



APPENDIX A OF ADDENDUM 12 TO THE REMEDIAL INVESTIGATION WORK PLAN

FIELD SAMPLING PLAN 12A – QUARTER 2, 2024 GROUNDWATER MONITORING

SMURFIT – STONE / FRENCHTOWN MILL SITE
Missoula, Montana

Prepared for:
WestRock CP, LLC
1000 Abernathy Road NE, Suite 125
Atlanta, GA 3032

International Paper Company
6400 Poplar Avenue
Memphis, TN 38197

Prepared by:
GSI ENVIRONMENTAL INC.
145 W. Front Street, Suite 1
Missoula, MT 59802
713.522.6300
www.gsienv.com

Job No.: 6968
Issued: 12 April 2024
Version: 2

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David Tooke
Project Coordinator

4/15/2024

Date



Allie Archer
Remedial Project Manager
U.S. Environmental Protection Agency Region 8

4/15/2024

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1.0 INTRODUCTION

Field Sampling Plan (FSP) 12A describes the scope of work related to sampling at the Smurfit-Stone/Frenchtown Mill Site (hereafter referenced as the “Site” (Figure 12A-1) during Quarter 2 2024. Activities related to sampling include monitoring of groundwater, installation of additional groundwater monitoring wells, installation of additional pressure transducers/specific conductance dataloggers, and collection of soil samples from well borings from the new monitoring wells. FSP 12A was prepared in accordance with Section 46 of the Administrative Settlement Agreement and Order on Consent (AOC) for Remedial Investigation/Feasibility Study (RI/FS) between the potentially responsible parties (PRPs; M2Green Redevelopment LLC, WestRock CP, LLC, International Paper Company) and the U.S. Environmental Protection Agency (EPA), filed November 12, 2015.

GSI Environmental Inc. (GSI) will conduct this groundwater investigation in the second quarter of 2024 (approximately April 8, 2024 through May 10, 2024) and prepare a data summary report on behalf of the PRPs. EPA will review and approve the study plan, oversee the investigation, and review the report. The Montana Department of Environmental Quality (MDEQ) will support the EPA with this investigation.

2.0 PURPOSE AND OBJECTIVES

FSP 12A will investigate the nature and extent of COPCs in groundwater at the Site, and the mobility of COPCs in groundwater from potential source areas toward downgradient receptors and along paleochannels near the Clark Fork River (CFR). Data from FSP 12A will also serve to improve the groundwater conceptual model (GCM) with additional data to enhance understanding of temporal patterns and reduce uncertainties in the risk assessment findings. The following DQOs apply the EPA's seven step approach (EPA 2006) to outline the principal study questions and investigation approach.

2.1 DATA QUALITY OBJECTIVES

2.1.1 *State the Problem*

Nature and Extent:

Additional groundwater data (water levels and water quality) and supporting data from other media (soil borings, surface water, and sediment) will help to refine the GCM for the Site, will supplement the dataset characterizing nature and extent of contamination, and groundwater quality spatial and temporal trend analysis. Long term water quality changes have been observed from a major ion signature similar to that of the treated discharge from the operating mill to a signature more similar to background groundwater.

Risk Assessment:

The nature and extent of polychlorinated biphenyls (PCBs) in groundwater was previously investigated using Aroclors which represent common commercial mixtures of PCBs sold from approximately 1930 to 1979. The potential presence or absence of (dioxin-like) PCB congeners (individual compounds) above concentrations that contribute to risk at the Site has not been confirmed and is therefore a potential data gap for risk assessment. Further, the evaluation of chromium exposures presented in the risk assessments are conservative based on assuming the most toxic form of chromium (i.e., hexavalent chromium) and likely overestimate actual Site risks. Additional PCB congener and hexavalent chromium data will minimize uncertainty in the risk assessments.

Sources to Groundwater and Transport Pathways:

The potential for paleochannels to serve as preferential pathways for contaminant transport is a data gap. Additional data will refine the understanding of contaminant mobilization from potential sources (primary and secondary wastewater treatment and former industrial practices) into groundwater, and from groundwater toward the CFR, or into paleochannels near the CFR.

2.1.2 *Identify the Goals of the Study*

This step identifies the principal study questions (PSQs). The PSQs help determine appropriate data inputs and investigation methods. Outcomes for the nature and extent and source-focused studies are not expected to lead to specific decisions, rather will lead to a greater understanding of the Site. Therefore, estimation statements are more applicable to the nature of the PSQ for those studies. The risk assessment study will lead to specific decisions; therefore, decision statements are more applicable.

Each principal study question is listed below:

Nature and Extent:

PSQ 1 How do the new Unit 1 groundwater well boring lithologic and soil data inform the current understanding of the nature and extent of contamination at the Site?

PSQ 2 How do the new groundwater water quality data supplement the current understanding of the spatial and temporal water quality trends at the Site?

Sources to Groundwater and Transport Pathways

PSQ 3 Are there constituents mobilizing from potential source areas into groundwater? Are contaminants mobilizing in groundwater (east to west) and do the paleochannels impact this movement?

Risk Assessment:

PSQ 4 Are PCB congeners present at detectable levels in Site soil or groundwater? If detected, do they contribute to site risk?

PSQ 5 How do the data minimize uncertainty or otherwise modify the risk assessments?

2.1.3 Identify Information Inputs

PSQ 1:

- Install 10 new wells in Unit 1 aquifer (Table 12A-1, Figure 12A-2).
 - Use sonic drilling method to support soil sample collection and lithologic logging
 - Locations of new wells increase spatial coverage downgradient of potential source areas and/or along paleochannels
 - Complete the wells consistent with the RIWP (**Attachment 1**)
 - Survey wells for both horizontal and vertical coordinates
- Collect soil samples using sonic cores and compositing soil (with the exception of VOCs) from these well borings during drilling to further evaluate the presence of constituents (Table 12A-4)
 - Collect up to 3 soil samples per boring – typically the saturated, intermittently saturated, and unsaturated zones; each sample will be comprised of a composite of a distinct ~2-foot depth interval
 - Collect opportunistic samples based on field observations and professional judgement
- Analyze soil samples for metals, dioxins/furans, PCB Aroclors/congeners, VOCs, mineralogy, total sulfur, total organic carbon, and grain size (Table 12A-4)

PSQ 2:

- Monitor up to 58 wells including 1 perched zone, 52 Unit 1 aquifer, and 5 Unit 3 aquifer (Table 12A-3, Figure 12A-2)
- Install transducers with conductivity sensors in 3 new wells and upgrade 8 existing transducers with conductivity sensors (Table 12A-3, Figure 12A-2). Two of the eight are surface water locations in the Clark Fork River.
 - Transducer locations are selected along three transects (Figure 12A-2); the transects generally follow three groundwater flow directions across the Site
- Record groundwater elevation measurements from monitoring wells (manually and via transducers) across the Site to monitor groundwater flow and gradient and to determine if settling ponds and solid waste basins are inundated during high groundwater conditions (Table 12A-3, Figure 12A-2)
- Record field parameters and analyze groundwater samples for total and dissolved metals, common ions, dioxins/furans, volatile organic compounds, and PCB Aroclors/congeners (Table 12A-3, Table 12A-7 Figure 12A-3)
 - Monitor for total and dissolved metals, common ions, dioxins/furans, and PCB Aroclors/congeners at all planned locations
 - Monitor for volatile organic compounds (VOCs) in locations where VOCs were previously detected and in new well locations downgradient from potential source areas

PSQ 3:

- 5 of the new wells will be in Unit 1 aquifer located downgradient from potential source areas, 5 in paleochannels and all near berms/roads or in other easily accessible locations, to the extent possible (Table 12A-3, Figure 12A-2)
- Monitor 28 (10 new, 18 existing) Unit 1 aquifer wells downgradient from potential source areas and paleochannels (Table 12A-3, Figure 12A-2)
 - NFMW5, NFMW13 and NFMW14 will be sampled to further investigate the northern portion of OU2
- Analyze groundwater samples for metals, common ions, dioxins/furans, VOCs, and PCB Aroclors/congeners (Table 12A-3, Table 12A-7, Figure 12A-3)

PSQ 4:

- Collect soil samples from 10 new well borings during drilling (Table 12A-4, Figure 12A-2)
- Monitor up to 58 wells including 1 perched zone, 52 Unit 1 aquifer, and 5 Unit 3 aquifer (Table 12A-3, Figure 12A-2)
- Analyze soil and groundwater samples for PCB congeners (Table 12A-3, Table 12A-4, Table 12A-7, Figure 12A-3)

PSQ 5:

- Collect soil samples from 10 new well borings during drilling (Table 12A-4, Figure 12A-2)
- Monitor up to 58 wells including 1 perched zone, 52 Unit 1 aquifer, and 5 Unit 3 aquifer (Table 12A-3, Figure 12A-2)

- Analyze soil and groundwater samples for COCs and hexavalent chromium (Table 12A-3, Table 12A-4, Table 12A-7 Figure 12A-3)

2.1.4 Define the Boundaries of the Study

Spatial Boundaries:

The spatial boundaries and locations of existing and new wells to be sampled during this investigation are shown on Figure 12A-3. Site groundwater includes Aquifer Unit 1 (shallow) and Unit 3 (deep) groundwater across the Site. For new wells installed in Aquifer Unit 1 (shallow), minimum boring depth will be based on encountering groundwater. Wells will be screened across a depth interval determined by the field hydrogeologist with estimated depths Table 12A-1.

Temporal Boundaries:

Groundwater and soil sampling described in this monitoring plan will be conducted in the Spring of 2024 between April 8, 2024, and May 10, 2024. Work will be limited to daylight hours. Concentrations of constituents in soil are not expected to change over the study period and are not influenced by temporal constraints. Constituents in groundwater are subject to change over the study period. For Quarter 2 (Spring of 2024), the groundwater samples shall be collected prior to spring runoff, which influences groundwater levels at the Site. Groundwater levels will be recorded prior to sample collection and then during a Site-wide single synoptic event. Additional sampling in 2024/2025 and beyond will be defined in subsequent monitoring plans.

2.1.5 Develop the Analytic Approach

PSQ 1:

Soil lithologic and analytical data will be combined with the current Site-wide dataset and included in future evaluations and assessments (i.e., GCM, risk assessments).

PSQ 2:

Groundwater data will be combined with the current Site-wide dataset and included in future evaluations and assessments (i.e., GCM, risk assessments).

PSQ 3:

Identify if and what constituents are detected in groundwater downgradient of potential source areas.

Characterize the distribution of constituent concentrations along paleochannel flow paths compared to adjacent groundwater concentrations.

Paired PCB congener and Aroclor data will be evaluated to determine if analysis for Aroclors is sufficient to investigate nature and extent.

PSQ 4:

If PCB congener concentrations in soil and/or groundwater affect risk assessment findings, then risk assessments will be updated accordingly.

PSQ 5:

If evaluation of Cr VI or any other constituent concentrations affect risk assessment findings, then risk assessments will be updated accordingly.

2.1.6 Specify Performance or Acceptance Criteria

GSI will employ quality assurance and quality control procedures and evaluate data usability in accordance with the Quality Assurance Project Plan (QAPP; NewFields, 2022b). The QAPP details acceptance criteria for the data collected as part of this study. Information and data gathered during this evaluation will be reviewed to ensure they are usable for their intended purposes.

2.1.7 Develop the Plan for Obtaining Data

FSP 12A will investigate the mobility of COPCs in groundwater from potential source areas toward downgradient receptors and along paleochannels near the CFR. Paleochannels were mapped based on historic aerial imagery collected from 1937 to 1955 (NewFields 2017). Selected sample locations and analyses are informed by results and observations from previous Site investigations which were last documented in the GCM (NewFields 2020b) and subsequent groundwater data summary report (NewFields 2022a). The rationale for selected sample locations and analysis are detailed in **Section 3, Table 12A-2, Table 12A-3**.

2023Data from FSP 12A will improve the GCM and reduce uncertainty in the risk assessments. FSP 12A includes the following:

- Drilling, installation, and development of 10 new proposed shallow (Unit 1 aquifer) monitoring wells (**Table 12A-1**), to characterize constituent mobilization downgradient from potential contaminant source areas in the Unit 1 aquifer toward the CFR and toward the Unit 3 aquifer. These wells will also help to investigate paleochannels within the Unit 1 aquifer.
- Installation and monitoring of transducers including conductivity sensors at 9 groundwater locations and 2 CFR locations to evaluate solute transport trends over time (including seasonality) through the Unit 1 aquifer. There are 7 additional pressure/temperature transducers in wells and one additional pressure/temperature transducer in O'Keefe Creek at the site. Nineteen pressure transducer locations will be continuously monitored going forward (Table 12A-3 and Figure 12A-2). Data from the transducers will be downloaded during each subsequent groundwater sampling event.
- Collection and analysis of soil samples from the soil borings of new wells (Table 12A-4) to evaluate the vertical and lateral migration of COPCs. Soil sample collection will include:
 - Lithologic logging and photographing soil cores obtained during sonic drilling
 - Up to 3 soil samples collected during drilling from each of the 10 new well locations.
 - The 3 samples will represent: 1) the vadose zone above the highest known groundwater level; 2) the vadose zone between the annual low groundwater level and high groundwater level; 3) the saturated zone.
 - Opportunistic samples based on field observations and professional judgement.

- Monitoring of 58 well locations (Table 12A-3) to refine characterization of constituent concentrations in site groundwater. Monitoring locations include:
 - 1 perched aquifer well,
 - 52 shallow (Unit 1 aquifer) wells (including the 10 new wells described above), and
 - 5 deep (Unit 3 aquifer) wells.
- Analyze for a list of constituents (Table 12A-7), collect field parameters (Table 12A-3), and collect manual and transducer water level data.

3.0 SCOPE OF WORK

The approach to additional groundwater investigation at the Site in Q2 2024 is based on available groundwater, soil, surface water and sediment data that were collected from 2014 to 2023 on and near the Site. The primary focus of this study is on groundwater monitoring and mobilization of constituents into and from groundwater, with supporting analysis of soils from new well borings. The rationale for selecting sample locations and analytes is presented in tables. **Table 12A-2** summarizes monitoring evaluation criteria associated with each study goal. **Table 12A-3** presents an assessment of each existing or proposed sampling location against the monitoring rationale for each goal. **Section 2.1.7** outlines the investigative approach for Q2 2024.

Work will be performed in general accordance with sampling methods described in previous EPA-approved planning documents, including the Field Sampling Plan included in the RIWP (NewFields, 2015), and the Quality Assurance Project Plan (QAPP; NewFields, 2022b¹). GSI will protect its workers and site visitors in accordance with the approved Health and Safety Plan (HASP; GSI 2024), as further discussed in Section 4.0. **Attachment 1** includes applicable standard operating procedures (SOPs) for fieldwork, laboratory work, and associated reporting. **Attachment 2** includes relevant field forms, well completion forms, and chain-of-custody (COC) forms. **Attachment 3** summarizes the schedule for completing this scope of work.

3.1 GROUNDWATER WELL INSTALLATION, DEVELOPMENT AND SURVEYING

This task includes installation of 10 additional monitoring wells for the purpose of groundwater level monitoring and water quality sampling. Five of these wells will be located to investigate potential mobilization of COPCs from source areas and five will be installed in CFR paleochannels. Wells will be drilled using sonic drilling methods. Proposed wells are shown in **Figure 12A-2** and listed in **Table 12A-1**.

This task involves soliciting bids from qualified drillers, improving safe access to sample locations if necessary, observing drilling efforts and logging soils recovered from boreholes, constructing, and developing wells in accordance with industry standards, and documenting the field effort. GSI will direct drillers to follow SOPs for monitoring well construction and development (i.e., SOP-16 and SOP-18; **Attachment 1**).

The construction of the new monitoring wells will be generally consistent with the existing Unit 1 groundwater monitoring well network. Aquifer Unit 1 occurs to a depth of approximately 35 feet below ground surface (ft bgs), with the water table surface generally located at a depth of approximately 15 to 20 ft bgs in the western portion of OU2. Each well will be constructed using 2-inch diameter Schedule 40 polyvinyl chloride (PVC) casing with 10 to 20 feet of 0.01-inch factory-slotted well screen. The screen will be set across the Unit 1 water table to accommodate seasonal groundwater fluctuations based on existing groundwater data; proposed well details are outlined in **Table 12A-1**. Construction will not include a sump at the bottom of the well. The total depth of each well will be completed near the bottom of the Unit 1 aquifer at a maximum depth of approximately 30 ft bgs. A 10/20 silica-sand filter pack will be emplaced in the annulus of the borehole at least two feet above the well screen. Bentonite chips will be installed into the borehole annulus above the sand filter pack to within one foot of the ground surface and hydrated with potable water from the Site. Monitoring wells will be finished at the surface with an above-ground metal monument equipped with a locking lid. The concrete pad surrounding the monument will be graded away from the monument to shed water away from the well. Top-of-casing elevation,

¹ Future revisions to the QAPP, when complete and approved by EPA, are applicable to this RIWP Addendum.

ground surface elevation, and coordinates of each new monitoring well will be surveyed by a Montana-licensed professional land surveyor following well installation.

After installation of new groundwater wells, a maximum of 10 well casing volumes of water will be removed by surge and bail techniques to develop the well and remove excess fines from the screened interval and surrounding aquifer material in accordance with SOP-18 (**Attachment 1**). The well will be allowed to equilibrate to initial static water level conditions prior to sampling, no less than 7 days following development. Conditions include stabilization of field parameters per SOP-12A (**Attachment 1**).

3.2 SOIL SAMPLING AT TIME OF DRILLING

Continuous subsurface soil cores will be obtained by sonic drilling during well installation in the Q2 2024 field event. The entire soil core from each boring will be logged in accordance with the Unified Soil Classification System (USCS), using the field form (**Attachment 2**), and the entire soil core will be photographed (see photographic log in **Attachment 2**).

Soil samples for analytical testing will be collected from the sonic core. Soil analytical parameters are specified in **Table 12A-4**. Soil samples will be tested for metals, PCBs (Aroclors and congeners), and dioxins/furans. At potential source area locations soil testing will also include VOCs. At these locations, field screening of VOCs will be performed in accordance with SOP-17 (**Attachment 1**). Drillers and/or field staff will decontaminate core barrels, and/or any equipment which will come into direct contact with soil, between drilling runs (SOP-2, **Attachment 1**). **Table 12A-6** details sample bottles, preservatives and hold times.

Sonic cores will typically be advanced at approximately 5- to 10-foot intervals. Cores will be laid out for observation, photographing, USCS logging, and sampling in accordance with SOP-14, with additional guidance from SOP-1 through 4, 24, and 25 (**Attachment 1**). For most boreholes, approximately three soil samples will be collected and tested from different depth intervals, with exact sample numbers and depth intervals to be confirmed based on specified parameters and conditions encountered. For each borehole, these three samples will typically consist of one sample each from an appropriate depth interval within the unsaturated, intermittently saturated, and saturated zones. Each soil sample will be comprised of a composite from a distinct ~1- to 2-foot depth interval, depending on the recovery amount of in situ material retrieved from the core barrel. Opportunistic samples may be collected based on field observations, including odor, VOC screening, or an unexpected layer of potential waste materials, and professional judgement. Opportunistic samples will be handled and analyzed consistent with the planned samples.

