Belt: "…a series of anticlinal- ridges and synclinal valleys that covers approximately 14,000 square kilometers of the western Columbia Plateau. The fold belt formed as basalt flows of the Columbia River Basalt Group intercalated sediments of the Ellensburg Formation…" (Reidel and Campbell 1987).

The Yakima Valley is bordered by two east-west trending basalt ridges. The valley floor typically is overlain by alluvium and/or windblown sediments. The subject property is underlain by silt loam soils of the Umapine silt loam soil series and the regional geology consists of loess overlying glacial flood deposits (HDR 2021). Based on our field observations during assessment activities, the surface and subsurface east/northeast of the subject property consists of alluvium and fill material.

Groundwater is present in these sediments as an unconfined aquifer that generally flows east to west towards the Yakima River, located approximately 2.86 miles west of the subject property. Static groundwater levels measured in on-site monitoring wells in 2019 and 2020 ranged between 3.36 and 11.10 feet below ground surface (bgs), respectively. Inferred groundwater flow direction varies seasonally between approximately 241.8 and 294.5 degrees from north (generally south-southwest and northwest, respectively; HDR 2018).

2.2 PREVIOUS INVESTIGATIONS

GeoEngineers, Inc. (GeoEngineers) identified a potential nutrient contaminant release (nitrate and sulfate) in the subsurface from the subject property while conducting environmental site assessment (ESA) activities at the adjacent Moxee City Shops property in 2014. GeoEngineers' findings from their assessment concluded that "groundwater anion data supports that a source area exists near and east of the Moxee City Shop…boundary and downgradient transport via groundwater flow are ongoing" (GeoEngineers 2014). Ecology subsequently notified Simplot of the potential release/source area beneath the subject property, Simplot entered into the VCP, and Simplot initiated site assessment activities in 2015.

In 2015, Simplot drilled a series of direct-push borings on the subject property and collected subsurface soil and grab groundwater samples. Results of the assessments concluded that elevated concentrations of nitrates were present in soil and groundwater beneath the subject property. Based on these results, Simplot drilled and constructed five monitoring wells on the subject property in 2016 (MW-1 through MW-5) and initiated groundwater monitoring activities. Data collected from groundwater monitoring events indicate that concentrations of nitrates/nitrites in groundwater beneath the subject property exceed the United States (US) Environmental Protection Agency's (EPA's) Maximum Contaminant Levels (MCLs), concentrations of sulfates and total dissolved solids (TDS) exceed EPA's Secondary MCLs, and portions of the plume extend beneath the Moxee City Shop property.

In October 2020, Simplot conducted assessment activities downgradient of the subject property, between the property and the right-of-way adjacent to SR 24. Simplot advanced six direct-push borings in the right-of-way and collected grab groundwater samples from temporary wells in each boring. Groundwater was encountered in these borings at depths ranging between approximately 6 and 7 feet bgs and grab groundwater samples were collected between 12 and 19 feet bgs. Analytical results from groundwater samples indicate that nitrates, sulfates, and/or TDS exceeded the MCLs/Secondary MCLs in each boring with the greatest nitrate concentrations observed deeper in the aquifer (16 to 19 feet bgs).

Simplot engaged Haley & Aldrich to assess the potential for nitrate and sulfate migration from hydraulically upgradient sources in March 2022. Our assessment included drilling five, direct-push borings north and east of the subject property. Haley & Aldrich collected soil samples directly above saturated soil in each boring and submitted the samples for nitrate and sulfate chemical analyses using EPA Method 300.0. We also collected grab groundwater samples from each boring and submitted the samples for nitrate-nitrogen and sulfate analyses by EPA Method 300.0 and TDS analysis by Standard Method (SM) 2540C.

Analytical results from this assessment indicate an upgradient sulfate source likely is present and impacting groundwater beneath the subject property. Assessment results also indicate that groundwater beneath the subject property likely has been impacted by SGS operations; however, there is a potential that the existing 12-inch diameter, concrete, downgradient sewer line that runs adjacent to the southwest subject property boundary could be a contributing source of nitrates to groundwater. Based on these findings, Haley & Aldrich recommended installing “shallow” and “deep” paired monitoring wells downgradient of the subject property to further assess the nitrate plume and potential sources.

3. Goals and Objectives

The primary goal of this project is to collect sufficient data to develop a range of cleanup options and prepare a Feasibility Study (FS) for site cleanup. Based on our review of previous reports and data collected from 2022 assessment activities, Haley & Aldrich developed this Work Plan to accomplish the following objectives to meet the project goal:

- further assess the downgradient extent of environmental impacts southwest of the subject property; and
- assess the potential for a second source of nitrates that could be contributing to the contaminant plume (i.e., comingling and/or overlapping plumes at different depths).

4. Assessment Activities

Simplot plans to complete the following activities as part of this Work Plan:

- Pre-field
  - mark proposed boring locations and locate underground utilities; and
  - update our site-specific Health and Safety Plan (HASP) (as applicable).
- Field
  - drill and construct two sets of paired monitoring wells (one “shallow” and one “deep” at each location);

  - survey each newly installed monitoring well;
  - conduct quarterly groundwater monitoring; and
  - install pressure transducers (transducers) to monitor seasonal fluctuations in groundwater elevation and assess inferred groundwater flow directions.
- Reporting
  - prepare a report documenting well installation and groundwater monitoring activities.

Further details of planned activities are provided in the following sections.

4.1 PRE-FIELD ACTIVITIES

Prior to initiating field activities, Haley & Aldrich will review and update our existing HASP to include the planned field activities. The proposed boring locations are located on BNSF Railroad property and our HASP will be updated to include safety precautions for working near rail lines.

Accessing the proposed well locations will require an agreement between Simplot and BNSF prior to any field work. Simplot will work with BNSF to obtain access prior to initiating field work. After obtaining access, Haley & Aldrich will mobilize to the subject property and mark the proposed boring locations with wooden stakes, survey tape, and/or white paint approximately three business days prior to drilling (see Figure 2, "Proposed Downgradient Monitoring Well Locations", for proposed locations). After each location is marked, Haley & Aldrich will notify the Washington Utility Notification Center, as required by the Revised Code of Washington (RCW) Chapter 19.122. In addition, Haley & Aldrich will subcontract a private utility locator to identify conductible utilities within 10 feet of the proposed boring locations (if present) prior to drilling; boring locations will be adjusted, if necessary, to avoid identified underground utilities.

4.2 FIELD ACTIVITIES

Haley & Aldrich will subcontract a contractor to drill, construct, and develop the monitoring wells. We also will subcontract a licensed surveyor to establish horizontal and vertical control of the new wells. We will then include the new wells into the quarterly groundwater monitoring events and install pressure transducers in select monitoring wells to record groundwater elevations over time. Additional details for these activities are provided in the sections below.

4.2.1 Monitoring Well Installation

Haley & Aldrich will contract a driller licensed in Washington State to drill four borings using drilling techniques to maximize soil sample recovery and documentation of subsurface conditions. The selected subcontractor will drill and construct two sets of paired monitoring wells at the proposed monitoring well locations are shown on Figure 2. Prior to advancing drill stem, the selected subcontractor will use a hand auger to excavate subsurface soil at each proposed boring location to a depth of approximately 4 feet bgs to help assess the location of subsurface utilities, if present. One well at each location will be completed to approximately 10 feet bgs ("shallow") and one well at each location will be completed to approximately 25 feet bgs ("deep"). Each boring will be advanced to the target depth or refusal, whichever occurs first. Soil cuttings will be collected by the driller using a macro sampler and the cuttings will be transferred to a plastic sample sleeve when brought to the surface. Haley & Aldrich will field-screen soil cuttings using visual and olfactory observations. We will document our observations, field screening results, sampling activities, and any deviations from this Work Plan in field notes and boring logs. After logging subsurface conditions, the driller will place soil cuttings and other investigation-derived waste (IDW) in steel 55-gallon drums pending off-site disposal.