3.3 GROUNDWATER QUALITY SAMPLING

Groundwater monitoring will be conducted during April/May in Quarter 2 2024 following well installation and development in accordance with EPA guidelines (EPA OSWER 542-S-02-001). The groundwater monitoring event will capture seasonally lower groundwater conditions prior to spring runoff in the Clark Fork River. **Tables 12A-3** and **12A-7** identify specific monitoring locations and corresponding analytical parameters for each well. A spatial representation of the groundwater monitoring program, including proposed analytes for each location, is shown on **Figure 12A-3**. Field staff will sample groundwater in accordance with SOPs-2 through 12C, SOP-24, and SOP-25 (**Attachment 1**). Based on the available historical water quality data and/or the location of the well (**Tables 12A-3** and **12A-7**), each groundwater monitoring location will be sampled for metals, common ions, PCBs (Aroclors and congeners), and dioxins/furans. At potential source area locations, testing will also include VOCs. **Table 12A-5** details bottles, preservatives, and hold times.

3.4 MANUAL GROUNDWATER LEVEL MONITORING

Due to the large number of monitoring wells and the multi-week duration of the sampling event, two sets of manual groundwater level measurements will be recorded from each well location during the monitoring event. One measurement will be recorded immediately prior to water quality sample collection, and a second measurement will be recorded as part of a final site-wide synchronous (synoptic) groundwater level measurements in which data are collected as quickly as possible (within two days) during the event. Synoptic water level data will be used to develop water table and potentiometric surface maps. Manual groundwater level measurements will be recorded in accordance with SOP-5 (**Attachment 1**).

3.5 TRANSDUCERS

In addition to manual groundwater level measurements collected during monitoring events, continuous groundwater elevation and temperature data is recorded using pressure transducers in select wells (**Table 12A-3, Figure 12A-2**). Pressure transducers are currently installed in a total of 13 monitoring wells, including: CountyMW, NFMW9, SMW16, SMW16D, SMW18, SMW18D, NFMW1d, NFMW7, SMW3, SMW4, NFMW2, NFMW3, and NFMW16.

GSI personnel will install nine additional combined conductivity/pressure transducers (**Tables 12A-3, Figure 12A-2**) in wells and replace two pressure transducers in CFR surface water locations (CFR1r and CFR2) (**Figure 12A-2**). These conductivity data locations generally align along three flow-path transects (**Figure 12A-2**) and will be used to support the east-west groundwater flow and surface water interaction study (FSP 12B – Quarter 3 2024). Transducer data, including conductivity data, will be downloaded during successive groundwater monitoring events.

3.6 FIELD DOCUMENTATION AND SAMPLE HANDLING

GSI personnel will document activities associated with this groundwater monitoring event in accordance with SOP-1 (**Attachment 1**). Field documentation and sample handling will be consistent with procedures described in the RIWP (NewFields, 2015) and SOP-1 through SOP-4. Field forms and laboratory COC forms are included in **Attachment 2**.

3.7 DECONTAMINATION PROCEDURES

Non-disposable field equipment used for sampling will be decontaminated in accordance with SOP-2 (**Attachment 1**). Decontamination wastes will be handled consistent with procedures described in the RIWP (NewFields, 2015).

3.8 INVESTIGATION-DERIVED WASTE

Investigation-Derived Waste (IDW) from soil borings, well development and purge water will be handled according to SOP-25 (**Attachment 1**). IDW will be handled and managed consistent with previous procedures described in the RIWP (NewFields, 2015) and subsequent addenda.

3.9 REPORTING

The field investigation will be documented in accordance with SOP-1 (**Attachment 1**) using the corresponding field forms (**Attachment 2**). Following completion of both well installation and Quarter 2 sampling activities, GSI will document investigation methods and results for the above-described tasks in a data summary report. Analytical results will be validated and uploaded to the

Scribe database in accordance with the QAPP (NewFields, 2022b). The report will include the following components, as applicable:

- Summary of observations, measured values, and laboratory results;
- Comparison of new data with currently understood concentration ranges;
- Updates to the conceptual model for the Site; and
- Recommendations for additional data collection, if deemed necessary.

Report format and content will be similar to previous reports approved by EPA and consistent with the RIWP (NewFields, 2015). The conceptual model for the Site may also be updated to reflect any new findings.

4.0 HEALTH AND SAFETY

Field staff involved in drilling, monitoring, and sampling activities will complete work in accordance with a revised HASP (GSI 2024, NewFields 2018a). The HASP will be complemented by Job Safety Analysis (JSA) worksheets to address safety concerns related to drilling; well installation; well development; groundwater, soil,; and water level monitoring. At the beginning of each workday, field team leaders will conduct daily staff safety meetings guided by the HASP and JSAs. Incidents, accidents, and emergency procedures are addressed in SOP-36 and SOP-38 (**Attachment 1**). The HASP details the responsibilities of health and safety officers. Dan Hoffman will serve as the project Health and Safety Officer. Pat Moffitt will be the site safety officer during drilling. India Phillips will be the site safety officer during monitoring. **Attachment 3** details drilling and monitoring periods.

5.0 SCHEDULE

GSI anticipates preparation and regulatory approval of Addendum 12 by early April. Based on the assumed authorization schedule, the fieldwork detailed in this FSP 12A will occur in April/May of 2024. The first event will include well drilling/installation, soil sampling, and groundwater monitoring (**Attachment 3**).

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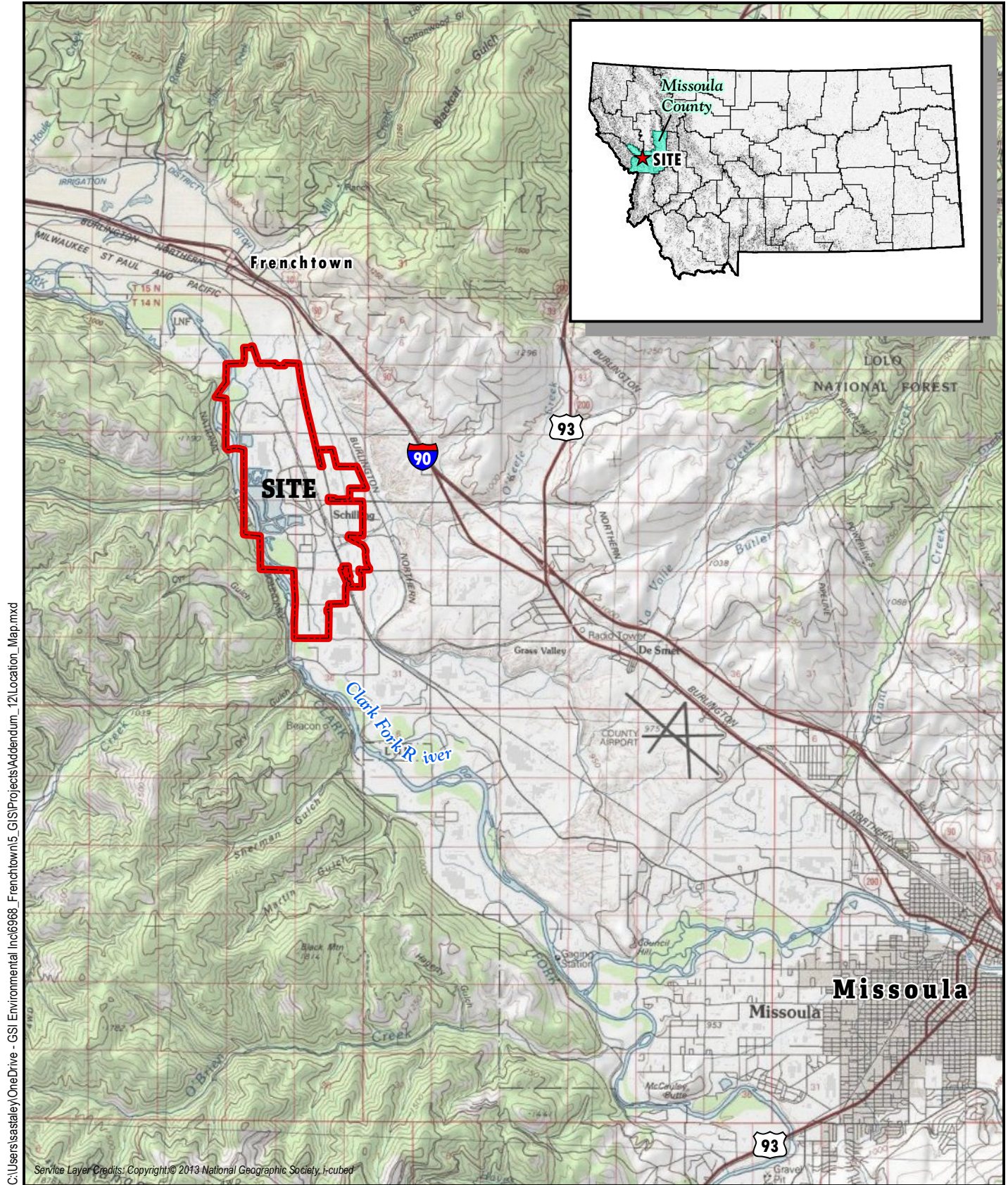
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NewFields, 2023a. Amendment A to Addendum 11 of the Remedial Investigation Work Plan, Former Smurfit-Stone/Frenchtown Mill Site, Missoula County, Montana. September 8.

FIGURES

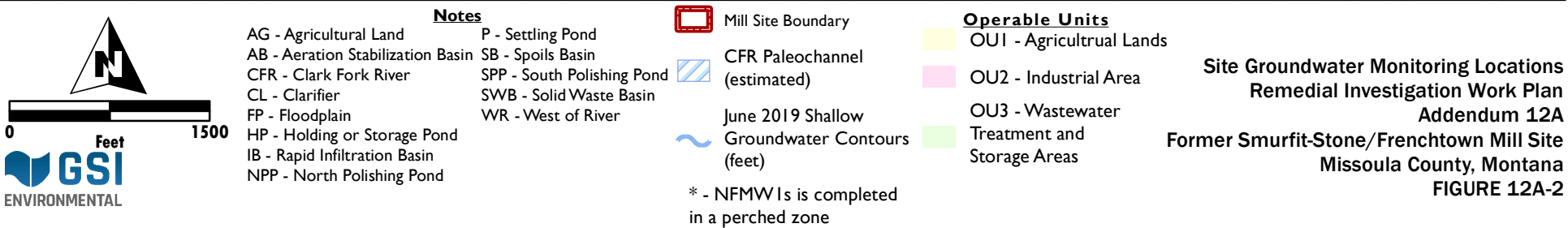
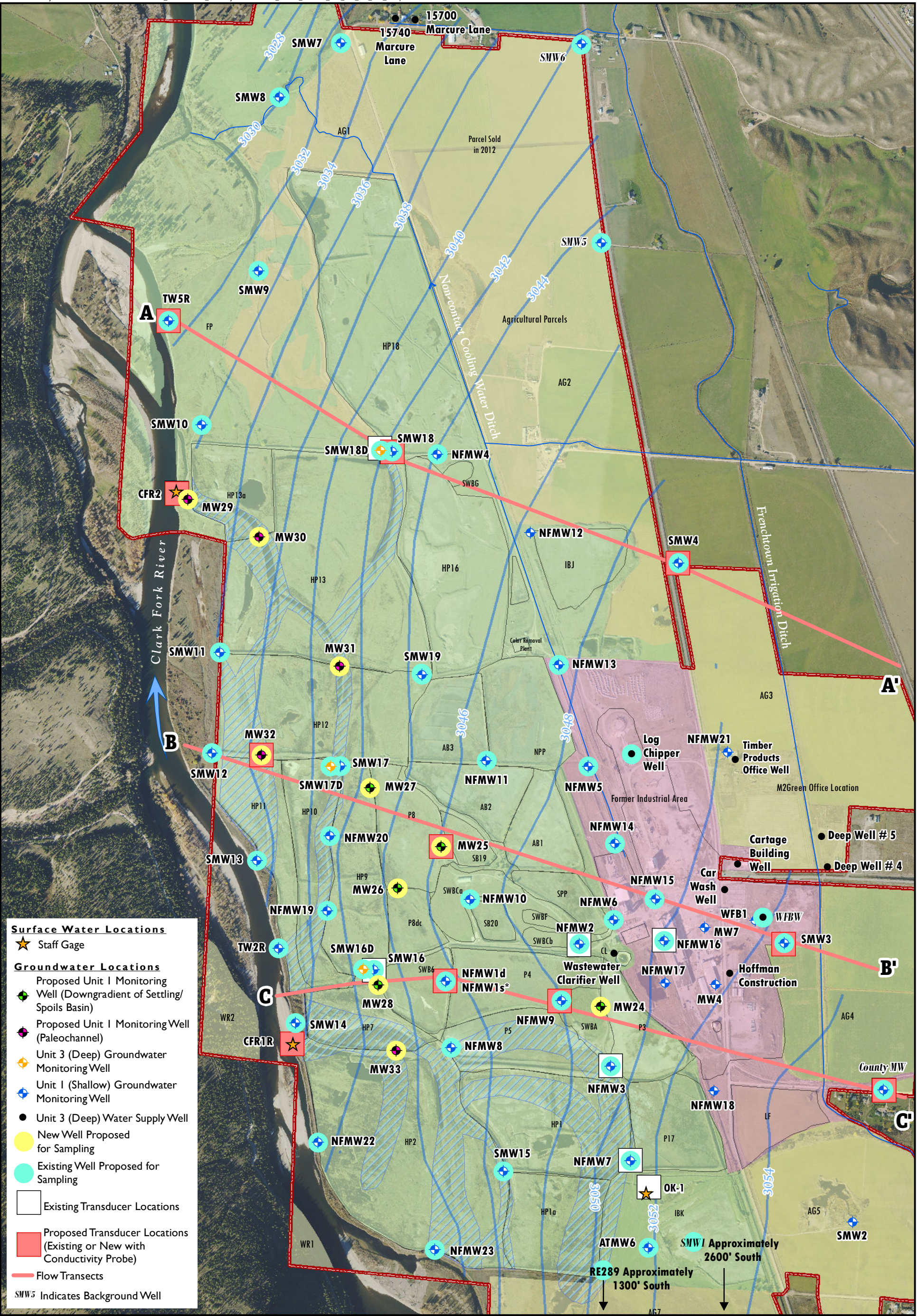
- Figure 12A-1 Site Location Map
- Figure 12A-2 Groundwater Monitoring Locations
- Figure 12A-3 Groundwater Sample Parameters

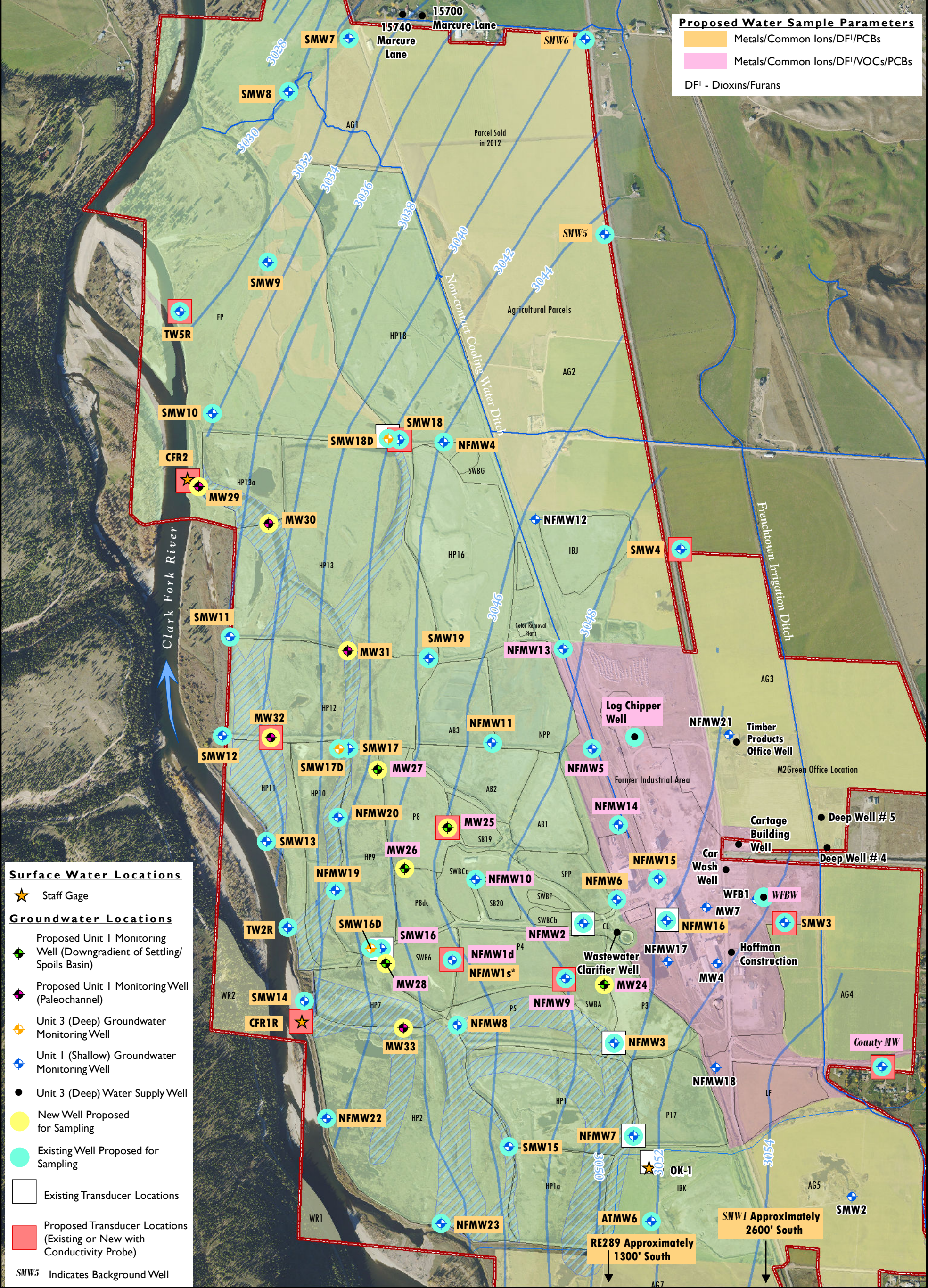


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Site Location Map
 Remedial Investigation Work Plan
 Addendum 12A
 Former Smurfit-Stone/Frenchtown Mill Site
 Missoula County, Montana
 FIGURE 12A-1





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TABLES

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Table 12A-1. Proposed Monitoring Well Details¹
Addendum 12A of the Remedial Investigation Work Plan, Former Smurfit-Stone/Frenchtown Mill
April 2024

Location	Proposed Northing (Montana State Plane International Feet)	Proposed Easting (Montana State Plane International Feet)	Proposed Well Land Surface Approximate Elevation	Expected DTW at Time of Drilling (April; feet bgs)	Estimated Seasonal DTW Range (feet)	Proposed Screen Interval (feet bgs)	Proposed Total Well Depth (feet bgs)
Proposed Source Investigation Wells							
MW24	1023240	795350	3072	24	3	20 - 30	30
MW25	1025287	793309	3055	10	5	5 - 15	15
MW26	1024519	792577	3051	9	4	5 - 15	15
MW27	1025867	792430	3054	13	4	5 - 25 ²	25
MW28	1023518	792503	3050	8	4	5 - 15	15
Proposed Paleochannel Wells							
MW29	1029733	790065	3049	16	4	10 - 30 ²	30
MW30	1029255	790976	3049	13	4	10 - 30 ²	30
MW31	1027595	792007	3050	11	4	7 - 17	17
MW32	1026460	791005	3051	16	4	10 - 30 ²	30
MW33	1022674	792729	3049	8	4	5 - 25 ²	25

Notes:

1 - Summary of approximate specifications for new proposed wells to be installed in 2024

2 - 20-foot screening interval proposed due to potential groundwater level uncertainty associated with location.