After drilling, the drilling subcontractor will construct monitoring wells in each boring (monitoring wells MW-7S and MW-7D [shallow and deep, respectively] and MW-8S and MW-8D [shallow and deep, respectively]). Each monitoring well will be constructed using 2-inch diameter, schedule 40, polyvinyl chloride (PVC) casings and 0.010-inch slotted, PVC screens. Monitoring wells MW-7S and MW-8S will be installed to approximately 10 feet bgs and will be screened between approximately 5 and 10 feet bgs; MW-7D and MW-8D will be installed to approximately 25 feet bgs and will be screened between approximately 20 and 25 feet bgs. The driller will construct and seal the wells in accordance with Washington State regulations and construct the wellheads with flush-mount monuments.

4.2.2 Monitoring Well Development

After the monitoring wells are constructed, the driller will develop each well using a surge block, bailer, and/or submersible pump to establish a hydraulic connection between the well and the aquifer and to remove sediment from the well. Well development will continue until purge water is visually clear or when 10 casing volumes have been removed, whichever occurs first. If the monitoring well is bailed or pumped dry, development will be considered complete when groundwater recovers in the well to static conditions. The driller will place well development water into 55-gallon drums pending off-site disposal.

4.3 MONITORING WELL SURVEY

Haley & Aldrich will subcontract a surveyor licensed in Washington State to establish horizontal and vertical control of each new well. The surveyor will survey the center and rim of the well monument, top of well casing, and ground surface adjacent to the monitoring well for each monitoring well installed. The surveyor will record the well locations using latitude and longitude coordinates and reference the top of casing elevations to the North American Vertical Datum of 1988 (NAVD88).

4.4 GROUNDWATER MONITORING

Haley & Aldrich will schedule construction of the new wells to coincide with a quarterly groundwater monitoring event, if possible. After development, Haley & Aldrich will wait a minimum of 24 hours prior to collecting groundwater samples in the newly installed monitoring wells; the new monitoring wells also will be incorporated into future groundwater monitoring events. Groundwater monitoring activities will include: measuring and recording depths to groundwater, collecting groundwater samples using low flow/low stress techniques, and submitting water samples to Eurofins Environment Testing Northwest LLC, in Spokane Valley, Washington (Eurofins) for chemical analysis.

4.4.1 Measuring Groundwater Elevations

Prior to sampling, the Haley & Aldrich field representative will measure the depth to groundwater in each monitoring well using an electronic water-level indicator. The Haley & Aldrich field representative will reference depth to water from the surveyed top of each monitoring well casing (typically the north side) and record the measurements to the nearest 0.01 foot.

4.4.2 Low Flow/Low Stress Groundwater Sampling

After the Haley & Aldrich field representative records depth to groundwater measurements, the Haley & Aldrich field representative will purge each well following low flow/low stress sampling techniques and using a peristaltic pump equipped with new, disposable tubing. The tubing inlet will be placed at the approximate middle of each well screen. After use, the tubing will be disposed of as solid waste. During purging, the Haley & Aldrich field representative will measure and record the following water quality parameters:

- pH;
- temperature in degrees Celsius (°C);
- electrical conductivity (conductivity) in millisiemens per centimeter (mS/cm);
- dissolved oxygen (DO) in milligrams per liter (mg/L);
- turbidity in nephelometric turbidity units (NTU); and
- oxidation-reduction potential (ORP) in millivolts (mV).

The Haley & Aldrich field representative will measure water quality parameters using a multimeter equipped with a flow-through cell. Purging and sampling will be conducted in general accordance with our "Low Stress/Low Flow Groundwater Sample Collection Procedure" (Operating Procedure OP3012) provided in Appendix A. If the well is purged dry, it will be allowed to recover before collecting a sample. The Haley & Aldrich field representative will place purge water in a 55-gallon drum pending off-site disposal.

Haley & Aldrich will collect each groundwater sample using the same peristaltic pump and tubing used for purging after removing the tubing from the flow-through cell. The Haley & Aldrich field representative will don a clean pair of nitrile gloves (or equivalent) prior to collecting the sample and will collect the samples directly into laboratory-supplied sample containers leaving minimal headspace. The Haley & Aldrich field representative will place groundwater samples in an insulated cooler with ice to preserve the samples until delivered to the analytical laboratory under chain-of-custody.

Haley & Aldrich will submit groundwater samples to Eurofins for analysis; Eurofins will analyze samples for nitrate- and nitrite-nitrogen by EPA Method 353.2, ammonia-nitrogen by EPA Method 350.1, sulfate by EPA Method 300.0, and TDS by SM 2540C. The first time the new wells are sampled, they will additionally be analyzed for caffeine by Method L-220, and Acesulfame potassium by Method L-221 to assess for the potential presence of municipal sewage from the downgradient sewer line.

4.4.3 Equipment Decontamination

The Haley & Aldrich field representative will use new, disposable sampling equipment (e.g., disposable gloves, groundwater sampling tubing) for each sample location and will discard sampling equipment after use to prevent cross-contamination between samples. The Haley & Aldrich field representative will clean non-disposable field equipment (e.g., sampling spoons, multimeter, flow-through cell, etc.) using a detergent (Liquinox®) solution, rinsing with tap water, and a deionized water rinse. Decontamination water will be collected in a steel 55-gallon drum pending off-site disposal.

4.4.4 Continuous Groundwater Elevation Monitoring

Haley & Aldrich will deploy three In-Situ Inc. (In-Situ) Rugged Troll 100 pressure transducers (transducers), one each in monitoring wells MW-1, MW-2, and MW-8S, to monitor seasonal groundwater elevation fluctuations. We will deploy the transducers approximately 1 foot above the bottom of the wells and program the transducers to record pressure and temperature every 6 hours. Haley & Aldrich also will install a barometric pressure logger in MW-1 and set the logger to record readings at the same frequency. We will use these atmospheric pressure readings when post-processing transducer data to compensate for local atmospheric pressure. We will export the post-processed data to Microsoft Excel and calculate groundwater elevations by subtracting the recorded depths to groundwater from surveyed top of casing elevations.

5. Reporting

After field activities have concluded and analytical data has been received from the laboratory, Haley & Aldrich will include a summary of completed field activities, field-screening results, and analytical data in a subsequent semi-annual groundwater monitoring report. The report will include tables, figures, and appendices as necessary to document the completed activities. Laboratory reports, including chain-of-custody documentation, will be attached to the report.

References

1. GeoEngineeers, 2014. Data Gap Investigation Report Moxee City Shop and Former STP, Moxee, Washington. Prepared for Washington State Department of Ecology by GeoEngineers Inc. April 3, 2014.

2. HDR, 2018. Additional Site Investigation Report, Simplot Grower Solutions, Moxee, Washington. Prepared for J.R. Simplot Company by HDR Inc. December 2019.

3. HDR, 2021. Offsite Groundwater Investigation Report, Simplot Grower Solutions, Moxee, Washington. Prepared for J.R. Simplot Company by HDR Inc. January 2021.

4. Reidel & Campbell, 1987. "Guide to the structure of the Yakima Fold Belt", Geologic Guidebook for Washington and adjacent areas, Washington Division of Geology and Earth Resources Information Circular 86. 275 304.

5. Haley & Aldrich, 2022. Simplot Grower Solutions Groundwater Assessment, Moxee Washington. June 2022.

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FIGURES

MAP SOURCE: ESRI
SITE COORDINATES: 46°33'43"N, 120°23'60"W

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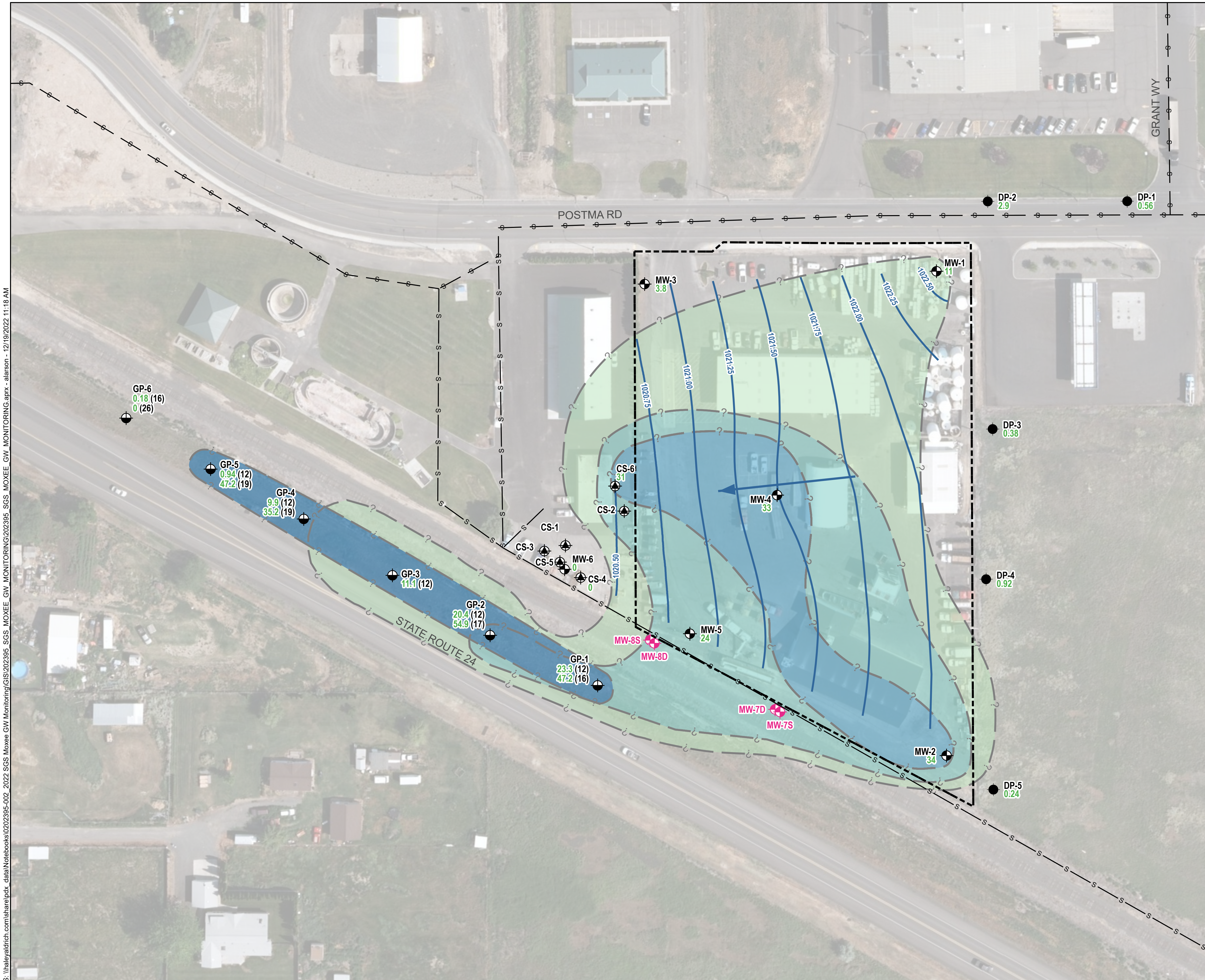
DOWNGRADIENT GROUNDWATER ASSESSMENT
SIMPLOT GROWERS SOLUTION
7528 POSTMA ROAD
MOXEE, WASHINGTON

VICINITY MAP

APPROXIMATE SCALE: 1 IN = 2000 FT
DECEMBER 2022

FIGURE 1

GIS: \\haleyaldrich.com\share\pdx_data\Notebooks\0202395-002_2022 SGS Moxee GW Monitoring\GIS\202395_SGS_MOXEE_GW_MONITORING\202395_SGS_MOXEE_GW_MONITORING.aprx - alarson - 12/16/2022 3:01 PM



LEGEND

- PROPOSED DOWNGRADIENT MONITORING WELL
- MARCH 2022 DIRECT-PUSH BORING WITH NITRATE CONCENTRATION
- MONITORING WELL WITH NITRATE CONCENTRATION
- CITY MONITORING WELL WITH NITRATE CONCENTRATION
- OCTOBER 2020 DIRECT-PUSH BORING WITH NITRATE CONCENTRATION (DEPTH SAMPLED IN FEET BGS)
- INFERRED GROUNDWATER ELEVATION CONTOUR, IN FEET
- GENERAL GROUNDWATER FLOW DIRECTION MARCH 2022
- SEWER LINE (SOURCE: CITY OF MOXEE)

INFERRED NITRATE CONCENTRATION (mg/L)

- 10 TO 20
- 20 TO 30
- 30 TO 40
- >40 (INFERRED DEEPER PLUME)
- PROPERTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. GP-1 THROUGH GP-6 SAMPLED IN OCTOBER 2020 BY HDR.
3. CONCENTRATIONS IN MILLIGRAMS PER LITER (mg/L)
4. ND = NITRATES NOT DETECTED AT OR ABOVE METHOD REPORTING LIMITS
5. -- = NOT ANALYZED
6. BGS = BELOW GROUND SURFACE
7. AERIAL IMAGERY SOURCE: ESRI

0 100 200
SCALE IN FEET

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DOWNGRADIENT GROUNDWATER ASSESSMENT
SIMPLOT GROWERS SOLUTION
7528 POSTMA ROAD
MOXEE, WASHINGTON

PROPOSED DOWNGRADIENT MONITORING WELL LOCATIONS

DECEMBER 2022

FIGURE 2

APPENDIX A

Low Stress/Low Flow Groundwater Sample Collection Procedure (Operating Procedure OP3012)

OPERATING PROCEDURE: OP3012

LOW STRESS/LOW FLOW GROUNDWATER SAMPLE COLLECTION PROCEDURE

PREPARATION AND APPROVALS

VERSION	AUTHORED/DATE	REVIEWED / DATE	REVIEWED / DATE	REVIEWED / DATE	APPROVED / DATE
Ver. 0.0	SLB/GMW / 05-02	NVD/ 12-01-02	GJM/ 6-5-02		JAK/ 6-10-03

Total Pages: 22

HALEY & ALDRICH

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OPERATING PROCEDURE: OP3012

LOW STRESS/LOW FLOW GROUNDWATER SAMPLE COLLECTION PROCEDURE

1. PURPOSE

This document describes procedures for collection of groundwater samples for laboratory analysis utilizing the "Low Stress/Low Flow Method". This method should be employed when it is critical to collect groundwater samples not impacted by over-purging, aeration, and sediment/colloid presence. Although the procedures described in this document are generally appropriate for obtaining groundwater samples as part of Monitored Natural Attenuation (MNA) programs, a more complete procedure for MNA programs is described in a separate document (Monitored Natural Attenuation Sample Collection Procedure).