Acronyms and Abbreviations:

DTW - Depth to water

bgs - Below ground surface

CFR - Clark Fork River

Table 12A-2. FSP 12A Groundwater Monitoring Evaluation Criteria Addendum 12A of the Remedial Investigation Work Plan, Former Smurfit-Stone/Frenchtown Mill April 2024				
Primary Rationale for Monitoring		Secondary Rationale for Monitoring	Applicable Analyte Group(s)	Monitoring Selection Criteria
1a	Confirm Nature and Extent of Contamination	Wells located along the downgradient Site boundary or background monitoring locations, or an upgradient well used to evaluate baseline water quality ¹ .	Metals Common Ions Dioxins/Furans VOCs ² PCBs ³	Select wells to compare water quality upgradient (east) and downgradient (west) from potential source areas.
1b		Monitoring well locations where dioxins/furans are present and could impose a risk to human health. PCBs could be present at these locations due to similar groundwater-mobility characteristics.	Metals Common Ions Dioxins/Furans PCBs ³	Maximum detected Dioxins/Furans TEQ 0DL (2014-2022) greater than Montana DEQ-7 water quality standard (2 pg/L) ^{4,7} ; see Table 12A-3 for specific wells
1c		Aquifer Unit 1 wells located downgradient from or near solid waste basins (SWBs)	Metals Common Ions Dioxins/Furans VOCs PCBs ³	Monitoring wells NFMW1d, NFMW2, NFMW9, NFMW10, and SMW16
1d		Monitoring wells completed in Aquifer Unit 3	Metals Common Ions Dioxins/Furans PCBs ³	Monitoring wells Log Chipper Well, SMW16D, SMW17D, and SMW18D; Background monitoring well WFBW
1e		Monitoring wells that do not have sufficient data to help evaluate changes to water quality over time.	Metals Common Ions Dioxins/Furans PCBs ³	Wells that have not been previously sampled or were sampled for limited analytes at a limited frequency. See Table 12A-3.
1f		Monitoring wells that demonstrate long term changes to ionic signature.	Metals Common Ions Dioxins/Furans PCBs ³	Wells that demonstrate changes to ionic signature over time (based on the GCM evaluation (NewFields 2020b).
2a	Investigate Potential for Mobilization of Groundwater Constituents	Constituents mobilizing from a potential source area ⁵	Metals Common Ions Dioxins/Furans PCBs ³	Downgradient from potential source areas or where PCB Aroclors were detected; see Table 12A-3 for specific wells
2b		Constituents mobilizing from east to west toward the Clark Fork River.	Metals Common Ions Dioxins/Furans PCBs ³	Wells that will be used to evaluate changes in water quality from east to west across the site. See wells along transects A, B and C in Figure 12A-2.
2c		Constituents mobilizing along Clark Fork River paleochannels	Metals Common Ions Dioxins/Furans PCBs ³	Wells located within historic Clark Fork River channel in floodplain, based on channel mapping from LiDAR imagery and historic aerial photographs ⁶ ; see Table 12A-3 for specific wells
3a	Update Risk Assessments	Location previously had aroclor detection or is a new monitoring well.	PCBs ³	See NewFields 2022a results and Table 12A-3.
3b		Locations where Risk assessments may be require updates with combined Dioxins/Furans TEQ and Dioxin-like PCB TEQ results.	Dioxins/Furans PCBs ³	Maximum detected Dioxins/Furans TEQ 1/2DL (2014-2022) greater than Montana DEQ-7 water quality standard (2 pg/L) ^{4,7} ; see Table 12A-3 for specific wells
3c		Locations with total Cr concentrations higher than the Cr VI background and RBC level.	Metals	Total Cr background is 0.91 ug/L, Cr VI RBC is 0.035 ug/L. All locations exceed the Cr VI RBC. See results in GSI 2024 and Table 12A-3 for locations that exceed background.

Notes:

- 1 - Upgradient wells also include SMW4 and SMW3, which are not designated background wells but are located upgradient of potential source areas.
- 2 - Analyte groups for background monitoring locations are specific to Aquifer Units 1 and 3; see Table 12A-3 for details.
- 3 - Polychlorinated Biphenyl (PCB) congener and Aroclor analysis to confirm nature and extent of PCBs.
- 4 - Montana Department of Environmental Quality, 2019. DEQ-7 Montana Numeric Water Quality Standards.
- 5 - Typically refers to primary settling basins, spoils basins, and/or solid waste basins or areas where former industrial operations occurred.
- 6 - NewFields, 2017, Addendum 6 to Remedial Investigation Work Plan, Geotechnical Stability Evaluation of the Clark for River Berm, November; and NewFields, 2018, Geotechnical Evaluation of the Clark Fork River Berm, Version 2, December.
- 7 - Using data from NewFields, 2022a we compared TEQ 0DL (1b criteria) and TEQ 1/2DL (3b criteria) results to the DEQ7 standard. Locations with TEQ > 2ppq are checkmarked accordingly in Table 12A-3.

References:

NewFields, 2020b. Groundwater Conceptual Site Model, Former Smurfit Stone/Frenchtown Mill Site Remedial Investigation, Missoula County, Montana. Version 3. June 26.

NewFields, 2021. Addendum 11 of the Remedial Investigation Work Plan, Smurfit-Stone/Frenchtown Mill, Missoula County, Montana. September 9. Version 3.

NewFields, 2022a. Annual Groundwater Data Summary Report. Former Smurfit Stone/Frenchtown Mill Site Remedial Investigation, Missoula County, Montana. Version 2. June 30.

Acronyms and Abbreviations:

- | | |
|---|---|
| LiDAR - Light detection and ranging | 1/2DL - TEQ calculated one half the detection limit for congener concentrations reported below detection limits |
| PCBs - polychlorinated biphenyls | VOCs - volatile organic compounds |
| SWB - solid waste basins | ug/L - micrograms per liter |
| TEQ - toxicity equivalence dioxins/furans | |

Table 12A-3. Groundwater Monitoring Summary - Quarter 2 2024																				
Addendum 12A of the Remedial Investigation Work Plan, Former Smurfit-Stone/Frenchtown Mill																				
April 2024																				
	Rationale: Confirm Nature and Extent of Contamination (Modified from Addendum 11)						Rationale: Investigate Potential for Mobilization of Groundwater Constituents			Rationale: Update Risk Assessments			Transducer Locations	FSP 12A: Monitoring Location	Proposed Analytes (Groundwater Monitoring)					
Well/Sample Identifier	1a. Background or Site Boundary	1b. D/F TEQ 0DL > MDEQ7 (2 ppq)	1c. Solid Waste Basins	1d. Aquifer Unit 3	1e. No previous temporal data	1f. Notable long term changes to ionic signature	2a. Potential Source Area ¹	2b. East to west groundwater flow	2c. Paleochannel Location	3a. Detectable Aroclors or is new monitoring well	3b. D/F TEQ 1/2DL > MDEQ7 (2 ppq)	3c. Total Cr > background or no Cr data			Field Parameters ¹¹	Metals ²	Common Ions ³	Dioxins/ Furans ⁴	VOCs ⁵	PCBs ⁶
Perched Zone																				
NFMW1s		X					X				X	X		X	X	X	X		X	
Aquifer Unit 1																				
ATMW6											X	X		X	X	X	X		X	
County MW	X							X					X ^{7,8}	X	X	X	X	X	X	
NFMW1d			X				X	X			X	X	X ⁸	X	X	X	X	X	X	
NFMW2			X			X	X			X	X		X	X	X	X	X	X	X	
NFMW3							X		X			X	X	X	X	X	X		X	
NFMW4							X	X			X	X		X	X	X	X		X	
NFMW5							X							X	X	X	X	X	X	
NFMW6							X							X	X	X	X		X	
NFMW7							X		X		X	X	X	X	X	X	X		X	
NFMW8							X		X			X		X	X	X	X		X	
NFMW9		X	X				X	X			X	X	X ⁸	X	X	X	X	X	X	
NFMW10			X				X				X	X		X	X	X	X	X	X	
NFMW11							X				X	X		X	X	X	X		X	
NFMW12																				
NFMW13							X							X	X	X	X	X	X	
NFMW14							X							X	X	X	X	X	X	
NFMW15							X	X		X	X	X		X	X	X	X		X	
NFMW16		X					X				X		X	X	X	X	X		X	
NFMW17																				
NFMW18																				
NFMW19							X		X			X		X	X	X	X		X	
NFMW20							X		X		X	X		X	X	X	X		X	
NFMW21																				
NFMW22	X										X	X		X	X	X	X		X	
NFMW23	X								X		X	X		X	X	X	X		X	
RE289											X			X	X	X	X		X	
SMW1	X													X	X	X	X		X	
SMW2																				
SMW3	X							X					X ⁸	X	X	X	X		X	
SMW4	X					X		X					X ⁸	X	X	X	X		X	
SMW5	X													X	X	X	X		X	
SMW6	X											X		X	X	X	X		X	
SMW7	X					X								X	X	X	X		X	
SMW8	X										X	X		X	X	X	X		X	
SMW9	X										X			X	X	X	X		X	
SMW10	X					X					X	X		X	X	X	X		X	
SMW11	X								X		X	X		X	X	X	X		X	
SMW12	X					X		X	X		X	X		X	X	X	X		X	
SMW13	X								X		X	X		X	X	X	X		X	
SMW14	X								X		X	X		X	X	X	X		X	
SMW15						X			X			X		X	X	X	X		X	
SMW16			X				X				X	X	X	X	X	X	X	X	X	
SMW17		X							X	X	X	X		X	X	X	X		X	
SMW18						X		X	X		X	X	X ⁸	X	X	X	X		X	
SMW19							X				X	X		X	X	X	X		X	
SMW20																				
TW2R	X								X		X	X		X	X	X	X		X	
TW5R	X							X				X	X ⁹	X	X	X	X		X	

Table 12A-3. Groundwater Monitoring Summary - Quarter 2 2024																				
Addendum 12A of the Remedial Investigation Work Plan, Former Smurfit-Stone/Frenchtown Mill																				
April 2024																				
Well/Sample Identifier	Rationale: Confirm Nature and Extent of Contamination (Modified from Addendum 11)						Rationale: Investigate Potential for Mobilization of Groundwater Constituents			Rationale: Update Risk Assessments			Transducer Locations	FSP 12A: Monitoring Location	Proposed Analytes (Groundwater Monitoring)					
	1a. Background or Site Boundary	1b. D/F TEQ 0DL > MDEQ7 (2 ppq)	1c. Solid Waste Basins	1d. Aquifer Unit 3	1e. No previous temporal data	1f. Notable long term changes to ionic signature	2a. Potential Source Area ¹	2b. East to west groundwater flow	2c. Paleochannel Location	3a. Detectable Aroclors or is new monitoring well	3b. D/F TEQ 1/2DL > MDEQ7 (2 ppq)	3c. Total Cr > background or no Cr data			Field Parameters ¹¹	Metals ²	Common Ions ³	Dioxins/ Furans ⁴	VOCs ⁵	PCBs ⁶
Aquifer Unit 1 (continued)																				
MW24					X		X			X		X		X	X	X	X	X	X	X
MW25					X		X	X		X		X	X ⁹	X	X	X	X	X	X	X
MW26					X		X			X		X		X	X	X	X	X	X	X
MW27					X		X	X		X		X		X	X	X	X	X	X	X
MW28					X		X	X		X		X		X	X	X	X	X	X	X
MW29					X				X	X		X		X	X	X	X	X		X
MW30					X				X	X		X		X	X	X	X	X		X
MW31					X				X	X		X		X	X	X	X	X		X
MW32					X			X	X	X		X	X ⁹	X	X	X	X	X		X
MW33					X				X	X		X		X	X	X	X	X		X
Aquifer Unit 3																				
WFBW	X			X								X		X	X	X	X	X	X	X
SMW16D				X									X	X	X	X	X	X		X
SMW17D				X							X			X	X	X	X	X		X
SMW18D				X							X		X	X	X	X	X	X		X
Log Chipper Well				X	X		X					X		X	X	X	X	X	X	X
CFR Locations																				
CFR1r													X ⁸							
CFR2													X ⁸							
OKI													X							
Total Natural Sample Locations	19	4	5	5	11	7	26	14	19	13	29	41	19	58	58	58	58	58	16	58
Quality Control Samples																				
Replicates (Groundwater)															3	3	3	3	1	3
Equipment Rinse Blanks (Groundwater)															3	3	3	3	1	3
Field Blank															1	1	1	1	1	1
Total Samples															65	65	65	65	19	65

Notes:

X	Monitoring as designated in Amendment A to RIWP Addendum 11 (NewFields, 2023)
X	New monitoring rationale, location, or analyte added since RIWP Addendum 11A
SMWI	[Background well sampling locations are in italics]
grey font	These locations were evaluated but did not meet any criteria for sampling, or met only one minor criterion which did not justify additional investigation.

Cr - chromium, CFR - Clark Fork River, D/F - dioxins/furans; FSP - Field Sampling Plan; N/A - not applicable; PCBs - polychlorinated biphenyls; ppq - parts per quadrillion; S - sulfur; TEQ - toxicity equivalence; TOC - total organic carbon; WL - water level; TEQ 1/2DL calculated one half the detection limit for congener concentrations reported below detection limits; TEQ 0DL calculated by substituting 0 for detection limit for congener concentrations reported below detection limits

- 1 - Typically refers to investigation locations downgradient from primary settling basins, spoils basins, solid waste basins, or areas where former industrial operations occurred.
- 2 - Total and Dissolved Metals (Al, As, Ba, Cd, Cr, Co, Cu, Fe, Pb, Mn, Ni, Ag, Tl,V, Zn) by EPA Method 6020, Hg by EPA Method 7470/7471, Cr (VI) by EPA Method 7199, and Ca, Mg, K, and Na (Method 6010)
- 3 - Common ions include; Nitrate and Nitrite (Method 353.2); Total Phosphorus (Method SM4500-H-2011); TOC (Method SM 5310C); Sulfate, Chloride, and Fluoride (Method 300.0); Total Dissolved Solids (Method SM 2540-C); pH (Method SM 4500-H+B); Alkalinity (Total, Bicarbonate, Carbonate) (Method SM 2320B)
- 4 - Dioxins/Furans (D/F) by EPA Method 8290
- 5 - VOCs - Volatile Organic Compounds by EPA Method 8260
- 6 - PCBs - Polychlorinated Biphenyls by EPA Method 8082 (Aroclors) and 1668 (209 congeners)
- 7 - CountyMW transducer monitored by Missoula County; data to be shared with GSI upon request; proposed transducer upgrade assumes permission is granted by Missoula County
- 8 - Existing transducer location; conductivity probe will be installed
- 9 - New transducer location; conductivity probe will be installed
- 10 - NFMW18 is not proposed for sampling because it only triggers one criterium (3a). Groundwater concentrations of iron, sodium potassium and sulfate at this location correlate with fluctuations in water level.
- 11 - Field Parameters include: pH, specific conductance, temperature, dissolved oxygen and oxidation/reduction potential (ORP).

References:

MDEQ7 = Montana Department of Environmental Quality, 2019. DEQ-7 Montana Numeric Water Quality Standards.

NewFields, 2023. Amendment A to Addendum 11 of the Remedial Investigation Work Plan, Smurfit-Stone/Frenchtown Mill, Missoula County, Montana. September 8.

Table 12A-4. Soil Sampling Summary - Quarter 2 2024										
Addendum 12A of the Remedial Investigation Work Plan, Former Smurfit-Stone Frenchtown Mill										
April 2024										
	Samples from this well represent soils interacting with groundwater within or downgradient from:			Proposed Analytes						
Location (Proposed)	Background	Potential Source Area	Paleochannel	Metals ¹	Dioxins/ Furans ²	VOCs ³	PCBs ⁴	Grain Size ⁵	Total S ⁶ , TOC ⁷	Mineralogy ⁸
Proposed New Monitoring Wells										
MW24		X		3	3	3	3	3	3	3
MW25		X		3	3	3	3	3	3	3
MW26		X		3	3	3	3	3	3	3
MW27		X		3	3	3	3	3	3	3
MW28		X		3	3	3	3	3	3	3
MW29			X	3	3		3	3	3	3
MW30			X	3	3		3	3	3	3
MW31			X	3	3		3	3	3	3
MW32			X	3	3		3	3	3	3
MW33			X	3	3		3	3	3	3
Quality Control Samples										
Replicates (Soil)				2	2	1	2		2	
Equipment Rinse Blanks ⁹				2	2	1	2		2	
Field Blanks				1	1	1	1		1	
Total (Proposed)	N/A	5	5	35	35	18	35	30	35	30

X - Monitoring rationale for establishing new well location; see Tables 12A-1 and 12A-2 for details

3 - Three samples analyzed; samples typically taken from 1-foot intervals within the saturated zone, the unsaturated zone, and the intermittently saturated zone

Notes:

- 1 - Metals (Al, As, Ba, Cd, Cr, Co, Cu, Fe, Pb, Mn, Ni, Ag, Ti, V, Zn) by EPA Method 6020, Hg by EPA method 7040/7041, Cr(VI) by EPA Method 7199, Ca, Mg, K, and Na by EPA Method 6010

2- Toxicity equivalence dioxins and furans by EPA method 8290

3 - Volatile organic compounds by EPA Method 8260

4 - PCBs - Polychlorinated biphenyls by EPA Method 8082 (Aroclors) and 1668 (209 congeners)

5 - Grain size analysis per ASTM D422
- 6 - Total sulfur by EPA Method 6010

7 - Total organic carbon by EPA Method 9060

8 - X-ray Diffraction (XRD) followed by other methods if needed.

9 - Soil equipment blanks performed with water matrix.

Table 12A-5. Groundwater Bottle Counts, Preservatives, and Holding Times by Location
Addendum 12A of the Remedial Investigation Work Plan, Former Smurfit-Stone/Frenchtown Mill
April 2024

Sample Identifier	Metals				Common Ions				Dioxins/Furans			Volatile Organic Compounds			Polychlorinated Biphenyls																		
	Number of Bottles	Bottle Type and Preservation		Hold Time	Number of Bottles	Bottle Type and Preservation			Hold Time	Number of Bottles	Bottle Type and Preservation	Hold Time	Number of Bottles	Bottle Type and Preservation	Hold Time	Number of Bottles	Bottle Type and Preservation		Hold Time														
		Metals by EPA Methods 6020, 6010 & 7470/7471	Hexavalent Chromium (Cr6+)			NO ₃ /NO ₂ & Phosphate	Fl, SO ₄ ,Cl, pH, Alkalinity, TDS	TOC									PCB Congeners	PCB Aroclors															
Perched Zone																																	
NFMW1s	3	Same as below	Same as below	Same as below	4	Same as below	Same as below	Same as below	Same as below	2	Same as below	Same as below				4	Same as below	Same as below	Same as below														
Aquifer Unit 1 Wells																																	
ATMW6	3	2 x 250-mL HDPE bottles	1 x 125-mL HDPP tube	All analytes 6 months except mercury (28 days) and chromium (VI) (24 hours).	4	1 x 250-mL HDPE bottle	1 x 250-mL HDPE bottle and 1 x 1-L HDPE bottle	1 x 250-mL amber glass bottle	All analytes 28 days except TDS (7 days).	2	2 x 1-liter amber glass bottles	Store at 6°C or lower, in the dark. Extract within 30 days and analyze within 45 days of extraction. Analyze within 1 year if sample extracts stored in the dark at < -10°C.			4	2 x 1-liter amber glass bottles	2 x 100-mL amber glass bottles	Extract within 1 year of sample collection. Analyze within 40 days of extraction.															
RE289	3				4					2					4																		
County MW	3				4					2			3	3 x 40-mL VOA Vial Cool to <6°C; HCl to pH<2; Na ₂ S ₂ O ₃ if Cl present	14 days				4														
NFMW1d	3				4					2			3						4														
NFMW2	3				4					2			3						4														
NFMW3	3				4					2									4														
NFMW4	3				4					2									4														
NFMW5	3				4					2			3	3 x 40-mL VOA Vial Cool to <6°C; HCl to pH<2; Na ₂ S ₂ O ₃ if Cl present	14 days				4														
NFMW6	3				4					2									4														
NFMW7	3				4					2									4														
NFMW8	3				4					2									4														
NFMW9	3				4					2			3	3 x 40-mL VOA Vial Cool to <6°C; HCl to pH<2; Na ₂ S ₂ O ₃ if Cl present	14 days				4														
NFMW10	3				4					2			3						4														
NFMW11	3				4					2									4														
NFMW13	3				4					2			3	3 x 40-mL VOA Vial Cool to <6°C; HCl to pH<2; Na ₂ S ₂ O ₃ if Cl present	14 days				4														
NFMW14	3				4					2			3						4														
NFMW15	3				Cool to <6°C; nitric acid to pH < 2					Cool to <4°C; buffer solution ¹ to pH 9-9.5									4	Cool to <4°C; sulfuric acid to pH <2	Cool to 4°C	Cool to <4°C; HCl to pH < 2		2	Cool to <6°C; sodium thiosulfate (Na ₂ S ₂ O ₃)				4	Cool to <6°C but above freezing	Cool to <6°C but above freezing		
NFMW16	3																		4					2									4
NFMW19	3																		4					2									4
NFMW20	3																		4					2									4
NFMW22	3	4	2				4																										
NFMW23	3	4	2				4																										
SMW1	3	4	2				4																										
SMW3	3	4	2				4																										
SMW4	3	4	2				4																										
SMW5	3	4	2				4																										
SMW6	3	4	2				4																										
SMW7	3	4	2				4																										
SMW8	3	4	2				4																										
SMW9	3	4	2				4																										
SMW10	3	4	2				4																										
SMW11	3	4	2				4																										
SMW12	3	4	2				4																										
SMW13	3	4	2				4																										
SMW14	3	4	2				4																										
SMW15	3	4	2				4																										

Table 12A-5. Groundwater Bottle Counts, Preservatives, and Holding Times by Location
Addendum 12A of the Remedial Investigation Work Plan, Former Smurfit-Stone/Frenchtown Mill
April 2024

Sample Identifier	Metals				Common Ions				Dioxins/Furans			Volatile Organic Compounds			Polychlorinated Biphenyls								
	Number of Bottles	Bottle Type and Preservation		Hold Time	Number of Bottles	Bottle Type and Preservation			Hold Time	Number of Bottles	Bottle Type and Preservation	Hold Time	Number of Bottles	Bottle Type and Preservation	Hold Time	Number of Bottles	Bottle Type and Preservation		Hold Time				
		Metals by EPA Methods 6020, 6010 & 7470/7471	Hexavalent Chromium (VI)			NO ₃ /NO ₂ & Phosphate	Fl, SO ₄ ,Cl, pH, Alkalinity, TDS	TOC									PCB Congeners	PCB Aroclors					
Aquifer Unit 1 Wells (continued)																							
SMW16	3	2 x 250-mL HDPE bottles	1 x 125-mL HDPP tube	All analytes 6 months except mercury (28 days) and chromium (VI) (24 hours).	4	1 x 250-mL HDPE bottle	1 x 250-mL HDPE bottle and 1 x 1-L HDPE bottle	1 x 250-mL amber glass bottle	All analytes 28 days except TDS (7 days).	2	2 x 1-liter amber glass bottles	Store at 6°C or lower, in the dark. Extract within 30 days, analyze within 45 days of extraction. Analyze within 1 year if sample extracts stored in dark < -10°C.	3	3 x 40-mL VOA Vial Cool to <6°C; HCl to pH<2; Na ₂ S ₂ O ₃ if Cl present	14 days	4	2 x 1-liter amber glass bottles	2 x 100-mL amber glass bottles	Extract within 1 year of sample collection. Analyze within 40 days of extraction.				
SMW17	3				4					2				4									
SMW18	3				4					2				4									
SMW19	3				4					2				4									
TW2R	3				4					2				4									
TW5R	3				4					2				4									
MW24	3				4					Cool to <40°C; sulfuric acid to pH <2			2	Cool to <6°C; sodium thiosulfate (Na ₂ S ₂ O ₃)	14 days	3				3 x 40-mL VOA Vial Cool to <6°C; HCl to pH<2; Na ₂ S ₂ O ₃ if Cl present	4	Cool to <60°C but above freezing	Cool to <60°C but above freezing
MW25	3				4								3			4							
MW26	3				4								3			4							
MW27	3				4								3			4							
MW28	3				4								3			4							
MW29	3				4											4							
MW30	3				4											4							
MW31	3				4											4							
MW32	3				4											4							
MW33	3				4											4							
Aquifer Unit 3 Wells																							
WFBW	3	2 x 250-mL HDPE bottles	1 x 125-mL HDPP tube;	All analytes 6 months except mercury (28 days) and chromium (VI) (24 hrs)	4	1 x 250-mL HDPE bottle;	1 x 250-mL HDPE bottle and 1x1-L mL HDPE bottle	1 x 250-mL amber glass; Cool <4°C; HCl to pH < 2	All analytes 28 days except TDS (7 days).	2	2 x 1-liter amber glass bottle; Cool to <6°C; sodium thiosulfate (Na ₂ S ₂ O ₃)	Same as above				4	2 x 1-liter amber glass bottle; Cool to <6°C but above freezing	2 x 1-liter amber glass bottle; Cool to <6°C but above freezing	Extract within 1 year of sample collection. Analyze within 40 days of extraction.				
SMW16D	3				4					2						4							
SMW17D	3				4					2						4							
SMW18D	3				4					2						4							
Log Chipper Well	3				4					2						4							

Bold - new proposed monitoring well
Analyte not proposed for analysis at well location.

Notes:
°C - degrees Celsius; mL - milliliter; TDS - total dissolved solids; HDPE - high density polyethylene; HDPP - high density polypropylene; HCl - hydrochloric acid; VOA - Volatile Organic Analysis; Fl - fluoride; Cl- chloride; SO₄ - sulfate; NO₃ - nitrate; NO₂ - nitrite; TOC - total organic carbon
See Table 12A-7 for full analyte lists. Note that bottle counts do not include Quality Assurance/Quality Control (QA/QC) samples.
I - Buffer solution consists of ammonium sulfate, ammonium hydroxide, and reagent water.

Table 12A-6. Soil Bottle Counts, Preservatives, and Holding Times by Location																									
Addendum 12A of the Remedial Investigation Work Plan, Former Smurfit-Stone/Frenchtown Mill																									
April 2024																									
Sample Identifier	Metals				Miscellaneous Analytes			Dioxins/Furans			Mineralogy			Volatile Organic Compounds			Polychlorinated Biphenyls								
	Number of Containers	Container and Preservation		Hold Time	Number of Containers	Container and Preservation		Hold Time	Number of Containers	Container and Preservation	Hold Time	Number of Containers	Container and Preservation	Hold Time	Number of Containers	Container and Preservation	Hold Time	Number of Containers	Container and Preservation		Hold Time				
		Metals by EPA Methods 6020, 6010, 7470/7471	hexavalent Chromium (VI)			TOC, Total Sulfur	Grain Size												PCB Congeners	PCB Aroclors					
New Monitoring Wells																									
MW24	6	1 x 8-oz clear glass jar; Cool to <6°C	1 x 8-oz clear glass jar; Cool to <6°C	All analytes 6 months except mercury (28 days) and chromium (VI) (30 days to extract, 7 to analyze).	6	1 x 8-oz clear glass jar; Cool to <6°C	1 x 4-oz clear glass jar; Cool to <6°C	TOC = 14 days or 6 months if frozen (-18°C; Grain size = 6 months	3	1 x 4-oz amber glass jar (at least 10 grams) Cool to <6°C	Store at <6°C, in the dark. Extract within 30 days and analyze within 45 days of extraction. Analyze within 1 year if sample extracts stored in the dark at <-10°C.	3	1 x 4-oz clear glass jar (at least 30 grams)	None	6	2 x TerraCore kit; 2oz WM plus Plunger; 1 x 40 mL amber VOA Vial; Methanol, cool to 6°C	14 days	6	1 x 4-oz amber glass jar	1 x 4-oz amber glass jar (at least 10 grams)	Extract within 1 year of sample collection. Analyze within 40 days of extraction.				
MW25	6				6				3			3			6										
MW26	6				6				3			3			6										
MW27	6				6				3			3			6										
MW28	6				6				3			3			6										
MW29	6				6				3			3			6										
MW30	6								Cool to <6°C but above freezing							Cool to <6°C but above freezing									6
MW31	6																								6
MW32	6																								6
MW33	6																								6

Bold - new proposed monitoring well

Analyte not proposed for analysis at well location.

Notes:

Each soil sample will be sampled at 3 depths: samples typically taken from 1-foot intervals within the saturated zone, the unsaturated zone, and the intermittently saturated zone

See Table 12A-7 for full analyte lists. Note that bottle counts do not include Quality Assurance/Quality Control (QA/QC) samples.

Acronyms and Abbreviations:

°C - degrees Celsius; mL - milliliter; oz - ounce; HDPE - high density polyethylene; VOA - Volatile Organic Analysis; TOC - total organic carbon

Table 12A-7. Analytes										
Addendum 12A of the Remedial Investigation Work Plan, Former Smurfit-Stone/Frenchtown Mill										
April 2024										
Extraction Method for Soil/Sediment	Analytical Method(s) for Water	Target Analyte	CAS	Water				Soil/Sediment		
				Target Laboratory Reporting Limit	RBC ¹	DEQ-7 Water Quality Standard ²	Units	Target Laboratory Reporting Limit	RBC ¹	Units
Dioxins / Furans										
EPA 8290 High Resolution	EPA 8290 High Resolution	2,3,7,8-TCDD	1746-01-6	1.07	--	--	pg/L	0.5	---	ng/kg
		1,2,3,7,8-PeCDD	40321-76-4	1.74	--	--	pg/L	2.5	---	ng/kg
		1,2,3,6,7,8-HxCDD	57653-85-7	2.54	--	--	pg/L	2.5	---	ng/kg
		1,2,3,4,7,8-HxCDD	39227-28-6	2.99	--	--	pg/L	2.5	---	ng/kg
		1,2,3,7,8,9-HxCDD	19408-74-3	2.99	--	--	pg/L	2.5	---	ng/kg
		1,2,3,4,6,7,8-HpCDD	35822-46-9	3.72	--	--	pg/L	2.5	---	ng/kg
		OCDD	3268-87-9	4.83	--	--	pg/L	5	---	ng/kg
		2,3,7,8-TCDF	51207-31-9	0.91	--	--	pg/L	0.5	---	ng/kg
		1,2,3,7,8-PeCDF	57117-41-6	1.1	--	--	pg/L	2.5	---	ng/kg
		2,3,4,7,8-PeCDF	57117-31-4	0.97	--	--	pg/L	2.5	---	ng/kg
		1,2,3,6,7,8-HxCDF	57117-44-9	1.21	--	--	pg/L	2.5	---	ng/kg
		1,2,3,7,8,9-HxCDF	72918-21-9	1.24	--	--	pg/L	2.5	---	ng/kg
		1,2,3,4,7,8-HxCDF	70648-26-9	1.33	--	--	pg/L	2.5	---	ng/kg
		2,3,4,6,7,8-HxCDF	60851-34-5	2.08	--	--	pg/L	2.5	---	ng/kg
		1,2,3,4,6,7,8-HpCDF	67562-39-4	1.52	--	--	pg/L	2.5	---	ng/kg
1,2,3,4,7,8,9-HpCDF	55673-89-7	2.55	--	--	pg/L	2.5	---	ng/kg		
OCDF	39001-02-0	6.85	--	--	pg/L	5	---	ng/kg		
WHO 2005 TEF Calculation	WHO 2005 TEF Calculation	TEQ	--	--	0.12 ³	2	pg/L	--	4.8	ng/kg
Target Analyte List Metals										
EPA 6020 (ICP-MS)	EPA 6020 (ICP-MS)	Aluminum	7429-90-5	20	2000	--	µg/L	10	7700	mg/kg
		Arsenic	7440-38-2	0.5	0.052	10	µg/L	0.2	0.68	mg/kg
		Barium	7440-39-3	0.3	380	1000	µg/L	0.5	1500	mg/kg
		Cadmium	7440-43-9	0.08	0.92	5	µg/L	0.2	7.1	mg/kg
		Chromium	7440-47-3	0.5	0.035	100	µg/L	1	0.3	mg/kg
		Cobalt	7440-48-4	0.5	0.6	--	µg/L	0.2	2.3	mg/kg
		Copper	7440-50-8	1	80	1300	µg/L	1	310	mg/kg
		Iron	7439-89-6	50	1400	--	µg/L	10	5500	mg/kg
		Lead	7439-92-1	0.1	15	15	µg/L	0.4	400	mg/kg
		Manganese	7439-96-5	0.5	43	--	µg/L	0.5	180	mg/kg
		Nickel	7440-02-0	0.5	39	100	µg/L	0.5	150	mg/kg
		Silver	7440-22-4	0.5	9.4	100	µg/L	0.1	39	mg/kg
		Thallium	7440-28-0	0.1	0.02	2	µg/L	0.4	0.078	mg/kg
		Vanadium	7440-62-2	1	8.6	--	µg/L	0.5	39	mg/kg
		Zinc	7440-66-6	5	600	2000	µg/L	5	2300	mg/kg
EPA Method 3060	EPA Method 7199	Chromium (VI)	18540-29-9	0.5	0.035	100	µg/L	2	0.3	mg/kg
EPA 7470/7471 (CVAA)	EPA 7470/7471 (CVAA)	Mercury	7439-97-6	0.2	0.57	2	µg/L	0.04	2.3	mg/kg
Polychlorinated Biphenyls (PCBs)										
EPA Method 8082A	EPA Method 8082A	Aroclor-1016	12674-11-2	0.1	0.14	--	µg/L	0.033	0.41	mg/kg
		Aroclor-1221	11104-28-2	0.1	0.0047	--	µg/L	0.033	0.2	mg/kg
		Aroclor-1232	11141-16-5	0.1	0.0047	--	µg/L	0.033	0.17	mg/kg
		Aroclor-1242	53469-21-9	0.1	0.0078	--	µg/L	0.033	0.23	mg/kg
		Aroclor-1248	12672-29-6	0.1	0.0078	--	µg/L	0.033	0.23	mg/kg
		Aroclor-1254	11097-69-1	0.1	0.0078	--	µg/L	0.033	0.12	mg/kg
		Aroclor-1260	11096-82-5	0.1	0.0078	--	µg/L	0.033	0.24	mg/kg
		Aroclor-1262	37324-23-5	0.1	--	--	µg/L	0.033	---	mg/kg
		Aroclor-1268	11100-14-4	0.1	--	--	µg/L	0.033	---	mg/kg
EPA Method 1668 ⁴	EPA Method 1668 ⁴	PCB-I through PCB-209	--	5 ⁵	--	pg/L	2.5-7.5	---	ng/kg	
Calculation ⁴	Calculation ⁴	Total PCBs	--	--	--	0.5	µg/L	---	---	mg/kg
Volatile Organic Compounds (VOCs)										
EPA Method 8260	EPA Method 8260	1,1,1,2-Tetrachloroethane	630-20-6	1	0.57	2.0	µg/L	0.0025	---	mg/kg
		1,1,1-Trichloroethane	71-55-6	1	800	200	µg/L	0.0025	---	mg/kg
		1,1,2,2-Tetrachloroethane	79-34-5	1	0.076	--	µg/L	0.0025	---	mg/kg
		1,1,2-Trichloroethane	79-00-5	1	0.041	3	µg/L	0.0025	---	mg/kg
		1,1,2-Trichlorotrifluoroethane	76-13-1	1	0.33	--	µg/L	0.0025	---	mg/kg
		1,1-Dichloroethane	75-34-3	1	2.8	--	µg/L	0.0025	---	mg/kg
		1,1-Dichloroethene	75-35-4	1	28	7	µg/L	0.0025	---	mg/kg
		1,1-Dichloropropene	563-58-6	1	--	--	µg/L	0.0025	---	mg/kg
		1,2,3-Trichlorobenzene	87-61-6	1	0.7	--	µg/L	0.0125	---	mg/kg
		1,2,3-Trichloropropane	96-18-4	4	0.00075	--	µg/L	0.0125	---	mg/kg
		1,2,4-Trichlorobenzene	120-82-1	1	0.4	70	µg/L	0.0125	---	mg/kg
		1,2,4-Trimethylbenzene	95-63-6	1	5.6	--	µg/L	0.005	---	mg/kg
		1,2-Dibromo-3-chloropropane	96-12-8	4	0.00033	0.2	µg/L	0.025	---	mg/kg
		1,2-Dibromoethane (EDB)	106-93-4	1	0.0075	0.017	µg/L	0.0025	---	mg/kg
		1,2-Dichlorobenzene	95-50-1	1	30	600	µg/L	0.005	---	mg/kg
		1,2-Dichloroethane	107-06-2	1	0.17	4	µg/L	0.0025	---	mg/kg
		cis-1,2-Dichloroethene	156-59-2	1	--	--	µg/L	0.0025	---	mg/kg
		trans-1,2-Dichloroethene	156-60-5	1	--	--	µg/L	0.005	---	mg/kg
		1,2-Dichloropropane	78-87-5	4	0.82	5	µg/L	0.005	---	mg/kg
		1,3,5-Trimethylbenzene	108-67-8	1	6	--	µg/L	0.005	---	mg/kg
		1,3-Dichlorobenzene	541-73-1	1	--	600	µg/L	0.005	---	mg/kg
		1,3-Dichloropropane	142-28-9	1	37	--	µg/L	0.005	---	mg/kg
		1,4-Dichlorobenzene	106-46-7	1	0.48	75	µg/L	0.005	---	mg/kg
		2,2-Dichloropropane	594-20-7	4	--	--	µg/L	0.0025	---	mg/kg
		2-Butanone (MEK)	78-93-3	5	--	--	µg/L	0.1	---	mg/kg
		2-Chlorotoluene	95-49-8	1	0.22	--	µg/L	0.0025	---	mg/kg
		4-Chlorotoluene	106-43-4	1	--	--	µg/L	0.005	---	mg/kg
		4-Methyl-2-pentanone (MIBK)	108-10-1	5	0.88	--	µg/L	0.025	---	mg/kg
		Acetone	67-64-1	20	1400	--	µg/L	0.05	---	mg/kg
		Allyl chloride	107-05-1	4	0.21	--	µg/L	0.0125	---	mg/kg
		Benzene	71-43-2	1	0.46	5	µg/L	0.001	---	mg/kg
		Bromobenzene	108-86-1	1	6.2	--	µg/L	0.0125	---	mg/kg
		Bromochloromethane	74-97-5	1	8.3	--	µg/L	0.0025	---	mg/kg
		Bromodichloromethane	75-27-4	1	--	10	µg/L	0.0025	---	mg/kg
		Bromoform	75-25-2	4	3.3	80	µg/L	0.025	---	mg/kg
		Bromomethane	74-83-9	4	0.75	10	µg/L	0.0125	---	mg/kg
		Carbon tetrachloride	56-23-5	1	0.46	3	µg/L	0.005	---	mg/kg
		Chlorobenzene	108-90-7	1	7.8	100	µg/L	0.0025	---	mg/kg
		Chloroethane	75-00-3	1	2100	--	µg/L	0.005	---	mg/kg
		Chloroform	67-66-3	1	0.22	70	µg/L	0.0025	---	mg/kg
		Chloromethane	74-87-3	4	19	600	µg/L	0.0125	---	mg/kg
		Dibromochloromethane	124-48-1	1	0.87	8	µg/L	0.0025	---	mg/kg
		Dibromomethane	74-95-3	4	--	--	µg/L	0.005	---	mg/kg
		Dichlorodifluoromethane	75-71-8	1	20	1000	µg/L	0.005	---	mg/kg
		Dichlorofluoromethane	75-43-4	1	--	--	µg/L	0.0025	---	mg/kg
		Diethyl ether (Ethyl ether)	60-29-7	4	390	--	µg/L	0.0025	---	mg/kg
		Ethylbenzene	100-41-4	1	1.5	700	µg/L	0.0025	---	mg/kg
		Hexachloro-1,3-butadiene	87-68-3	1	0.14	5	µg/L	0.025	---	mg/kg
		Isopropylbenzene (Cumene)	98-82-8	1	45	--	µg/L	0.0025	---	mg/kg
		Methyl-tert-butyl ether	1634-04-4	1	14	30	µg/L	0.001	---	mg/kg
Methylene Chloride	75-09-2	4	11	5	µg/L	0.025	---	mg/kg		
Naphthalene	91-20-3	4	0.12	100	µg/L	0.0125	---	mg/kg		
Styrene	100-42-5	1	120	100	µg/L	0.0125	---	mg/kg		
Tetrachloroethene	127-18-4	1	4.1	5	µg/L	0.0025	---	mg/kg		
Tetrahydrofuran	109-99-9	10	340	--	µg/L	0.0125	---	mg/kg		
Toluene	108-88-3	1	110	1000	µg/L	0.005	---	mg/kg		
Trichloroethene	79-01-6	0.4	0.28	5	µg/L	0.001	---	mg/kg		
Trichlorofluoromethane	75-69-4	1	520	2000	µg/L	0.0025	---	mg/kg		
Vinyl chloride	75-01-4	0.2	0.019	0.2	µg/L	0.0025	---	mg/kg		
Xylene (Total)	1330-20-7	3	--	10000	µg/L	0.0065	---	mg/kg		