The method described herein is most appropriate for wells that can accept a submersible pump and have a screened interval of ten feet or less. However, the procedure is flexible and can be modified for a variety of well construction and groundwater yield situations. The low-flow purging and sampling method is not appropriate for use in all hydrogeologic regimes, and certain groundwater monitoring well designs may make the method unsuitable (e.g. open hole and long screen monitoring wells in bedrock and stratified sand and clay where the water bearing zones have not been characterized).
This procedure does not address wells that contain Non-Aqueous Phase Liquids (NAPLs).

Note: The methods described in this document are provided for training use and general information. Depending upon regulatory agency and other project specific requirements, appropriate field procedures may differ from those described herein. These procedures should be confirmed with the Haley & Aldrich Project Manager prior to implementation.

1.1 BACKGROUND

Research conducted by Puls et al. (1992), Puls and Powell (1992), and Powell and Puls (1993) has shown that high-volume purging and sampling cause significant turbidity and suspended particulate artifacts that can result in an overestimation of certain analytes of interest (e.g., metals or hydrophobic organic compounds). Additionally, standard purging procedures can cause pressure changes and bailing can cause aeration that can strip volatile organic compounds from groundwater samples (Pennino, 1988) and provide misrepresentative data on aquifer conditions (such as dissolved oxygen and redox). Overpurging of a well can cause water to cascade down the well screen, causing undesirable aeration and volatilization.

The use of low-flow pumping devices for purging and sampling minimizes both the disturbance of water in well casing and the potential for mobilization of colloidal material (Barcelona et al., 1994). Low-flow purging with maintenance of water level in the well and stabilization of indicator parameters (especially turbidity) allows collection of groundwater samples that are more representative of conditions without filtering (U.S. EPA, 1993; Backhus et al., 1993). In many cases, use of a low-flow pump to purge and sample monitoring wells decreases sampling time, reduces the need to handle large volumes of purge water and lowers the cost associated with its disposal, and may allow collection of samples for without filtering.

Low-flow refers to the velocity with which water enters the pump intake and that is imparted to the formation pore water in the immediate vicinity of the well screen. It does not necessarily refer to the flow rate of water discharged at the surface that can be affected by flow regulators or restriction. Water level drawdown provides the best indication of the stress imparted by a given flow-rate for a given hydrological situation. The objective is to pump in a manner that minimizes stress (drawdown) to the system to the extent practicable taking into account established site sampling objectives (USEPA, Puls and Barcelona, April 1996).

2. EQUIPMENT & SUPPLIES

1. Adjustable rate, positive displacement pumps (e.g. low flow-rate submersible centrifugal or bladder pumps constructed of stainless steel or Teflon). The pump should be easily adjustable and capable of operating reliably at lower flow rates. An example is QED MicroPurge bladder pump (available for purchase or rental at US Environmental 781-899-6969, among others).

   Under most regulatory programs, peristaltic pumps may be used for collection of inorganic samples only – they are NOT appropriate for collection of VOCs. Bailers are inappropriate for use in this procedure. Waterra tubing purging and sampling is also not recommended for low-flow sampling by the USEPA.

2. Tubing: Tubing used in purging and sampling each well must be dedicated to the individual well. Once properly located, moving the pump in the well should be avoided. Consequently, the same tubing should be used for purging and sampling. The tubing wall thickness should be maximized (3/8 to ½ inch) and the tubing length should be minimized (i.e. do not have excess tubing outside of the well)

   - **Organic analysis**: Teflon or Teflon-lined polyethylene tubing must be used to collect samples.
   - **Inorganic analysis**: Teflon or Teflon lined polyethylene, PVC, Tygon or polyethylene tubing may be used to collect samples.

3. Polyethylene sheeting and sampling gloves.

4. Water level measuring device, 0.01 feet accuracy, (electronic preferred for tracking water level drawdown during all pumping operations).

5. Flow measurement supplies (e.g. graduated cylinder and stopwatch).

6. Interface probe, if needed.

7. Power source (e.g. generator, located downwind; nitrogen tank, etc). The generator should not be oversized for the pump.

8. In-line flow-through cell containing purge criteria parameter monitoring instruments for pH, turbidity, specific conductance, temperature, Eh and dissolved oxygen (DO). The in-line device should be bypassed or disconnected during sample collection. An example is the Horiba U-22 which is a flow-through cell that comes with probes capable of measuring pH, dissolved oxygen, conductivity, salinity, TDS, temperature, turbidity and oxidation-reduction potential. Available from Ashtead Technologies, 800.242.3910, www.ashtead-technology.com or Pine Environmental, 800-301-9663, www.pine-environmental.com, among others.

9. Photoionization detector (PID), or flame ionization detector (FID) or equivalent.

10. Nylon stay-ties

11. Decontamination supplies

12. Field book or well sampling form

13. Sample Bottles. It is recommended that preservatives be added to sample bottles prior to field activities to reduce potential error or introduction of contaminants.

14. Sample preservation supplies (as required by the analytical method; see previous item)

15. Sample tags or labels, and chain of custody.

16. Well construction data, location map, field data from last sampling event.

17. Sampling Plan or Work Plan

18. Health & Safety Plan

19. pH meter

20. Conductivity meter

21. Dissolved Oxygen (DO) meter

22. Oxidation -reduction (REDOX) reaction potential (ORP) meter

23. Nephlometer (turbidity)

24. Temperature gauge

25. Field test kits (such as Hach kits for measurement of dissolved iron (Fe^{+2}), carbon dioxide, and alkalinity). See the document "Monitored Natural Attenuation Groundwater Sample Collection Procedure" for specifications and ordering information for these types of kits.

26. Field filtration units (if required)

3. PROCEDURE

3.1 Sampling Preparatory Activities

Prior to entering the field there are several activities that should be conducted. The activities are as follows:

- Obtain and review a copy of the Sampling or Work Plan and Health & Safety Plan.
- Obtain and review previous groundwater sampling data (if available), previous water level measurements and well construction details (total depth and length of well screen).
- Locate a site map denoting the wells to be sampled.
- Obtain well wrenches, well keys and any other equipment needed to access the wells.
- Coordinate site access.
- Coordinate with laboratory to obtain sample bottles and necessary quality assurance samples.
- Perform an inventory of necessary purging, sampling, and field measurement equipment. Certain equipment may need to be purchased or rented for the sampling event. Check field measurement probes for proper calibration and ensure that the probes and kits are complete (i.e., contain calibration and analytical solutions) for the entire sampling event.

3.2 Preliminary Site Activities

Once on site the following activities should be conducted prior to beginning sampling.

- Verify well identification and location using borehole log details and location site map. Check the condition of the well and record any evidence of damage or need for repair in the field book or field sampling form. Following field activities inform the Project Manager of any necessary repair work required.
- Lay out sheet of clean polyethylene around the well for monitoring and sampling equipment.