Table 12A-7. Analytes										
Addendum 12A of the Remedial Investigation Work Plan, Former Smurfit-Stone/Frenchtown Mill										
April 2024										
Extraction Method for Soil/Sediment	Analytical Method(s) for Water	Target Analyte	CAS	Water				Soil/Sediment		
				Target Laboratory Reporting Limit	RBC ¹	DEQ-7 Water Quality Standard ²	Units	Target Laboratory Reporting Limit	RBC ¹	Units
VOC's Continued										
EPA Method 8260	EPA Method 8260	cis-1,2-Dichloroethene	156-59-2	1	3.6	70	µg/L	0.0025	---	mg/kg
		m-Xylene (coelute)	108-38-3	2	--	--	µg/L	0.004	---	mg/kg
		p-Xylene	106-42-3	2	--	--	µg/L	0.004	---	mg/kg
		n-Butylbenzene	104-51-8	1	--	--	µg/L	0.0125	---	mg/kg
		n-Propylbenzene	103-65-1	1	--	--	µg/L	0.005	---	mg/kg
		o-Xylene	95-47-6	1	19	--	µg/L	0.0025	---	mg/kg
		p-Isopropyltoluene	99-87-6	1	--	--	µg/L	0.005	---	mg/kg
		sec-Butylbenzene	135-98-8	1	--	--	µg/L	0.0125	---	mg/kg
		tert-Butylbenzene	98-06-6	1	--	--	µg/L	0.005	---	mg/kg
		trans-1,3-Dichloropropene	10061-02-6	4	--	2	µg/L	0.005	---	mg/kg
trans-1,2-Dichloroethene	156-60-5	1	6.8	100	µg/L	0.005	---	mg/kg		
Common Ions										
EPA 6010 (ICP-AES)	EPA 6020 (ICP-AES)	Calcium	7440-70-2	500	440000	--	µg/L	100	---	mg/kg
		Magnesium	7439-95-4	500	130000	--	µg/L	100	---	mg/kg
		Potassium	7440-09-7	2500	1900000	--	µg/L	100	---	mg/kg
		Sodium	7440-23-5	1000	560000	--	µg/L	100	---	mg/kg
CSA06V	---	Total Sulfur	7704-34-9	---	---	---	mg/L	0.05	---	%
---	EPA 300.0	Chloride	16887-00-6	1.2	310	--	mg/L	20	---	mg/kg
Fluoride		7782-41-4	0.05	350	4	mg/L	2	---	mg/kg	
Sulfate		18785-72-3	1.2	--	--	mg/L	50	---	mg/kg	
SM 4500-P B/E(M)	SM-4500P-H-201 I or EPA 365.4	Total Phosphorus	7723-14-0	0.01	130000	--	mg/L	2	---	mg/kg
---	EPA 353.2	Nitrate+Nitrite	NO3+NO2	0.1	10	--	mg/L	---	---	---
SM 9056	---	Nitrate	14797-55-8	---	--	--	---	10	---	mg/kg
	---	Nitrite	14797-65-0	---	--	--	---	10	---	mg/kg
---	SM 2320B	Alkalinity	ALK	5	--	--	mg/L	---	---	---
SW846 9045	SM 4500-H+B	pH	PH	0.01	--	--	s.u.	0.01	---	s.u.
---	SM 2540C	Total Dissolved Solids	TDS	10	--	--	mg/L	---	---	---
SM 2540 G-201 I	---	Total Solids	SOLIDS	---	--	--	---	0.1	---	%
ASTM D422	---	Grain Size Analysis	---	---	--	--	---	---	---	mg/kg
EPA 9060A	EPA Method 9060; SM 5310C	Organic Carbon, Total (TOC)	TOC	1	--	---	mg/L	10	---	mg/kg

Notes:

Target Reporting Limits are from Pace Analytical and Enthalpy Analytical Laboratories. SGS will analyze all FSP 12A samples. Equivalent target reporting limits were requested.

-- :not available or not applicable

1 - RBCs from Final Human Health Risk Assessment, Operable Unit 3, Soil from Table 3-16, Water from Table 3-17 (EPA, 2022).

2 - Human Health Standard for groundwater in DEQ-7 Montana Numeric Water Quality Standards.

3 - RBC for TEQ 1/2DL (1/2 DL = TEQ calculated substituting one half the detection limit for congener concentrations reported below detection limits)

4 - All 209 PCB congeners (PCB-1 through PCB-209) will be analyzed by EPA method 1668. In some cases, PCB congener results are reported as coelutions of two or more congeners (when more than one graphical peak is visible). The "Total PCB Congeners" value for a sample is calculated regardless of the number of reported congeners or coeluting pairs.

5 - The number of coeluted congeners can effect laboratory reporting limits. In general, each additional coeluted congener may add 5 pg/L to the reporting limit listed in this table (i.e. the reporting limit for PCB-106/118 could be 10 pg/L).

Acronyms and Abbreviations:			
RBC - Risk-Based Concentration	TEQ - toxicity equivalence	pCi/L - picocuries per liter	
AES - atomic emission spectroscopy	mg/kg - milligrams per kilogram	% - percent	
CAS - Chemical Abstracts Service	mg/L - milligrams per liter		
CVAA - Cold Vapor Atomic Absorption	MS - mass spectroscopy		
ICP - inductively coupled plasma	pg/L - picograms per liter		
EPA - United State Environmental Protection Agency			

References:

EPA. (2022). Final Human Health Risk Assessment for the Smurfit-Stone/Frenchtown Mill Operable Unit 3 Site located in Missoula County, Montana.

Montana DEQ, Water Quality Division, Water Quality Planning Bureau, Water Quality Standards and Modeling Section. (2019). DEQ-7 Montana Numeric Water Quality Standards. Helena, MT: Montana Dept. of Environmental Quality.

ATTACHMENT 1

Standard Operating Procedures

STANDARD OPERATING PROCEDURES TABLE OF CONTENTS	
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SOP-I

FIELD RECORDS AND FIELD SAMPLING FORMS

Field investigation and sampling information should be recorded on appropriate paper or digital sampling forms, with supplemental notes recorded in a field log book as needed, to provide a continual record of actions taken each day on the site. Examples of situations where use of a field log book is appropriate include: as a backup option in case of technological difficulties, use by additional team member(s) when fewer electronic field tablets than people are available, and/or to record additional details not typically included in the digital field forms. If a field log book is used, all relevant details from the log book shall be transferred onto official project forms prior to completion of the field project, and/or notes shall be scanned and filed as part of the project record to be incorporated into final reports, as appropriate.

Electronic field forms are accessed on a field tablet or smart phone through QNOPY, a secure external field data entry application. GSI employees have unique logins to access the QNOPY application on a computer, tablet, or smart phone. Each field team is responsible for completing a record of the day's activities in sufficient detail such that someone can reconstruct the field activities without relying on the memory of the field crew. At a minimum, entries on the field log shall include:

- Project and client name
- Purpose of the field effort
- Names of field crew leader and team members present on the site, and other site visitors
- Description of site conditions and any unusual circumstances, including weather conditions
- Details of actual work effort, particularly any deviations from the field work plan or standard operating procedures
- Location of sample site, including map reference, if relevant
- Field observations
- Field measurements made (e.g., PID readings, pH, temperature, water levels, field parameters) on appropriate forms
- Date and time of initiation and cessation of work

Specific details for each sample collected should be recorded using GSI standardized paper field forms or electronic field forms. Electronic field forms have been developed by GSI within the QNOPY software application and were designed to have an identical format and contain the same information as the standard paper forms. Electronic field forms utilized by GSI include daily field reports, electronic photograph logs, site inspection forms, groundwater sampling forms, equipment calibration forms, well development forms, water level measurement forms, and other specific forms developed for specific project objectives. Electronic field forms contain either text, numerical, or drop-down menu fields, some of which can be programmed for a specific routine sampling program to reduce typographical errors and increase consistency. Certain fields of the electronic forms are automatically recorded by the QNOPY application and field tablet including a date/time stamp as well as GPS coordinates

Purpose

Provide guidance on how to document activities completed in the field.

Goal and Objective

To provide a record of project work and decisions made in the field.

Equipment Needs

Indelible Ink Pen
Field Log Book
Field Sampling Forms
Field Tablet + Charger
QNOPY Application

of any photographs collected within the application.

Field forms, both paper and digital, contain blank queries to be filled in by field personnel. Items typically recorded on field sampling forms include the following:

- Sample location and attributes (e.g., well completion information)
- Photos of sample location and/or sample media (if applicable)
- Water levels (static and during purging)
- Sampling method, particularly any deviations from standard operating procedures
- Water quality parameters (during purging and prior to sample collection)
- Sample name
- Time and date samples were collected
- Number and type (media; natural, duplicate, QA/QC) of samples collected
- Laboratory analysis requested
- Sample preservative (if applicable)
- Names or initials of samplers

All entries on the field sampling forms must be made in indelible ink (if using paper) or typed into field computers, tablets, or smart phones, and synchronized with the GSI servers promptly when service is available. Upon completion of the field effort, any paper field forms (if used) shall be scanned and maintained in the project file, along with any relevant log book entries. Electronic field forms will be saved on external servers which are automatically backed up to GSI servers at the end of each day. Copies of electronic field forms from sampling events will be downloaded and stored in the project folder on GSI servers and will be included in any subsequent sampling or data reports, as applicable. At the end of a sampling event, a qualified person other than the GSI employee that originally recorded the form shall conduct a review of the field forms (paper or electronic) to ensure completeness, consistency, and technical/historical accuracy (to the extent possible) prior to being finalized.

SOP-2

EQUIPMENT DECONTAMINATION

Decontamination of field equipment is necessary to prevent cross-contamination between sites and sampling locations. Decontamination should be performed on all non-dedicated and non-disposable sampling equipment that may contact potentially contaminated media. Field personnel must wear disposable gloves while decontaminating equipment to prevent cross-contamination.

The following should be done to decontaminate field equipment:

- Set-up a decontamination area, preferably upwind and upgradient from the sampling area.
- Prior to initiating decontamination, visually inspect sampling equipment for evidence of contamination; use stiff brush to remove visible material.
- Once rough brushing is complete, decontaminate each piece of equipment following a sequential process of washing with Liquinox or an equivalent degreasing detergent; rinsing with deionized or laboratory grade distilled water; rinsing with 10% dilute nitric acid; and finally rinsing with deionized/distilled water three times. Best procedure is to set up multiple wash tubs for each of the above processes.
- Rinse equipment with 10% dilute methanol instead of nitric acid if sampling for organic contamination.
- Decontaminated equipment that is used for sampling organics should be wrapped in aluminum foil or another inert material if not used immediately.

Field equipment can be decontaminated by steam cleaning as an alternative. If equipment is steam cleaned, it should still be rinsed with 10% dilute nitric acid and deionized/distilled water.

All disposable items (e.g., paper towels, Nitrile gloves) should be deposited into a garbage bag and disposed in a proper manner. Handling and disposal procedures for the rinse and wash water will depend on the likely presence and type of contaminant in the wash water. The project Sampling & Analysis Plan should be reviewed to determine the process for handling wash water.

A list of equipment for decontamination is provided in the green box to the right. The amount of deionized/distilled water needed on site will depend on the number of samples to be collected and the sampling methods.

Purpose

Describe general decontamination procedures for field equipment

Goal and Objective

To sufficiently clean field equipment to prevent cross-contamination between sites and sample locations

Equipment Needs

5-gallon Plastic Tub(s) (minimum of four tubs)
 Distilled/Deionized Water
 1-gallon Container of 10% Nitric Acid
 Spray Bottle(s) of 10% Methanol
 Liquinox or equivalent
 Hard Bristle Brush
 Garbage Bags
 Disposable Nitrile Gloves
 Paper Towels
 55-gallon Drums (optional depending on need to containerize wash water)

SOP-3

SAMPLE NOMENCLATURE, DOCUMENTATION, AND CHAIN-OF-CUSTODY PROCEDURES

When completing sampling, it is critical that the process used to label and transport samples to the laboratory for analysis is sufficient to demonstrate with confidence that the samples were collected from the location indicated, and that during transport to the laboratory, no actions were taken to potentially alter the integrity of samples. Without following strict sample labeling and chain-of-custody procedures, analytical data collected at a site have little to no value.

SAMPLE NOMENCLATURE

Samples should be labeled in such a way to allow a person unfamiliar with the site to understand where the samples were collected. Samples should be labeled sequentially as follows:

Project site initials - sample type - sampling method -
sample number - sample depth.

For example, sample KR-SBSS-TPI-12', indicates the following: sample was collected at Knife River (KR); sample is a sub-surface soil sample (SBSS); sample is from test pit 1 (TP-1); and sample was collected at depth of 12 feet. Sample or sample site numbers should be numerically sequential (TPI, TP2, etc.). Prior to initiating sampling, field personnel should familiarize themselves with the Sampling & Analysis Plan and the sample nomenclature to be used for the site. The character prefixes in the table below are recommended for sample types.

SAMPLE DOCUMENTATION

In addition to the chain-of-custody forms discussed below, field personnel must keep a list of samples collected at the field in the field log book and on appropriate field sampling forms (see SOP-1). This allows you to go back and verify sample locations and numbers should there be any confusion at a later time. Upon returning to the office, the field log book and forms should be scanned and maintained in the project file, and subsequent copies sent to the laboratory, or other designated parties, as needed.

Each person in the field is responsible for putting entries into the field log and sampling forms. Designating an individual from the sampling team for record keeping is fine, provided all field personnel come to an agreement as to who this will be, and the field crew leader is certain field personnel are familiar with the record keeping requirements. All entries on the log book and field sampling forms must be made in indelible ink.

Purpose

Identify specific requirements for labeling and documenting sample collection

Goal and Objective

To increase confidence in sample locations and to submit samples to the laboratory without risk of integrity loss

Equipment Needs

Indelible Ink Pen

Chain-of-Custody Forms

Field Log Book

Field Sampling Forms

Sampling Acronym	Label
EB	Equipment Blank
TB	Trip Blank
FB	Field Blank
MW	Monitoring Well
DW	Domestic Well
IW	Injection Well
OB	Observation Well
UST	Underground Storage Tank
VE	Vapor Extraction
AA	Ambient Air
SUMP	Sump (Water sample)
POND	Ponds
SPR	Spring
LAKE	Lake
MTH	Methamphetamine
SW	Surface Water, Stream or River
SR	Surface Runoff
GW	Groundwater Sample
TP	Excavated Test Pit
SS	Surface Soil Sample
SBSS	Subsurface Soil Sample

CHAIN-OF-CUSTODY PROCEDURES

A chain-of-custody form must be generated for all samples collected in the field for laboratory analysis. Samples from more than one project should not be included on the same chain-of-custody form; however, multiple samples from a specific project can be included on the same chain-of-custody form.

Copies of the chain-of-custody form should be maintained in the project file. The sampler may use GSI's chain-of-custody form or a form provided by the laboratory. Sample custody records must be maintained from the time of sample collection until the time of sample delivery to the analytical laboratory, and should accompany the sample through analysis and final disposition. Information to be included on the chain-of-custody form will include, but is not limited to:

- Project number/site name
- Sampler's name and signature
- Date and time of sample collection
- Unique sample identification number or name
- Number of containers
- Sample media (e.g., soil, water, vapor, etc.)
- Sample preservative (if applicable)
- Requested analysis

- Comments or special instructions to the laboratory

Each sample must be assigned a unique sample identification number as described above. The information on the chain-of-custody form, including the sample identification number, must correspond to the information recorded by the sampler on the field forms, log book, and label on the sample container.

A sample is considered under a person's control when it is in their possession. When custody of a sample is relinquished by the sampler, the sampler will sign and date the chain-of-custody form and note the time that custody was relinquished. The person receiving custody of the sample will also sign and date the form and note the time that the sample was accepted into custody. The goal is to provide a complete record of control of the samples. Should the chain be broken (signed by the relinquisher, but not receiver, or vice versa), the integrity of the sample is lost and the resulting analytical data are suspect. Samples must be packaged and shipped to the laboratory following the procedures described in SOP-4. If an overnight shipping service is used to transport the samples to the laboratory, custody of the samples must be relinquished to the shipping service. If possible, have the shipping service sign the chain-of-custody form prior to placing the chain-of-custody form in the sample cooler. If this is not possible (i.e., form placed in sealed cooler), a note should be included on the chain-of-custody that the shipping company will receive the samples with the chain-of-custody form inside the sample container.

SOP-4

SAMPLE PACKAGING AND SHIPPING

SAMPLE PACKAGING

Samples must be packaged to preclude breakage or damage to sample containers, and shipped to comply with shipper, U.S. EPA, and U.S. DOT regulations. When packaging samples:

- Use sample labels from the laboratory whenever possible. Place the sample label on the sample container prior to collecting the sample, and use indelible ink when completing the label.
- Place labeled sample bottles in a high quality cooler. Place the samples in an upright position inside the cooler and wrap the samples with cushioning material for protection during transport. The cooler should be able to withstand tough handling during shipment without sample breakage.
- Make sure the cooler has an adequate amount of ice (secured inside sealed Ziploc® bags) to maintain a temperature of 4°C or less inside the cooler from the time the samples are placed in the cooler until they are received by the laboratory. Excess ice should be used when sampling in warm weather. Ensure the cooler drain plug is taped shut.
- Fill out the appropriate chain-of-custody forms and place them in a Ziploc bag and tape it to the inside lid of the shipping container. If more than one cooler is used per chain-of-custody form, put a photocopy of the form in the other coolers and mark them as a copy.
- Close and seal the cooler using strapping shipping tape.
- Place signed and dated sample custody seals on the outside of the cooler such that the seals will be broken when the cooler is opened. Secure the custody seals on the cooler with clear strapping tape.
- Secure a shipping label with address, phone number, and return address on the outside of the cooler where it is clearly visible.

Purpose

Ensure samples are properly packaged for shipment to the analytical laboratory

Goal and Objective

To have samples received by the analytical laboratory in good condition and within EPA temperature thresholds

Equipment Needs

Indelible Ink Pen
Chain-of-Custody Forms
Custody Seals
Sample Labels from Lab
Coolers and Ice
Strapping Tape
Field Sampling Forms
Ziploc Bags

SHIPPING HAZARDOUS MATERIALS/WASTE

Transportation regulations for shipping of hazardous substances and dangerous goods are defined by the U.S. DOT in 49 CFR, Subchapter C, Part 171 (October 1, 1988); IATA and ICAO. These regulations are accepted by Federal Express and other ground and air carriers.

According to U.S. DOT regulations, environmental samples are classified as Other Regulated Substances (ORS). ORS are articles, samples, or materials that are suspected or known to contain contaminants and/or are capable of posing a risk to health, safety, or property when transported by ground or air. Samples, substances, or materials from sources other than material drums, leachate streams, and sludges should be considered as ORS or environmental samples. Materials shipped under the classification of ORS must not meet any of the following definitions:

Class 1: explosives; Class 2: gases-compressed, liquefied, dissolved under pressure, or deeply refrigerated; Class 3: flammable liquids; Class 4: substances susceptible to spontaneous combustion; Class 5: oxidizing substances; Class 6: poisonous (toxic and infectious); Class 7: radioactive materials; and/or Class 8: corrosives.

If your samples might meet any of the above definitions, contact the project manager to obtain instructions on sample shipment.

SOP-5

FIELD MEASUREMENT OF GROUNDWATER LEVEL

FIELD PROCEDURE

- Verify the water level indicator is operating correctly prior to leaving for the field by placing probe in tap water to test the buzzer and light. Repair as necessary. Make certain the meter and extra batteries are in the carrying case. Verify that the water level indicator cable length is sufficient to reach estimated water level depths.
- Prior to collecting a measurement, decontaminate the water level indicator (see SOP-2), and check probe cable depth markings with a measurement tape. Note any corrections to water level meter measurements on field form.
- Measure all wells (monitoring and domestic) from the top of the well casing in the north quadrant or from a designated measuring point. Measure and record the distance from the measuring point to ground level. Make sure the measuring point is labeled on the well, so future measurements can be made from the same location.
- Measure depth to water from the measuring point to the nearest hundredth of a foot.
- Record measurements on the appropriate field form. Also record the presence/absence of free product on the field forms, as appropriate.
- Decontaminate the water level meter between each measurement following procedures described in SOP-2.
- If free product is known or suspected to be present in a well, an oil-water level indicator or other method should be used to measure the depth to water and thickness of free product in the well, as described in SOP-6.

Purpose

Ensure groundwater levels are accurately measured in the field

Goal and Objective

To obtain accurate and precise water level measurements

Equipment Needs

Water Level Indicator

Extra Set of Batteries

Indelible Ink Pen

Field Sampling Form

Field Log Book

Decontamination Supplies

SOP-7

FIELD MEASUREMENT OF ELECTRIC CONDUCTIVITY (EC) OR SPECIFIC CONDUCTANCE (SC)

INSTRUMENT CALIBRATION

The conductivity meter should be calibrated prior to each sampling event following the manufacturer's recommendations. If the instrument is a multi-parameter meter, follow the instructions for measurement of electric conductivity (EC) or specific conductance (SC) from the manual.

Prior to conducting field measurements, verify the EC/SC meter automatically corrects for temperature variations. If the meter does not, apply the appropriate temperature correction to the field measurements.

FIELD MEASUREMENT PROCEDURE

Rinse a decontaminated glass container or plastic flow-through cell with sample water. Fill the container or flow-through cell with sample water, with enough available space to insert the EC/SC probe without undesired overflow.

Rinse the EC/SC or multi-parameter probe with deionized or distilled water and place it in the beaker of sample water. Immerse the probe in sample and move it around to displace any air bubbles. Keep the probe tip off of the sides of the beaker. Record the conductivity value from the meter on the field form.

Be sure to recognize the units of the meter reading value (i.e., microsiemens/centimeter ($\mu\text{S}/\text{cm}$), micromhos/centimeter ($\mu\text{mh}/\text{cm}$), or millisiemens/centimeter (mS/cm)). Record the reading on the field sampling form and field log book. If the reading is being taken in-situ or using a flow-through cell, wait until the reading stabilizes and record it on the sample field form.

Remove the probe from sample and decontaminate probe. Store the probe following the manufacturer's recommendations. Refer to SOP-2 for complete decontamination procedures.

Purpose

To ensure measurement of EC/SC is done consistently and correctly in the field

Goal and Objective

To obtain accurate EC/SC measurements in the field

Equipment Needs

EC/SC Meter
Calibration Standard(s)
Measurement Container
Extra Set of Batteries
Indelible Ink Pen
Field Sampling Form
Deionized/Distilled Water

SOP-8

FIELD MEASUREMENT OF pH

INSTRUMENT CALIBRATION

The pH meter must be calibrated prior to each field event and after every 10 samples during a sampling event, or more frequently if required by the project/client. Follow the manufacturer's recommendations to calibrate the meter. This typically involves the following sequence of steps:

1. Verify sensor is clean and filled with solution, then turn on meter.
2. Place in pH 7 solution, press "cal", and wait until calibration is complete.
3. Rinse sensor in deionized or distilled water.
4. Place in pH 10 (or pH 4) buffer solution, press "cal" a second time, and wait until endpoint is reached.
5. Rinse in distilled water.

Three-point calibration is the standard procedure. If the instrument is a multi-parameter meter, follow instructions for measurement of pH from the manual.

Periodically throughout the field day, place the probe in 7.0 pH buffer solution. If the measured value differs from the expected value by more than 0.1 pH units, recalibrate the meter according to the manufacturer's instructions.

FIELD MEASUREMENT PROCEDURE

- Rinse a decontaminated glass beaker or plastic flow-through cell with sample water three times.
- Rinse the pH probe with deionized or distilled water.
- Fill the container with sample water.
- Immerse the probe in the sample and agitate it to provide thorough mixing. Continue to agitate until the reading has stabilized. Read the pH value from the meter to the nearest 0.1 standard unit (s.u.) and record on the field sampling form. If the reading is being taken in-situ or using a flow-through cell, wait until the reading stabilizes and record the final pH value.
- Note any problems such as erratic readings. If previous readings are available, compare the current measurement to previous reading to check that the current reading is within reasonable limits.
- Rinse probe with deionized or distilled water and store according to the manufacturer's instructions (see SOP-2 for complete decontamination procedures).

Purpose

Provide guidelines for pH measurements in water samples

Goal and Objective

To obtain accurate pH measurements in the field

Equipment Needs

pH Meter
 Calibration Standards (within expiration date)
 Glass Container or Flow-through Cell
 Extra Set of Batteries
 Indelible Ink Pen
 Field Sampling Form
 Deionized/Distilled Water

SOP-9

FIELD MEASUREMENT OF DISSOLVED OXYGEN (DO)

INSTRUMENT CALIBRATION

Before each use, clean and rinse the dissolved oxygen (DO) electrode tip in accordance with decontamination procedures outlined in SOP-2. Verify that the membrane cap has been filled with DO electrolyte in accordance with manufacturers required maintenance schedule.

Calibrate the probe and meter using the fresh water-air calibration method described in the manufacturer's manual. Correct the calibration value for temperature and altitude and adjust the meter accordingly. Sensor can maintain polarization when disconnected from the meter for up to three hours.

FIELD MEASUREMENT PROCEDURE

Place the probe directly into the stream or well to be measured. If possible, place the probe into a flow-through cell receiving a continuous stream of water from the source being measured. Allow sufficient time for the probe to stabilize to sample temperature and DO concentration. Record the DO value on the field form. Rinse probe with deionized or distilled water when measurement is complete.

If sensor will not calibrate, becomes sluggish or erratic, or saturation is not above 95%:

- Clean tip and refill cap with DO electrolyte in accordance with manufacturer's instructions (care must be taken to eliminate air bubbles from inside probe, and probe tip must be scarified using manufacturer-provided sandpaper).
- Check membrane for damage; replace if necessary.
- Check meter with test plug.
- Replace battery.

Note that gasoline residue can foul the probe and cause drifting and erratic measurements.

Purpose

Provide guidelines for dissolved oxygen measurements in water samples

Goal and Objective

To obtain accurate dissolved oxygen measurements in the field

Equipment Needs

Dissolved Oxygen Meter
Deionized/Distilled Water
Calibration Cup
Extra Set of Batteries
Indelible Ink Pen
Field Sampling Form

SOP-10

FIELD MEASUREMENT OF OXIDATION-REDUCTION POTENTIAL (ORP)

INSTRUMENT CALIBRATION

The oxidation-reduction potential (ORP) meter should be calibrated prior to each sampling event following the manufacturer's recommendations. If the instrument is a multi-parameter meter, follow the instructions for measurement and calibration of ORP. Use table of temperature adjustment information provided with the instrument instructions.

FIELD MEASUREMENT PROCEDURE

- Decontaminate a clean plastic or glass container with deionized or distilled water.
- Rinse the ORP electrode with deionized or distilled water and then with sample water prior to inserting it into the sample beaker.
- If possible, obtain an in-situ measurement of ORP. If not possible, preferably use a flow-through cell receiving a constant stream of water from the well or sample source material. If obtaining a sample for ORP measurement, minimize agitation of the sample in an effort to limit exposure to oxygen.
- Immerse the ORP electrode in the sample and allow at least one minute for the probe to equilibrate with the water.
- Obtain a reading to the nearest 10 millivolts (mV).
- Record the reading on standardized field form. Note any problems such as erratic or drifting readings.
- Decontaminate the probe in accordance with SOP-2.

Purpose

Provide guidelines for ORP measurements in water samples

Goal and Objective

To obtain accurate ORP measurements in the field

Equipment Needs

ORP Meter

Deionized/Distilled water

Calibration solution with table of temperature adjustment information

Extra set of batteries

Indelible Ink Pen

Field Sampling Form

SOP-11

FIELD SAMPLE FILTRATION

FIELD PROCEDURE

- Set-up a system whereby water samples can be filtered, including a filter apparatus/pump for retrieving water from a well or water body.
- To avoid the need for decontamination, use disposable tubing and equipment, if possible.
- If using a hand-vacuum pump, place groundwater or surface water into a vessel that can be pressurized using the hand-vacuum pump.
- Filtered effluent from the pump can be placed directly into sample containers post-filtering with a disposable 0.45 micron (μm) filter. The filter can be attached in-line with sampling tubing.
- As appropriate, fill pre-preserved, laboratory supplied sample containers with filtered sample and cap each container.
- Invert sample container several times to insure complete sample-preservative mixing, if applicable.
- Place samples into cooler; package and ship in accordance with SOP-4.
- If extremely turbid sample water is obtained, may need to pre-filter the sample using 3.0 or 5.0 micron filter paper followed by 0.45 micron filtration.
- Decontaminate, if necessary, all sample collection equipment in accordance with the SOP-2.

Purpose

Provide guidelines for filtering water samples in the field

Goal and Objective

To employ a method of filtering samples in the field, thus removing sediment from the sample and allowing for analysis of dissolved constituents in the sample

Equipment Needs

0.45, 3.0, and 5.0 micron
Disposable Filters
Sample Collection and Filter
Apparatus (Pump)
Preservatives, as required
Indelible Ink Pen
Field Sampling Form

SOP-12A

LOW FLOW GROUNDWATER SAMPLING

Prior to initiating groundwater sampling, all equipment should be inspected for damage and repaired/replaced, if necessary. Have on-hand: copies of well logs; sampling and analysis plan or work plan; any previous site sampling information/data; field planning worksheet; and field forms. Check with project manager to be sure you understand what type of pump(s) will be used to purge and sample groundwater. Equipment to be placed down-hole must be decontaminated in accordance with SOP-2.

Begin sampling at the well containing the lowest level of contamination, and sample wells in succession based on increasing contaminant concentrations. If the relative degree of concentrations cannot be determined, wells should be sampled in order of increasing proximity to the suspected source of contamination, preferably from the perimeter towards the center of the site.

A standard field sampling form must be completed for each well to document purging and sampling in accordance with relevant SOPs; individual sampling forms must also be completed for any field quality control samples (e.g., duplicates, rinsate blanks, and field blanks).

WATER LEVEL MEASUREMENT

Before purging each well, record the depth to water from the designated measuring point on the top of the well casing (or the north side of the top of casing if a measuring point is not identified) to the nearest 0.01-foot using an electronic water level meter in accordance with SOP-5. If sampling at a site where there may be free product, wells shall be checked for the presence of free product prior to purging and sampling using an oil-interface probe in accordance with SOP-6. Determine the thickness of free product by subtracting the depth to free product from the depth to water.

Record the following dimensions on the groundwater sampling form: depth to water; total well depth; depth to top of screened interval; depth to bottom of screened interval; depth to top of filter pack interval; depth to bottom of filter pack interval; and casing diameter. Well and filter pack depth information should be referenced from the well log; do not measure total depth of the well prior to purging and sample collection to avoid resuspension

Purpose

Provide guidelines for low flow sampling of groundwater

Goal and Objective

To employ a method of collecting groundwater samples that is representative of the chemistry of the aquifer

Equipment Needs

5-gallon Bucket, graduated in gallons

Purge/Sampling Pump(s)

Oil-Interface Probe, as necessary

Water Level Meter

Meters or Flow-through cell to measure temperature, pH, EC/SC, DO, and ORP.

Filtering apparatus/pump (if filtering samples)

Sample Containers

Preservatives, as required

Field Planning & Sampling Forms

Decontamination Supplies

Tubing for pump (include air-line and water-line for bladder pump)

Disposable bladders and O-ring kit for bladder pump

Generator or Power Supply; controller for bladder pumps

Coolers and Ice

Stop-watch

Rope and Bailer (for backup)

of any settled solids which may have accumulated within the casing. Use the following formula to calculate the volume of water present in the well casing (casing volume):

$$V = 3.14*(r^2)*d*7.48$$

Where:

V = volume (gallons)

r = well radius (feet)

d = depth of water or saturated thickness in well (feet)

The radius of the filter pack will be used for the well radius (r) for calculating borehole volumes, if required. For example, a 2-inch diameter PVC monitoring well installed in a 6-inch diameter hole with sand filter pack would use a well radius of 3 inches or 0.25 foot.

LOW FLOW PURGING

The goal of low flow purging is to collect water samples that reflect the total mobile organic and inorganic loads transported through the subsurface under ambient flow conditions, with minimal physical and chemical alterations from sampling operations. During low flow purging, emphasis is placed on minimizing hydraulic stress at the well-aquifer interface by maintaining low water-level drawdowns, and by using low pumping rates during purging and sampling operations. Low flow purging can be completed using a submersible pump and low flow controller, an air or nitrogen powered bladder pump, or a peristaltic pump where appropriate (e.g., shallow wells; sampling for non-volatile constituents). The specific pumping method shall be chosen based on depth to groundwater, diameter of well, existing well configuration, and contaminant(s) of concern. Additional guidance for low flow purging may be found in U.S. Environmental Protection Agency's 2010 Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells (USEPA, 2010).