- Prior to opening the well cap, measure the breathing space above the well casing with a PID or FID to establish baseline levels. Repeat this measurement once the well cap is opened. If either of these measurements exceeds the air quality criteria in the health and safety plan, field personnel should adjust their PPE accordingly.

- If the well does not have a water level reference point (usually a V-cut or indelible mark in the well casing), make one. Describe its location and record the date of the mark in the field book or sampling form.

- Collect a round of synoptic water level measurements and well depth (in the shortest possible time) before any purging or sampling activities begin. Water levels and well depths should be measured and reported to 0.01 ft. The water levels should be obtained from the denoted reference point on the well.

- Water level and total depth measurements must be obtained to determine the well volume for hydraulic purposes. In some settings it maybe necessary to allow the water level time to equilibrate. This condition exists if a watertight seal exists at the well cap and the water level has fluctuated above the top of screen thereby creating a vacuum or pressurized area in this air space. Three water level checks will verify static water level conditions or changing conditions.

- Check newly constructed wells for the presence of light or dense aqueous phase liquids before sampling.

3.3 Sampling Procedure

It is preferable to sample the wells in order of increasing chemical concentrations (known or anticipated). The following describes the procedure for the low-flow purging and sampling method. Equipment calibration, logbook documentation, sample bottle filling and preservation, and shipping will be conducted in accordance with the site-specific Quality Assurance Project Plan (QAPjP). Personal protective equipment will be donned in accordance with the requirements of the site-specific Health and Safety Plan.

1. Attach and secure the polyethylene tubing to the low-flow pump. See the equipment and materials section for recommended pump types. As the pump is slowly lowered into the well, secure the safety drop cable, tubing, and electrical lines to each other using nylon stay-ties. It is recommended that the pump be placed in the well 12 to (preferably) 48 hours prior to purging/sampling to minimize the effects of turbidity and mixing in the well from introducing the pump.

2. Pump, safety cable, tubing and electrical lines should be lowered slowly into the well to a depth corresponding to the center of the saturated screen section of the well, or at a location determined to either be a preferential flow path or zone where contamination is present. The pump intake should be kept above the bottom of the well to prevent mobilization of any sediment present in the bottom of the well.

3. Before starting the pump, measure the water level again with the pump in the well. Start pumping water from the well at a rate of **100 to 500 milliliters per minute (mL/min) which correlates to 0.03**

to 0.13 gallons per minute. Avoid surging. Observe air bubbles displaced from discharge tube to assess progress of steady pumping until water arrives at the surface. The pumping rate should cause little or no water level drawdown in the well (less than 0.2 ft) and the water level should stabilize.

Water level measurements should be made every three to five minutes. Precautions should be taken to avoid pump suction loss or air entrainment. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to avoid pumping the well dry and ensure stabilization of indicator parameters. If the recharge rate of the well is very low, purging should be interrupted so as not to cause the drawdown within the well to advance below the pump intake but the operator should attempt to maintain a steady flow rate with the pump to the extent practicable. Record adjustments made to the pumping rates and water levels immediately after each adjustment.

In low-yielding wells, where 100 mL/min exceeds the entrance rate of groundwater into the well, it is important to avoid dewatering the well screen interval and purging the well dry should be avoided to the extent possible. In these cases, the pump should remain in place and the water level should be allowed to recover repeatedly until there is sufficient volume in the well to permit collection of samples. Under these low-yield conditions, it may become difficult to maintain an adequate water volume in the flow-through cell described in the next step. An alternative means of sample collection may be necessary under these conditions and should be discussed with the Project Manager.

4. While purging the well, measurements of water quality indicator parameters utilizing an in-line flow-through cell (or similar equipment) should be collected every three to five minutes until all of the parameters have stabilized. See the Equipment and Materials section for recommendations. Stabilization is achieved when three successive readings are within the following tolerances noted in the table below.

Parameter	Stabilization Level (3 successive readings within)
Turbidity	+10% and final value between 5 and 10 NTU
Specific conductance	+3%
pH	±0.1
Dissolved oxygen (DO)	±10%
Redox potential (Eh)	±10mv

In general, the order of stabilization is pH, temperature and specific conductance, followed by redox potential, dissolved oxygen, and turbidity (USEPA, 1996). A minimum subset of these parameters that can be used to determine stabilization during purging in this procedure are pH, specific conductivity and turbidity or DO. Turbidity and DO are typically the last parameters to stabilize. If the parameters have stabilized, but the turbidity is not in the range of 10 NTU, then follow step 6. For informational purposes, the following table provides typical ranges of the various field parameters. Field data collected during purging and sampling should be compared against these values and, if substantial differences exist, the accuracy of the meter should be verified to rule out potential operational problems with the equipment.

Parameter	Typical Range of Values
Turbidity	10 – 500 NTU
Specific conductance	50 – 500 mS
pH	6 - 9
Dissolved oxygen (DO)	ND – 9 mg/L
Redox potential (Eh)	-250 - +400 mV

5. Once stabilization has been documented, go to step 8.

6. Should stabilization not be achieved for all field parameters (or turbidity only as described in Step 4), purging is continued until a maximum of 20 well screen volumes have been purged from the well. Since low-flow purging (LFP) likely will not draw groundwater from a significant distance above or below the pump intake, the screen volume is based upon a 5-foot (1.4 m) screen length. After purging 20 well screen volumes, purging is continued if the purge water remains visually turbid and appears to be clearing, or if stabilization parameters are varying slightly outside of the stabilization criteria listed above and appear to be approaching stabilization.

   - If low-turbidity samples are critical to the project goals, purging will be extended until turbidity has been reduced to 5 NTU or less.

   - The pump must not be removed from the well between purging and sampling.

7. If the turbidity measurements do not approach the range of that of natural groundwater (10 NTU), both filtered and unfiltered samples should be collected for analysis of compounds such as metals or hydrophobic compounds[1]. Filtered metal samples are to be collected with an in-line filter. A high capacity, in-line 0.45 micron particulate filter must be pre-rinsed according to the manufacturers recommendations, or with approximately 1 liter of groundwater following purging and prior to sampling. After the sample is filtered it must be preserved immediately.

8. Collect groundwater samples. All sample containers should be filled by allowing the pump discharge to gently flow down inside the container with minimal turbulence. The flow-through cell, or similar equipment, should be bypassed during sampling. As each sample bottle is collected, the bottle should be labeled with the following information then place into a cooler with the proper temperature control.

   - Sample number/ID
   - Date and time
   - Parameters to be analyzed
   - Project Reference ID
   - Samplers initials

[1] Filtering of samples for analysis is a project-specific requirement and should be confirmed with the Project Manager prior to filtration.

After collection of the samples, the tubing from the pump should be properly discarded or dedicated to the well for re-sampling (by hanging the tubing inside the well). Avoid handling the interior of the bottle or bottle cap and don new gloves for each well sampled to avoid contamination of the sample.