Decontaminated or dedicated low flow sampling equipment shall be used for purging and sampling. The pump and disposable tubing should be lowered gently and slowly, and set within the upper third or fourth of the screened interval. If the static water level is below the top of the screen, then the pump shall be lowered to within the upper third or fourth of the water column. In either case, the pump intake will be placed a sufficient distance above the bottom of the well to avoid mobilization of any accumulated sediment.

Purge at a rate of 0.1 to 0.5 liters per minute (Lpm) while monitoring drawdown of the water level in the well using an electronic water level meter every 5 minutes. If drawdown exceeds 0.3 foot (0.1 meter), reduce the purge rate accordingly. Purging rates should, as needed, be reduced to the minimum capabilities of the pump to ensure drawdown of less than 0.3 foot or stabilization of the water level. If the minimal drawdown that can be achieved exceeds 0.3 foot, but remains stable, continue purging until three casing volumes are removed and/or water quality parameters stabilize (see below).

Indicator field parameters (see below) are monitored every 5 minutes during purging in order to determine when sample collection may begin in accordance with the stabilization goals specified in the table below. Indicator field parameters, including pH, Oxidation/Reduction Potential (ORP), Electrical Conductivity (EC) or Specific Conductance (SC), Temperature, and Dissolved Oxygen (DO) should be measured using a flow-through cell. Turbidity should be measured using discharge from a T-valve located

upstream of the flow-through cell. Turbidity should not be measured downstream of the flow-through cell because it can entrain suspended solids resulting in inaccurate turbidity readings.

Indicator Parameter	Units	Stabilization Goal	Comment
pH	standard units (s.u.)	+/- 0.1 s.u. between three readings	
Electrical Conductivity (EC) or Specific Conductance (SC)	microsiemens, millisiemens, or micromhos per centimeter ($\mu\text{S}/\text{cm}$, mS/cm or $\mu\text{mhos}/\text{cm}$)	+/- 3% between three consecutive readings	
Oxidation/Reduction Potential (ORP)	millivolts (mV)	+/- 10 mV between three consecutive readings	
Temperature	degrees Celsius ($^{\circ}\text{C}$)	+/- 3% between three consecutive readings	
Dissolved Oxygen (DO)	milligrams per liter (mg/L)	+/- 10% between three readings or <0.5 mg/L	Considered stable if three DO values are less than 0.5 mg/L
Turbidity	Nephelometric Turbidity Units (NTU)	+/- 10% between three readings and <10 NTU	If turbidity is >10 NTU, consider stable if three turbidity values are +/- 10%

Note that the stabilization criteria listed in the table above are goals, and may not be achievable under all situations. Dissolved oxygen and turbidity generally require the longest time to stabilize. A turbidity value of 10 NTU may not be achievable in all monitoring wells. In the event that turbidity stabilizes (+/- 10% between three readings) above 10 NTU, proceed with sample collection and note the suspected reason(s) for the elevated turbidity. Attempt to remedy the elevated turbidity for subsequent sampling events at a given monitoring well or site. Remedies for elevated turbidity may include: well re-development, slightly higher pump placement, slower submersion of the sampling pump and tubing, and/or a reduced purge rate.

If the water level recovery of a low-yield well exceeds 2 hours after purging, a sample shall be extracted as soon as sufficient volume is available in the well. At no time should a monitoring well be pumped dry if the recharge rate results in formation water to cascade down the well screen, causing an accelerated loss of volatiles and possible change in pH.

COLLECTING WATER QUALITY SAMPLES

Label each sample container with project number, sample location, well owner, date, military time (24-hour), sampler's initials, preservative, and analysis required. Wear new disposable latex or nitrile gloves immediately prior to obtaining the sample.

Verify that the appropriate preservatives were added by the analytical laboratory, or should be added by field personnel. If required, add the necessary preservative to the appropriate sample container prior to sample collection (see table below).

Prior to filling the sample container, disconnect the flow-through cell from the pump discharge tubing while the well is still being purged. Water quality samples should never be collected downstream of the flow-through cell because the flow-through cell can entrain suspended sediment and result in a cross-

contaminated sample volume with a biased concentration of analytes. Place the pump's discharge tubing directly above the receiving sample container and add the sample volume directly to the bottle, minimizing turbulence as much as possible. For volatile analyses, fill appropriate vials at the rate of about 100 milliliters per minute (mL/min) (24 seconds to fill a 40 mL vial) or less. Fill each sample vial completely so the water forms a convex meniscus at the top to ensure that no head space exists in the vial after it has been capped. After filling, immediately cap, invert, and gently tap the vial to check for trapped air. If air bubbles are present, un-cap vial, add slightly more sample water and repeat procedure. If air bubbles are still present, discard the vial and fill another sample vial.

If analyzing for dissolved constituents, add field filter (usually 0.45 micron (μm) pore size) to the end of the pump's discharge line, and then fill the appropriate container(s).

Samples should be preserved as described in the table below, unless otherwise specified by the laboratory.

Parameter	Number of Bottles	Container	Preservation	Maximum Holding Time Extraction/ Analysis
VOCs	3	40 mL glass vial	$\leq 6^{\circ}\text{C}$ & HCL	14 days to analysis
SVOCs	2	1 L glass	$\leq 6^{\circ}\text{C}$	7 days / 40 days from extraction to analysis
Metals	1	500 mL plastic	$\leq 6^{\circ}\text{C}$ & HNO_3	6 months to analysis; mercury 28 days to analysis
Nutrients	1	500 mL plastic	$\leq 6^{\circ}\text{C}$ & H_2SO_4	Varies – contact laboratory for additional information
Common Ions	1	1 L plastic	$\leq 6^{\circ}\text{C}$	7 days / 40 days from extraction to analysis

Note: VOC = volatile organic compound; SVOC = semi-volatile organic compound; mL = milliliter; L = liter; HCL = hydrochloric acid; HNO_3 = nitric acid; H_2SO_4 = sulfuric acid; C = Celsius.

Properly cap and lock the well when sampling is complete. In the field notebook, record any damage to the well, monument, or items related to the well that need attention or repair prior to the next sampling event.

Purge water must be handled in accordance with SOP-25 for management of investigative-derived wastes. Groundwater purged from a well during purging or sampling that has a sheen or contains free product must be containerized in an appropriately labeled 55-gallon drum or tank pending receipt of analytical results. A drum should be dedicated to each well sampled so that analytical results of the groundwater sample can be used to characterize the water in the drum. Groundwater that contains no free product, sheen, or odors may be discharged directly to the ground if approved by the property owner. If groundwater is discharged directly to the ground, attention must be given to avoid direct recharge of shallow groundwater with purge water near the well. Purge water must be discharged downgradient and at an adequate distance from the well to be sampled to avoid mounding and interference with the water table.

Complete the necessary sample handling paperwork (SOP-3), sample handling, packaging, and shipping (SOP-4), and record all pertinent information on field sampling forms and field logbook (SOP-1).

SOP-12B

WATER SUPPLY WELL GROUNDWATER SAMPLING

Prior to initiating groundwater sampling, all equipment should be inspected for damage and repaired/replaced, if necessary. Check with project manager to be sure you understand what type of pump(s) will be used to purge and sample groundwater (i.e., existing pump(s) in the water supply well(s)). Equipment to be placed down-hole must be decontaminated in accordance with SOP-2.

If applicable, begin sampling at the well containing the lowest level of contamination, and sample wells in succession based on increasing contaminant concentrations. If the relative degree of concentrations cannot be determined, wells should be sampled in order of increasing proximity to the suspected source of contamination, preferably from the perimeter towards the center of the site.

Field sampling forms must be completed for each well to document purging and sampling in accordance with relevant SOPs.

WATER LEVEL MEASUREMENT

If required, open the well cap and remove any excess submersible pump wiring that may be present. If the wiring or wiring insulation appears damaged, do not proceed with sampling and notify the well owner. Be careful to not disturb any wire nuts or connections that may be present in or on the well.

Before purging each well, record the depth to water from top of well casing to the nearest 0.01-foot using an electronic water level meter in accordance with SOP-5. Water level measurements in wells with permanent submersible pumps installed can be difficult as the water level meter may become snagged on the pump wiring. If the water level meter becomes snagged, remove it using increasingly gradual tugs, avoiding shock loads on the water level tape when possible. An alternative type of water level meter to consider is a sonic-type meter that requires no in-hole probe; however, these instruments have less-accurate water level measurements.

If sampling at a site where there may be free product, wells shall be checked for the presence of free product prior to purging and sampling using an oil-interface probe in accordance with SOP-6. This may be difficult in an existing supply well that has a down-hole pump and wiring. Determine the saturated thickness of free product by subtracting the depth to product from the depth to water.

Purpose

Provide guidelines for sampling groundwater

Goal and Objective

To employ a method of collecting groundwater samples that is representative of the chemistry of the aquifer

Equipment Needs

5-gallon Bucket, graduated in gallons

Purge/Sampling Pump(s)

Oil-Interface Probe, as necessary

Water Level Meter

Meters or Flow through cell to measure temperature, pH, EC/SC, DO, and ORP.

Filtering apparatus/pump (if filtering samples)

Sample Containers

Preservatives, as required

Field Sampling Forms

Decontamination Supplies

Tubing, as needed

Generator or Power Supply

Coolers and Ice

Stop-watch

Rope and Bailer (for backup)

Record the following dimensions on the groundwater sampling form: depth to water; total well depth; depth to top of screened interval; depth to bottom of screened interval; depth to top of filter pack interval; and depth to bottom of filter pack interval. With the exception of depth to water, this information should be obtained from the well log, if available. Use the following formula to calculate the volume of water present in the well casing (i.e., “one casing volume”):

$$V = 3.14 * (r^2) * l * 7.48$$

Where:

V = one casing volume (gallons)

r = well radius (feet)

l = length of saturated well (feet)

WELL PURGING

For water supply wells, to obtain a representative sample of groundwater, wells shall be purged of a minimum of three casing volumes and until field water quality parameters stabilize. Connect a flow-through cell to the well discharge using a slip stream sampling device or sampling port.

If required, connect the generator to the pump leads and start the generator. Position the generator downwind of the well at a distance of greater than 20 feet to avoid sample contamination. Begin purging the well and monitor field parameters.

Field parameters shall be measured every 5 minutes using a flow-through cell, with a minimum of six parameter measurements completed before stabilization is determined as noted below. For this method, a minimum of three casing volumes will be removed prior to sample collection. If information on the well design is not available, then purging will be evaluated using only the stabilization of water quality parameters.

Turbidity should be measured using discharge from a “tee valve” located upstream of the flow through cell. Turbidity should not be measured downstream of the flow-through cell because it can entrain suspended solids resulting in an elevated turbidity reading.

Indicator Parameter	Units	Stabilization Goal	Comment
pH	standard units (s.u.)	+/- 0.1 s.u. between three readings	
Electrical Conductivity (EC) or Specific Conductance (SC)	Microsiemens, millisiemens, or micromhos per centimeter (µS/cm, mS/cm or µmhos/cm)	+/- 3% between three consecutive readings	
Oxidation/Reduction Potential (ORP)	millivolts (mV)	+/- 10 mV between three consecutive readings	
Temperature	degrees Celsius (°C)	+/- 3% between three consecutive readings	
Dissolved Oxygen (DO)	milligrams per liter (mg/L)	+/- 10% between three readings or <0.5 mg/L	Considered stable if three DO values are less than 0.5 mg/L
Turbidity	Nephelometric Turbidity Units (NTU)	+/- 10% between three readings and <10 NTU	If turbidity is >10 NTU, consider stable if three turbidity values are +/- 10%

Note that the stabilization goals listed in the table above are goals, and may not be achievable under all situations.

If the recovery of a low-yield well exceeds 2 hours after purging, a sample shall be extracted as soon as sufficient volume is available in the well. At no time should a well be pumped dry if the recharge rate results in formation water to cascade down the well screen, causing an accelerated loss of volatiles and change in pH.

COLLECTING WATER QUALITY SAMPLES

Label each sample container with project number, sample location, well owner, date, military time (24-hour), sampler's initials, preservative, and analysis required. Wear new disposable latex or nitrile gloves immediately prior to obtaining the sample.

Prior to filling the sample container, disconnect the flow-through cell from the pump discharge tubing while the well is still being purged. Water quality samples should never be collected downstream of the flow through cell, as the flow through cell can entrain suspended sediment and result in a cross-contaminated sample volume with a high biased concentration of analytes.

Verify that the appropriate preservatives were added by the analytical laboratory. If required, add preservative to the sample container prior to sample collection. Place the discharge tubing directly above the receiving sample container and add the sample volume directly to the bottle, minimizing turbulence as much as possible. For volatile analyses, fill vials at the rate of about 100 milliliters per minute (mL/min) (24 seconds for 40 mL vial) or less. Fill each sample vial completely so the water forms a convex meniscus at the top to ensure that no head space exists in the vial after it has been capped. After filling, immediately cap, invert, and gently tap the vial to check for trapped air. If air bubbles are present, un-cap vial, use the cap to pour into the vial to add slightly more sample water, and repeat procedure. If air bubbles are still present, discard the vial and fill another sample vial.

If analyzing for dissolved constituents, add field filter (usually 0.45 μm pore size) to the end of the discharge line.

Samples should be preserved as described in the table below, unless otherwise specified by the laboratory.

Parameter	Number of Bottles	Container	Preservation	Maximum Holding Time Extraction/ Analysis
VOCs	2	40 mL glass	$\leq 6^{\circ}\text{C}$ & HCL	14 days to analysis
SVOCs	1	1 L glass	$\leq 6^{\circ}\text{C}$	7 days/40days from extraction to analysis
Metals	1	500 mL plastic	$\leq 6^{\circ}\text{C}$ & HNO_3	6 months to analysis; mercury 28 days to analysis
Nutrients	1	500 mL plastic	$\leq 6^{\circ}\text{C}$ & H_2SO_4	Varies – contact laboratory for additional information
Common Ions	1	1 L plastic	$\leq 6^{\circ}\text{C}$	7 days/40 days from extraction to analysis

Note: VOC = volatile organic compound; SVOC = semi-volatile organic compound; mL = milliliter; HCL = hydrochloric acid; HNO_3 = nitric acid; H_2SO_4 = sulfuric acid; C = Celsius.

Properly cap and lock the well when sampling is complete. Note any damage to the well, monument, or items related to the well that need attention or repair prior to the next sampling event.

Purge water must be handled in accordance with SOP-25 for management of investigative-derived wastes. Groundwater purged from a well during purging or sampling that has a sheen or contains free product must be containerized in an appropriately labeled 55-gallon drum or tank pending receipt of analytical results. A drum should be dedicated to each well sampled so that analytical results of the groundwater sample can be used to characterize the water in the drum. Groundwater that contains no free product, sheen, or odors may be discharged directly to the ground if approved by the property owner. If groundwater is discharged directly to the ground, attention must be given to avoid direct recharge of shallow groundwater with purge water near the well. Purge water must be discharged down-gradient and at an adequate distance from the well to be sampled to avoid mounding and interference with the water table.

Complete the necessary sample handling paperwork (SOP-3), sample handling, packaging, and shipping (SOP-4), and record all pertinent information on field sampling forms and field log book (SOP-1).

SOP-14

SUBSURFACE SOIL SAMPLING

SUBSURFACE SOIL SAMPLING

Typically, subsurface sampling is completed using a hand-auger, split-spoon sampler, direct-push drilling equipment, or backhoe/excavator. Sampling procedures for each type of equipment are described below.

Hand Auger

- Arrive on-site equipped with stainless-steel auger rod and hand auger. If samples are to be collected from different intervals below grade, bring several sizes of stainless-steel augers (e.g., 2-inch, 4-inch, 6-inch, etc.).
- Hand-auger holes can be drilled as one size or in a telescoping manner, if desired, to collect discreet samples at intervals below grade, and prevent risk of cross-contamination between intervals. If a single depth sample is required, advance the auger bucket to the desired sampling interval depth and empty the contents of the auger in a stainless steel mixing bowl. Mix and place soil into appropriate sample containers.
- For the telescoping method, advance the largest auger first to the desired depth, collecting a specified depth increment sample as the auger bucket is advanced. Install temporary decontaminated PVC casing with a diameter slightly smaller than the borehole to keep the hole open and reduce possible cross-contamination between depth intervals. Using the next size smaller auger bucket, repeat the process.
- Fill-out appropriate sample labels, field forms, and chain-of-custody forms, and place samples for laboratory analysis in a cooler with ice in accordance with SOP-3 and SOP-4.
- Decontaminate all equipment between sample locations in accordance with procedures described in SOP-2.

Split-Spoon Sampler

- Arrive on-site equipped with at least two standard 1.4-inch inside diameter (ID) split-spoon samplers. If geotechnical information is desired, a 140-pound drop hammer is required.
- Install split-spoon sampler into borehole and advance to the desired depth with the 140-pound drop hammer. Record number of blow counts to complete sampling over each 18-inch or 24-inch interval, as necessary.

Purpose

Provide guidelines for sampling subsurface soil.

Goal and Objective

To employ a method of collecting subsurface soil samples representative of field conditions.

Equipment Needs

Will depend on sampling method

Stainless Steel Mixing Bowl and Sampling Trowel

Hand-Lens (10 power)

Munsel Color Book (if required)

Latex or Nitrile gloves

Locating Flags

GPS Unit

Coolers and Ice

Field Forms and Field Book

Decontamination Supplies

- Retrieve sampler and place on work table. Using the other sampler, repeat this sequence.
- Record lithology and percent recovery from cores retrieved from split-spoon sampler on a field form.
- If required by the project work plan, composite like core intervals by mixing in stainless-steel bowl in a similar manner as described for surface soil sampling (SOP-13). When sampling for volatile organic compounds (VOCs), the sample should not be mixed.
- Decontaminate sampling equipment between each interval sampled, if required, and/or between sample sites, in accordance with procedures described in SOP-2.

Direct-Push Drilling Equipment

- Locate the site to be sampled and ensure that drilling equipment can safely access the site.
- Minimize off-road travel to prevent off-site damage to surrounding vegetation.
- Advance direct-push sampling rods lined with acetate sleeves to the prescribed depth. Retrieve the rods, remove the sample sleeves, and secure sample on the work table.
- Record lithology and percent recovery from the retrieved sample sleeve.
- If required by the project work plan, composite like core intervals by mixing in stainless-steel bowl in a similar manner as described for surface soil sampling (SOP-13). When sampling for VOCs, the sample should not be mixed.
- Decontaminate sampling equipment between each interval sampled, if required, and/or between sample sites, in accordance with procedures described in SOP-2.