VOC and gas sensitive (e.g. Fe^{+2}, CH_4, H_2S/HS) parameter samples should be collected first. Refer the project sampling and analysis plan to determine which analytes will be measured in the field (wellhead) and which will be submitted to a fixed-base laboratory. The order of sample collection is as follows:

1. Volatile organic compounds
2. Gas sensitive parameters (e.g. Fe^{+2}, CH_4, H_2S/HS)
3. Semi-volatile organic compounds
4. Total organic carbon (TOC)
5. Total organic halogens (TOX)
6. Extractable organics
7. Total metals
8. Dissolved metals
9. Phenols
10. Cyanide
11. Sulfate and chloride
12. Nitrate and ammonia
13. Radionuclides

Note: ***The pumping rate used to collect a sample for VOCs should not exceed 100 mL/min.*** *Samples should be transferred directly to the final container 40 mL glass vials completely full and topped with a Teflon cap. Once capped the vial must be inverted and tapped to check for headspace/air presence (bubbles). If air is present the sample vial will be discarded, and re-collected until free of air. Field filtration will be performed if dictated by the project Work Plan.*

9. Measure and record final water level and well depth.

10. Secure the well (close and lock).

3.4 Decontamination

Decontaminate sampling equipment prior to use in the first well and following sampling of each subsequent well. Pumps will not be removed from well between purging and sampling operations. The pump and tubing (including support cable and electrical wires that are in contact with the well) will be decontaminated by one of the procedures listed below.

3.4.1 Procedure 1

Decontamination solutions can be pumped from buckets through the pump, or the pump can be disassembled and flushed with the decontamination solutions. It is recommended that the detergent and isopropyl alcohol be used sparingly in the decontamination process and that water-flushing steps be extended to ensure that any sediment trapped in the pump is removed. The pump exterior and electrical wires must be rinsed with the decontaminating solutions, as well. The procedure is as follows:

1. Flush the equipment/pump with potable water.

2. Flush with non-phosphate detergent solution. If the solution is recycled, the solution must be changed periodically.

3. Flush with potable or distilled/deionized water to remove all of the detergent solution. If the water is recycled, the water must be changed periodically.

4. Flush with isopropyl alcohol (pesticide grade). If equipment blank data from the previous sampling event shows that the level of contamination is low, then this step may be skipped.

5. Flush with distilled/deionized water. The final water rinse must not be recycled.

6. Decontaminate the in-line flow-through cell and other sampling equipment with similar procedures, as appropriate.

3.4.2 Procedure 2

1. Steam clean the outside of the submersible pump.

2. Pump hot potable water from the steam cleaner through the outside of the pump. This can be accomplished by placing the pump inside a three or four inch diameter PVC pipe with cap. Hot water from the steam cleaner jet will be directed inside the PVC pipe and the pump exterior will be cleaned. The hot water from the steam cleaner will then be pumped from the PVC pipe through the pump and collected into another container. Note: additives or solutions should not be added to the steam cleaner.

3. Pump non-phosphate detergent solution through the inside of the pump. If the solution is recycled, the solution must be changed periodically.

4. Pump potable water through the inside of the pump to remove all of the detergent solution. If the solution is recycled, the solution must be changed periodically.
5. Pump distilled/deionized water through the pump. The final water rinse must not be recycled.

6. Decontaminate the in-line flow-through cell and other sampling equipment with appropriate procedures.

3.5 Field Documentation

Field notes must document all the events, equipment used, and measurements collected during the sampling activities. The logbook or sampling form (see Appendix C Forms) should document the following for each well sampled:

- Identification of well
- Well depth
- Static water level depth and measurement technique
- Sounded well depth
- Presence of immiscible layers and detection/collection method
- Well yield - high or low
- Purge volume and pumping rate
- Time well purged
- Measured field parameters - record measurements obtained every 3-5 minutes to monitor for stabilization, see attached example record log.
- Purge/sampling device used
- Well sampling sequence
- Sampling appearance
- Sample odors
- Sample volume
- Types of sample containers and sample identification
- Preservative(s) used
- Parameters requested for analysis
- Field analysis data and method(s)
- Sample distribution and transporter

- Laboratory shipped to
- Chain of custody number for shipment to laboratory
- Field observations on sampling event
- Name collector(s)
- Climatic conditions including air temperature
- Problems encountered and any deviations made from the established sampling protocol.

3.6 Groundwater/Decontamination Fluid Disposal

Groundwater disposal methods will vary on a case-by-case basis and field personnel should consult the Project Manager for site-specific requirements. Disposal options may include:

- Off-site treatment at private treatment/disposal facilities or public owned treatment facilities.
- On-site treatment at Facility operated facilities.
- Direct discharge to the surrounding ground surface, allowing groundwater infiltration to the underlying subsurface regime.
- Direct discharge to impervious pavement surfaces, allowing evaporation to occur
- Decontamination fluids should be segregated and collected separately from wash waters/groundwater containers. Often small volumes of solvents used during the day can be allowed to evaporate if left in an open pail. In the event evaporation is not possible or practical, off-site disposal arrangements must be made.

APPENDIX A
REFERENCES

- USEPA Low-flow (minimal drawdown) groundwater sampling procedures (EPA/540/S-95/504), April 1996.
- USEPA Ground-Water Sampling-A Workshop Summary, Dallas, Texas, November 30 - December 2, 1993. EPA/600/R-94/205.
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- Puls, R.W., D.A. Clark, B. Bledsoe, R.M. Powell, and C.J. Paul. 1992. Metals in Ground Water: Sampling Artifacts and Reproducibility. Hazardous Waste and Hazardous Materials. V. 9, pp. 149-162.
- USEPA Region 3. 1997. Recommended Procedure for Low-Flow Purging and Sampling of Groundwater Monitoring Wells. Waste and Chemicals Management Division - Low Flow Sampling. Bulletin No. QAD023.
- USEPA Region 1. 1996. Low Stress (Low Flow) Purging and Sampling for the Collection of Groundwater Samples from Monitoring Wells. SOP #: GW 001. Revision 2. pp.13.
- USEPA Region 2. 1998. Ground Water Sampling Procedure, Low Stress (Low Flow) Purging and Sampling. GW Sampling SOP, Final.

APPENDIX B
RELATED HALEY & ALDRICH PROCEDURES

▪	OP3000	General Environmental Field Procedures and Protocol
▪	OP3001	Preservation and Shipment of Environmental Samples
▪	OP3008	Manual Water Level Measurement Procedure
▪	OP3009	Monitoring Well Development Procedure
▪	OP3010	Groundwater Quality Sampling Procedure
▪	OP3013	Monitored Natural Attenuation Groundwater Sample Collection Procedure
▪	OP3014	NAPL Monitoring and Sampling Procedure

APPENDIX C
FORMS

- Form 3001 Sampling Labels (Environmental)
- Form 3003 Chain of Custody
- Form 3004 Sampling Record
- Form 3005 Groundwater Sampling Record
- Form 3006 Monitoring Well Development Report

HALEY & ALDRICH

Haley & Aldrich, Inc.
465 Medford St., Suite 2200
Boston, MA 02129
Tel: 617-886-7400

Sample ID:	File Number:
Depth:	Project:
Date:	Analysis:
Time:	Preservative:
Collected By:	Laboratory:
Comments:	

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Date:	Analysis:
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Collected By:	Laboratory:
Comments:	

HALEY & ALDRICH

Haley & Aldrich, Inc.
465 Medford St.,
Suite 2200,
Boston, MA 02129-1400

CHAIN OF CUSTODY RECORD

Phone (617) 886-7400
Fax (617) 886-7600

Page of

H&A FILE NO.		**LABORATORY**		**DELIVERY DATE**	
PROJECT NAME		**ADDRESS**		**TURNAROUND TIME**	
H&A CONTACT		**CONTACT**		**PROJECT MANAGER**	

Sample No.	Date	Time	Depth	Type	Analysis Requested: VOA	ABNs PAH only	Metals RCRA (8) PP(13)	Pesticides PCBs	VPH Full Suite C-ranges only	EPH Full Suite C-ranges only	TPH (specify)	TCLP (specify)	Reactivity Ignitability Corrosivity				Number of Containers	Comments (special instructions, precautions, additional method numbers, etc.)

Sampled and Relinquished by	Received by
Sign	Sign
Print	Print
Firm	Firm
Date Time	Date Time
Relinquished by	**Received by**
Sign	Sign
Print	Print
Firm	Firm
Date Time	Date Time
Relinquished by	**Received by**
Sign	Sign
Print	Print
Firm	Firm
Date Time	Date Time

LIQUID

												VOA Vial
												Amber Glass
												Plastic Bottle
												Preservative
												Volume

SOLID

												VOA Vial
												Amber Glass
												Clear Glass
												Preservative
												Volume

PRESERVATION KEY

A Sample chilled	**C** NaOH	**E** H_2SO_4	**G** Methanol
B Sample filtered	**D** HNO_3	**F** HCL	**H** Sodium Bisulfate

Sampling Comments

Evidence samples were tampered with? YES NO

If YES, please explain in section below.

WHITE - Laboratory **CANARY** - Project Manager **PINK** - Haley & Aldrich Laboratory **GOLDENROD** - Haley & Aldrich Contact

Form 3003

WATER AND WASTEWATER METHODS

Analysis Description	Method No.	Preservative	Solid Sample Volume/Container	Liquid Sample Volume/Container	Holding Time
Alkalinity	310	Cool 4° C	N/A	250 mL HDPE	14 days
Amenable Cyanide	Std. Mth. 412 F.	pH>12 NaOH, Cool 4° C	N/A	1 L HDPE	14 days
Ammonia	350	pH<2 H2SO4, Cool 4° C	N/A	1 L HDPE	28 days
Base/Neutral & Acid Extractables	625	Cool 4° C	N/A	1 L Amber	7 days Ext/40 days Analyze
Biochemical Oxygen Demand (BOD)	405.1	Cool 4° C	N/A	2 L HDPE	48 hours
Chemical Oxygen Demand (COD)	410	pH<2 H2SO4, Cool 4° C	N/A	125 mL HDPE	28 days
Chloride	300.0, 325	None Required	N/A	125 mL HDPE	28 days
Chromium, Hexavalent	3500D, 218.4/5	None Required	N/A	1 L HDPE	24 hours
Fluoride	300.0, 340	None Required	N/A	500 mL HDPE	28 days
Hardness, Total (as CaCO3)	130	pH<2 H2SO4, Cool 4° C	N/A	250 mL HDPE	6 Months
Nitrate	300.0, 352.1	Cool 4° C	N/A	250 mL HDPE	48 Hours
Nitrite	300.0, 354.1	Cool 4° C	N/A	125 mL HDPE	48 Hours
Orthophosphate	300.0, 365	Filter, Cool 4° C	N/A	125 mL HDPE	48 Hours
PCBs	608	Cool 4° C	N/A	1 L Amber	7 days Ext/40 days Analyze
Pesticides	608	Cool 4° C	N/A	1 L Amber	7 days Ext/40 days Analyze
Physiologically Available Cyanide	MADEP draft	pH>12 NaOH, 4° C	N/A	1 L HDPE	14 days
Priority Pollutant Metals (13 Metals)	200.7/AA, 200 Series	pH<2 HNO3, 4° C	N/A	1 L HDPE	28 days (Hg), 6 mos. (others)
Purgeable Halocarbons & Aromatics	601/602	pH 2 HCl, Cool 4° C	N/A	40 mL Glass Vial	14 days
RCRA Metals (8 Metals)	200.7/AA, 200 Series	pH<2 HNO3, 4° C	N/A	1 L HDPE	28 days (Hg), 6 mos. (others)
Sulfate	300.0, 375	Cool 4° C	N/A	250 mL HDPE	28 days
Sulfide	376	pH>9 NaOH, Zn Acetate, Cool 4° C	N/A	1 L HDPE	7 days
Sulfite	377.1	None Required	N/A	125 mL HDPE	Analyze Immediately
Total Cyanide	335	pH>12 NaOH, Cool 4° C	N/A	1 L HDPE	14 days
Total Dissolved Solids (TDS)	209	Cool 4° C	N/A	250 mL HDPE	7 days
Total Organic Carbon (TOC)	415	pH<2 HCl or H2SO4, Cool 4° C, Dark	N/A	40 mL Amber	28 days
Total Organic Halogen (TOX)	506	pH<2 HNO3, 4° C	N/A	1 L Amber	check with lab
Total Phenolics	420.1	pH<2 H2SO4, Cool 4° C	N/A	1 L Amber	28 days
Total Phosphorus	365	pH<2 H2SO4, Cool 4oC	N/A	125 mL HDPE	28 days
Total Solids (TS)	160.3	Cool 4° C	N/A	250 mL HDPE	7 days
Total Suspended Solids (TSS)	160.2	Cool 4° C	N/A	250 mL HDPE	7 days
Volatile Organics	624	pH 2 HCl, Cool 4° C	N/A	40 mL Glass Vial	14 days
Weak and Dissociable Cyanide	Std. Mth. 412 H.	pH>12 NaOH, Cool 4° C	N/A	1 L HDPE	14 days
DRINKING WATER ANALYSIS					
Volatile Organics	502.2 or 524.2	pH 2 HCl, Cool 4° C	N/A	40 mL Glass Vial	14 days
MICROBIOLOGY					
Fecal Coliform	STDMTH	Cool 4o C	N/A	sterile, 125 mL	6 hours
Standard Plate Count	STDMTH	Cool 4o C	N/A	sterile, 125 mL	6 hours
Total Coliform	STDMTH	Cool 4o C	N/A	sterile, 125 mL	6 hours
Yeast and Mold	STDMTH	Cool 4o C	N/A	sterile, 125 mL	6 hours

SOIL/SEDIMENTS/WATER

Analysis Description	Method No.	Solids (S) / Liquids (L) Preservative	Solid Sample Volume/Container	Liquid Sample Volume/Container	Holding Time
Acid Extractables/Base/Neutral Extractables	8270	S/L: Cool 4° C	8 oz. CWM	1 L Amber	7 days Ext/40 days Analyze
Amenable Cyanide	-	S: 4° C / L: pH>12 NaOH, 4° C	4 oz. CWM	1 L HDPE	14 days
Chromium, Hexavalent	3060A/7196	S/L: Cool 4° C	8 oz. CWM	1 L HDPE	24 hours
Extractable Hydrocarbons	8015B	S: Cool 4° C / L: pH<2 HCl, 4° C	8 oz. CWM	1 L Amber	7 days Ext/40 days Analyze
Herbicides	8150	S/L: Cool 4° C	8 oz. CWM	1 L Amber	7 days Ext/40 days Analyze
Non-Halogenated Organics	8015B	S: Cool 4° C / L: pH<2 HCl, 4° C	4 oz. CWM	40 mL Glass Vial	14 days
PAH (low level)	8310 or GC/MS SIM	S/L: Cool 4° C	8 oz. AWM	1 L Amber	7 days Ext/40 days Analyze
Paint Filter Liquids Test	9095	S: Cool 4° C	8 oz. CWM	1 L Amber	Analyze ASAP
PCBs	8082	S/L: Cool 4° C	8 oz. CWM	1 L Amber	7 days Ext/40 days Analyze
Pesticides	8081	S/L: Cool 4° C	8 oz. CWM	1 L Amber	7 days Ext/40 days Analyze
Physiologically Available Cyanide	MADEP draft	S: 4° C / L: pH>12 NaOH, 4° C	4 oz. CWM	1 L HDPE	14 days
Priority Pollutant Metals(13 Metals)	6010&7000	S: 4° C / L: pH<2 HNO3, 4° C	8 oz. CWM	1 L Amber	28 days (Hg), 6 mos. (others)
RCRA Metals (8 Metals)	6010&7000	S: 4° C / L: pH<2 HNO3, 4° C	8 oz. CWM	1 L Amber	28 days (Hg), 6 mos. (others)
Total Cyanide	9010	S: 4° C / L: pH>12 NaOH, 4° C	4 oz. CWM	1 L HDPE	14 days
Volatile Hydrocarbons	8015B	S: Cool 4° C / L: pH<2 HCl, 4° C	4 oz. CWM	40 mL Glass Vial	14 days
Volatile Organics	8260B, 8021	S: methanol/$NaHSO_4$, 4° C / L: pH<2 HCl, 4° C	4 oz. CWM	40 mL Glass Vial	14 days
RCRA HAZARDOUS WASTE CHARACTERIZATION					
Corrosivity (pH only)	SW846-7.2	S: Cool 4° C	4 oz. CWM	check with lab	Analyze ASAP
Ignitability/Flashpoint	SW846-7.1	S: Cool 4° C	4 oz. CWM	check with lab	Analyze ASAP
Reactivity (CN-/S2-)	SW846-7.3	S: Cool 4° C	4 oz. CWM	check with lab	Analyze ASAP
TCLP (RCRA 8) Metals (check for mercury)	1311	S: Cool 4° C	16 oz. CWM	check with lab	6 mos. Ext/6 mos. Analyze
TCLP Pesticides/Herbicides	1311	S: Cool 4° C	16 oz. CWM	check with lab	14 days Ext/40 days Analyze
TCLP Semivolatiles	1311	S: Cool 4° C	16 oz. CWM	check with lab	14 days Ext/40 days Analyze
TCLP Volatiles	1311	S: Cool 4° C	8 oz. CWM	check with lab	14 days Ext/14 days Analyze
HYDROCARBON OIL & GREASE ANALYSIS					
MADEP EPH Method	MADEP REV. 0	S: Cool 4° C / L: pH<2 HCl, 4° C	4 oz. Amber	1 L Amber	S:7 days Ext / L:14 days Ext
MADEP EPH Method (C-Ranges only)	MADEP REV. 0	S: Cool 4° C / L: pH<2 HCl, 4° C	4 oz. Amber	1 L Amber	S:7 days Ext / L:14 days Ext
MADEP VPH Method	MADEP REV. 0	S: methanol, 4° C / L: pH<2 HCl, 4° C	40 mL+2 oz. CWM.	40 mL Glass Vial	S: 28 days / L: 14 days
MADEP VPH Method (C-Ranges only)	MADEP REV. 0	S: methanol, 4° C / L: pH<2 HCl, 4° C	40 mL+2 oz. CWM.	40 mL Glass Vial	S: 28 days / L: 14 days
MADEP EPH Method - with selected PAHs (including acenaphthene, naphthalene, 2-methylnaphthalene, and phenanthrene)	MADEP REV. 0	S: Cool 4° C / L: pH<2 HCl, 4° C	4 oz. Amber	1 L Amber	S:7 days Ext / L:14 days Ext
Petroleum Identification	ASTM D3328				
Quantitative (include Chromatograms)		S: Cool 4° C / L: pH<2 H_2SO_4, 4° C	4 oz. CWM	1 L Amber	S: 7 days / L: 28 days
Total Petroleum Hydrocarbons (Infrared)	418.1	S: Cool 4° C / L: pH<2 H_2SO_4, 4° C	4 oz. CWM	1 L Amber	S: 7 days / L: 28 days

AIR METHODS

Analysis Description	Method No.	Preservative	Sample Volume/Container		Holding Time
Volatile Organic Compounds	EPA T01/T02	tubes: 4° C; Tedlar Bags: dark	N/A	N/A	tube: 14 days; bag: 72 hours
Volatile Organic Compounds	EPA T014	check with lab	N/A	N/A	can: 14 days; bag: 72 hours
VPH in air	EPA T01/T02	tubes: 4° C; Tedlar Bags: dark	N/A	N/A	tube: 14 days; bag: 72 hours
VPH in air	EPA T014	check with lab	N/A	N/A	can: 14 days; bag: 72 hours

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SAMPLING RECORD

Page ____ of ____

PROJECT		**H&A FILE NO.**	
LOCATION		**PROJECT MGR.**	
CLIENT		**FIELD REP**	
CONTRACTOR		**DATE**	

Weather ____________________ **Temperature** ____________

Ground surface Conditions ☐ Dry ☐ Wet ☐ Damp ☐ Standing Water ☐ Snow (_____in) ☐ Other___________

Comments ____________________

SOIL SAMPLING AND SURFACE WATER SAMPLING INFORMATION

Sample No.	Location	Depth (ft)	Time	Sample Description	Sampling Device	Cleaning Prodedure	Container Type

General Comments: (ie: field filtrations, persons communicated with at site, etc.)

HALEY & ALDRICH

GROUNDWATER SAMPLING RECORD

PROJECT ______ H&A FILE NO. ______
LOCATION ______ PROJECT MGR. ______
CLIENT ______ FIELD REP ______
CONTRACTOR ______ DATE ______

GROUNDWATER SAMPLING INFORMATION

Well No.							
Water Depth (ft)							
Time							
Product							
Depth Of Well (ft)							
Inside Diameter (in)							
Standing Water Depth (ft) (1)							
Volume Of Water In Well (gal)							
Purging Device							
Volume of Bailer/Pump Capacity							
Cleaning Procedure							
Bails Removed/ Volume Removed							
Time Purging Started							
Time Purging Stopped							
Sampling Device							
Cleaning Procedure							
TIME SAMPLES TAKEN: VOA							
TIME SAMPLES TAKEN: ABN							
TIME SAMPLES TAKEN: Metals							
TIME SAMPLES TAKEN:							
TIME SAMPLES TAKEN:							
TIME SAMPLES TAKEN:							
PARAMETERS: Color							
PARAMETERS: Odor							
PARAMETERS: pH							
PARAMETERS: Conductivity							
PARAMETERS: Turbidity							
PARAMETERS: Dissolved Oxygen							
PARAMETERS: Temp, ^{0} C							
PARAMETERS: Salinity							

Remarks: (ie: field filtrations, persons communicated with at site, etc.)

1. Standing Water Depth = Depth of Well - Water Depth

HALEY & ALDRICH

MONITORING WELL DEVELOPMENT REPORT

Well No.

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP.	
CONTRACTOR		DATE	
ELEVATION SUBTRAHEND			

Estimated Volume of Water Lost During Drilling: ____________ gallons

Comments: ____________

Depth to Water Before Development: ____________ feet

Comments: ____________

Depth to Well Bottom Before Development: ____________ feet

Comments: ____________

Turubitiy of Water Before Development: ____________ NTU

Comments: ____________

Volume of Water Removed: ____________ gallons

Comments: ____________

Method of Removal (bailing, pumping): ____________

Comments: ____________

Depth to Well Bottom After Development: ____________ feet

Comments: ____________

Depth to Water After Development: ____________ feet

Comments: ____________

Turubitiy of Water After Development: ____________ NTU

Comments: ____________