Backhoe or Hand-Dug Excavations

- Locate the site to be sampled and ensure that equipment can safely access the site.
- Minimize off-road travel to prevent off-site damage to surrounding vegetation.
- Orient excavation to maximize use of the angle of the sun to illuminate the pit for photographs.
- Excavate to the depth specified in the work plan. Place excavated material a sufficient distance from the excavation. If the pit exceeds 5 feet in depth, OSHA construction standards for shoring or sloping must be observed to prevent accidental burials. Sampling personnel should avoid entering any pit to collect samples, and if required to do so, strict adherence to all OSHA standards must be implemented.
- Soil profile descriptions shall be made from a hand-cleaned surface along the pit wall.
- Complete profile descriptions and take photographs before pit is sampled.
- Soil samples shall be collected from depth intervals specified in the work plan. When a depth interval is sampled, an equal volume of soil should be collected from the entire interval exposed on the pit wall by the excavating bucket. When the bucket is brought to the surface, soil samples should be collected from the bucket with the stainless-steel trowel and placed in the mixing bowl according to methods described for surface soil sampling (SOP-13). When sampling for VOCs, the sample should not be composited or mixed.
- After sampling is completed, the pit should be backfilled with excavated material in the reverse order that it was excavated so that topsoil material is returned to the top of the pit. When

backfilling is complete, the area should be cleaned-up to its original condition. If a test pit is left open overnight, temporary fencing and appropriate signs and flagging tape should be used to prevent access to the excavation.

- Decontaminate the excavator bucket and all sampling equipment between sampling sites. Excavation equipment should be cleaned between sites with water (where possible) or with a shovel to remove accumulated dirt and mud.

SAMPLE CONTAINERS AND PRESERVATION

Soil samples should be preserved as described in the table below.

Parameter	Number	Container	Preservation	Maximum Holding Time Extraction/ Analysis
VOCs	1	4 oz glass	4°C	14 days to analysis
VPH	1	4 oz glass	4°C	Preserve in methanol within 7 days/40 days from preservation to analysis
EPH	1	4 oz glass	4°C	14 days/40 days from extraction to analysis
SVOCs	1	4 oz glass	4°C	7 days/40days from extraction to analysis
Metals	1	4 oz glass or plastic	4°C	6 months to analysis; mercury 28 days to analysis

Note: VOC = volatile organic compound; VPH = volatile petroleum hydrocarbons; EPH = extractable petroleum hydrocarbons; SVOC = semi-volatile organic compound; oz = ounce; °C = degrees Celsius.

SOP-16

MONITORING WELL CONSTRUCTION

FIELD PROCEDURE

The following is a generalized procedure for installing a typical monitoring well. Refer to the project-specific work plan which should include more details about the design and method of completing monitoring wells on a project site.

- Arrive on site with the appropriate drilling equipment and materials for site conditions. Be sure to review the work plan or SAP to determine anticipated lithology. Filter pack material and well-screen slotting size should be based on the lithology. Ensure that the driller has properly decontaminated all drilling equipment and materials prior to arrival on-site in accordance with SOP-2.
- Many states now require certification and licensing for monitoring well drillers. Verify the driller is licensed in the state (if required) prior to beginning field work.
- Safety equipment required on-site for the drill rig is mandatory. Personal protective equipment includes (at a minimum): hardhat, safety glasses, steel-toed boots, gloves, first aid kit, and site health and safety plan (with routes to nearest hospital known by all personnel on-site).
- Acceptable drilling techniques for the installation of monitoring wells include air-rotary, cable-tool, and hollow-stem auger. If unconsolidated material is encountered, it may be necessary to drive steel casing during drilling to maintain borehole integrity.
- Appropriate decontamination of the auger flights or drill string and other down-hole equipment, between boreholes is required.
- Drilling mud or drilling solutions are not to be used during drilling activities in conjunction with monitoring well construction, unless necessary and approved for the project (e.g., biodegradable material with no petroleum-based constituents). Water used for drilling purposes should be potable quality.
- Hydraulic jacks or the drill rig can be used to pull-back steel casing following emplacement of plastic casing.
- Subsurface samples must be collected by the driller at intervals specified in the work plan. When

Purpose

Provide guidelines for installing monitoring wells in the field

Goal and Objective

To employ a standard method of installing monitoring wells, which will allow for collection of representative groundwater samples

Equipment Needs

Drilling System (appropriate for well design and site conditions)

Well Completion Material (e.g., screen, filter pack, borehole seal, and surface seal) consistent with anticipated lithology

Hand-Lens (10 power)

USGS Soil Classification Chart and Munsell Color Book

Latex or Nitrile Gloves

Boring Log Forms and Field Log Book

drilling with cable tool or hollow-stem auger, down-hole soil samples should be collected using a standard 1.4-inch inside diameter split-spoon sampler and 140-pound drive hammer. The number of blows necessary to obtain an 18-inch or 24-inch length of sampler by the driller should be recorded on the boring log. When drilling with an air or mud rotary rig, cuttings will be collected from the discharge stream.

- A detailed lithologic boring log must be completed during drilling activities. Soils and geologic cuttings should be described on the log according to the procedures outlined in the United Soil Classification System (USCS; method ASTM D2487) or the Soil Conservation Service (SCS) classification system. Soil texture should be classified by either the USCS or the U.S. Department of Agriculture (USDA) classification. Water-bearing characteristics of the formations should also be noted on the boring log. In addition, details of monitoring well construction should be described on the well log, including total depth, perforated interval, sizes and types of construction materials, etc.
- When completing the well, install factory-slotted well screen (size dependent on lithology) and blank PVC (stainless-steel or teflon for organics) well casing into the borehole. Emplace chemically inert silica sand at least 2 feet above and below any perforated sections and install a bentonite plug above the sand. Backfill remaining well annulus with bentonite slurry, grout, or chips to the ground surface. Measure and record the depth of filter pack and sealing material at regular intervals during installation to document well construction details.
- Develop the well prior to sample in accordance with procedures described in SOP-18.
- Place locking protective well cover over well casing(s) after outer steel casing has been removed from the borehole (if performed). Place bentonite plug below bottom of well cover; grout cover in place and install lock on cover.

SOP-17

FIELD SCREENING OF VOLATILE ORGANIC COMPOUNDS IN SOIL

FIELD METHOD

- Field screening can be done using a flame ionization detector (FID), photoionization detector (PID), or combustible gas indicator (GCI). Which instrument is used will depend on the contaminants at the site and site conditions. The project work plan should be reviewed to identify the field screening instrument to be used at the site.
- If using a PID, ensure the instrument is equipped with the appropriate lamp for the compound(s) of interest (refer to table below). Use a filter to prevent moisture and dust from contacting the PID lamp.
- Calibrate the instrument prior to each field day following the manufacturer's instructions. Document the calibration on the appropriate field form or in the project field book.
- Place the probe adjacent to the media to be sampled, and record the maximum reading on the field form.
- Obtain a soil sample from the interval of interest, place it in a new ziploc bag, and seal the bag. Shake the bag to thoroughly mix the sample with the air in the headspace.
- Allow the sample to come to room temperature (approximately 70 to 80 °F) by placing it in a warm location (not in direct sunlight). In the winter, it may be necessary to place the sample bag adjacent to a vehicle heater vent.
- Insert the probe in the ziploc bag and record the maximum reading on the field form.

Purpose

Provide guidelines for field screening of volatile organic compounds in soil

Goal and Objective

To employ a standard method for measuring the concentration of volatile organics in soil

Equipment Needs

FID, PID, or GCI, as required
Indelible Ink Pen
Ziplock Bags
Latex or Nitrile gloves
Field Log Book and Sampling Forms

PID Lamp Selection

Lamp	Description	Typical Compounds Detected
9.8 eV	Most selective lamp	Benzene, aromatic compounds, amines
10.6 eV	Standard PID lamp	All compounds detected by 9.8 eV lamp and chlorinated compounds, including vinyl chloride, DCE, TCE, PCE, and chlorobenzene
11.7 eV	Detects broadest range of analytes	All compounds detected by 10.6 eV lamp, used to detect methylene chloride, carbon tetrachloride, chloroform, 1,1,1-trichloroethane

SOP-18

MONITORING WELL DEVELOPMENT

FIELD PROCEDURE

Prior to sampling groundwater from a new monitoring well, the well must be developed to remove excess fines and set the filter pack installed during well construction. The following is a general procedure for performing well development:

- Visually inspect all well development equipment for damage, and repair, as necessary.
- Decontaminate all down-hole equipment, including stingers, air hoses, and surge blocks following procedures described in SOP-2.
- If using compressed air method for well development, verify the compressor utilized does not produce air laden with hydraulic fluid for lubricating purposes. This may affect the integrity of the monitoring well for producing viable water quality data.
- Develop well by using surging techniques (surge block or bailer), followed by evacuation of water and sediment. Place the surge block or bailer in the well and lower to bottom. Move the surge block or bailer up and down over the entire length of the well screen several times. Remove and evacuate water from the well. Repeat this procedure until evacuated water is visibly clean and essentially sand-free. Measure clarity of water using a properly calibrated turbidity meter (turbidimeter) and record measurements on the well development form. If a turbidimeter is not available during well development activities, describe water clarity in field log book or on a well development form using a turbidity tube, and collect a sample for future analysis.
- Record general water quality parameters (e.g., pH, conductivity, temperature) with a properly calibrated meter(s) during evacuation on a well development field form.
- Evacuated water should be disposed following the process defined in the project work plan.
- Report field observations and volume of water removed on well development form.

Purpose

Provide guidelines for developing monitoring wells

Goal and Objective

To ensure wells are properly developed prior to groundwater sampling

Equipment Needs

Decontamination Supplies

Latex or Nitrile gloves

Well Development Form

Turbidity Meter

Water Quality Meter for pH, conductivity, temperature

SOP-19

SURFACE WATER SAMPLING

Samples of surface water (e.g., streams, rivers, springs, ponds, and lakes) can be collected using a variety of methods, with the grab sampling method being the most common. This method is described below, along with a method of sampling free product floating on a surface water body.

GRAB SAMPLING

- When collecting a grab sample of surface water, the sample bottles commonly are placed directly in the water body, and the container(s) are allowed to fill with the water source. Optionally, a single container, such as a clean bucket, can be filled with the water source and then the composited water used to fill the individual sample bottles (see additional description below).
- When collecting water samples from a stream or river, attempt to collect the sample at the interval in the stream which exhibits the largest volume of flow and/or highest velocity. If safely wadable, the samples can be collected away from the bank. If not, the samples should be collected from or near the bank where flow is evident. More than one depth interval may be sampled in the water body.
- When collecting water samples from a pond or lake, the water samples typically are collected from or near the bank where water depths are greater than a few inches.
- Latex or nitrile gloves should be worn when sampling surface water. Decontamination procedures typically are not required for collection of surface water samples, with the exception of meter probes used for measurement of field water quality parameters (see bullet below). Refer to SOP-2 for decontamination procedures.
- Field parameters (pH, temperature, conductivity) should be measured in accordance with applicable SOPs prior to sample collection for laboratory analysis. Take care to collect measurements from the sample locations in the water body similar to the grab sample. Try to limit the disturbance of fine sediment on the bed of the water body while collecting samples. The intent is to prevent increasing the turbidity prior to and during sample collection. If, during sampling, fine sediment on the bed is disturbed, wait until the water clears before collecting a sample.
- Prior to collecting the water samples, the sample bottle labels should be adhered to the bottles and the sample information completed on each label with indelible ink.

Purpose

Provide field sampling methodologies for surface water

Goal and Objective

To ensure surface water samples are collected correctly and consistently in the field

Equipment Needs

Decontamination Supplies

Latex or Nitrile gloves

Water Quality Meter for pH, conductivity, temperature

Coolers and Ice

Sample Bottles & Preservatives

Indelible Marking Pen

Field Sampling Form

Chain-of-Custody

- To collect a sample, submerge a sample bottle such that mouth of bottle is submerged below the water surface at least 2 to 3 inches, if possible. Initially, allow each bottle to fill partially, then rinse bottle by shaking and discharge this water away from sample site. Repeat this procedure three times. Do not rinse sample bottles if the laboratory has previously added a preservative to the container.
- Once the sample container is filled, add preservative (if necessary), and cap the container. If water is too shallow to fill directly to sample bottles, use a decontaminated container to collect sample water. Transfer water from compositing container into the individual sample bottles.
- If the water is too shallow to sample with a bottle, a peristaltic pump can be used to collect a sample. New tubing should be used to pump the shallow surface water directly into sample bottles. A peristaltic pump is also the preferred method of collecting a filtered surface water sample for dissolved constituents because the filter can be placed in-line for ease of sample collection. Refer to SOP-11 for the proper method of filtered sample collection.
- Place sample containers in a cooler with sufficient ice; sample packaging and shipping procedures are included in SOP-4. Sample documentation and chain-on-custody procedures are described in SOP-3.
- Fill out appropriate field form(s) documenting sample location, time, and other pertinent information prior to leaving sampling site (see SOP-1).

SAMPLING FREE PRODUCT ON SURFACE WATER

The procedure described below is to be used when sampling for free phase organic constituents floating on top of a surface water body (e.g., sheen):

- Latex or nitrile gloves should be worn when conducting the sampling procedure.
- Using a wide-mouth jar, submerge the container in such a manner that leaves the mouth of the container half-way out of the water; allow the container to fill.
- Transfer sample from wide-mouth jar directly into sample bottles for lab analysis.
- Refer to SOP-3 and SOP-4 for information about procedures for sample documentation, chain-of-custody, and sample packaging and shipping.

SOP-20

SUBAQUEOUS SEDIMENT SAMPLE COLLECTION

This SOP describes field equipment and sampling methods for collection of fresh-water sediment samples in shallow water (less than 8 feet deep). Methods explained in this SOP may be different from those identified in project specific work plans, which should be referenced for additions or deletions to the methods noted below.

SAMPLE COLLECTION

- Prior to sample collection and between samples, decontaminate all non-disposable sampling equipment in accordance with SOP-2.
- Prepare and label sample containers in accordance with the naming conventions outlined in SOP-3.
- If you can wade into the surface water body, collect the sediment sample using a stainless-steel scoop or spoon. Collect the sediment sample with the scoop or spoon while facing upstream. Sediment should be collected from within the upper 6 inches of sediment depth. Excess water may be removed from the scoop or spoon; however, care should be exercised to avoid the loss of fines when decanting excess water.
- In surface water bodies that are too deep to wade, but less than 8 feet deep, a stainless-steel spoon or scoop attached to a piece of pipe may be used from the banks if the surface water body is narrow, or from a boat.
- Repeat the above steps if more sediment volume is required.
- Record observations of sediment characteristics in the appropriate field log book or field form. Observations may include color, texture, biological organisms, presence of debris, presence of oily sheen, or obvious contamination or odor.
- Document sample collection and location with photographs.
- Following collection, place the sediment sample in a stainless-steel mixing bowl. Remove any large pieces of cobble, wood waste, or other debris greater than 0.5-inch diameter. When analyzing for volatile organic compounds, place the sediment in the sample jar prior to homogenizing as homogenizing may release the more volatile constituents from the sediments. Homogenize the sediment thoroughly using a stainless-steel spoon, and then place a portion of the sample in each sample container. Add preservatives to the sample, as needed.

Purpose

Describe field methodology for subaqueous sediment sample collection

Goal and Objective

To ensure subaqueous sediment samples are collected correctly and consistently in the field

Equipment Needs

Decontamination Supplies

Latex or Nitrile gloves

Stainless-steel Scoop, Spoon, or Trowel

Extension Pipe (if required)

Stainless-steel Mixing Bowl and Mixing Spoons

Sample Jars with Teflon-lined Lids and Jar Labels

Munsel Color Book or Geotechnical Guage (if required)

Cooler and Ice

Field Forms and Field Book

Chain-of-Custody Forms

Camera and Photo Board

- Place sample containers in a cooler with sufficient ice; sample packaging and shipping procedures are included in SOP-4. Sample documentation and chain-on-custody procedures are described in SOP-3.
- Fill out appropriate field form(s) documenting sample location, time, and other pertinent information prior to leaving sampling site (see SOP-1).

SOP-24

QUALITY CONTROL SAMPLING

Quality Control (QC) samples are submitted along with natural samples to provide supporting laboratory data to validate laboratory results. QC field samples are submitted blind to the laboratory with the exception of trip blanks. In general, field equipment blanks and duplicate samples should be collected during every sampling event. Duplicate samples should be collected at a frequency of one sample for every 20 natural samples. Check the project-specific work plan before going to the field to determine what QC samples are required for the sampling event, and at what frequency QC samples should be collected.

With the exception of trip blanks, QC samples are prepared in the field. Trip blanks are supplied by the laboratory and will accompany each sample cooler containing samples for analysis of volatile organic compounds (VOC). Trip blanks provide data to evaluate whether the samples were affected by organic compounds during transport to the laboratory. Matrix spike and matrix spike duplicates (MS/MSD) are generated by submitting three duplicate samples from the same sample to the laboratory. The laboratory spikes two of the three samples with known concentrations of select target compounds, and all three are analyzed to evaluate the accuracy of the analysis.

The most common QC samples are shown in the table below:

Purpose

Outline the quality control samples to be collected in the field

Goal and Objective

To ensure quality control samples are collected along with natural samples to validate laboratory results

Equipment Needs

Field Forms and Field Book
Chain-of-Custody Forms

Most Common Quality Control Samples		
SP	Split Sample	A portion of a natural sample collected for independent analysis; used in calculating laboratory precision
D	Duplicate Sample	Two samples taken from the same media under similar conditions; also used to calculate precision
FB	Field Blank	Deionized water collected in sample bottle; used to detect contamination introduced during the sampling process.
RB	Rinsate Blank	Deionized water run through or over decontaminated equipment; used to verify the effectiveness of equipment decontamination procedures
MS/MSD	Matrix Spike/ Matrix Spike Duplicate	Certified materials of known concentration; used to assess laboratory precision and accuracy
TB	Trip Blank	Inert material (deionized water or diatomaceous earth) included in sample cooler; sent by the lab, the sample is used to detect any contamination or cross-contamination during handling and transportation.

QC sample collection frequencies are presented in the table below. Each field crew leader will be responsible for all QC samples prepared by that crew.

QC Sample	Purpose	Collection Frequency
Field Duplicate	Measure analytical precision.	1 per every 20 samples
Matrix Spike/Matrix Spike Duplicate	Measure analytical accuracy.	1 per every 20 samples
Equipment Rinse Blanks	Evaluate effectiveness of equipment decontamination and sample handling procedures.	1 per sampling event per media
Field Blank	Assess possible cross-contamination of samples due to ambient conditions during sample collection.	1 per sampling event
Trip Blanks	Evaluate sample preservation, packing, shipping, and storage.	1 per sampling event with volatile constituents

SOP-25

MANAGEMENT OF INVESTIGATIVE-DERIVED WASTE

Prior to the field sampling event, review the project-specific work plan to understand how wastes generated during the investigation should be handled. This SOP is applicable to non-hazardous wastes. If hazardous wastes may be generated, consult with the project manager.

SOIL

Whenever possible, soil excavated from test pits should be placed back in the test pit in the reverse order that it was excavated.

To determine appropriate method for handling drill cuttings from soil borings or monitoring well installation, soil exhumed from the borehole should be monitored for staining and field screened for volatile organic compounds (VOCs) using a photoionization detector (PID) in accordance with SOP-17. Based on the PID screening, cuttings with VOC concentrations greater than 100 parts per million (ppm) should be containerized in labeled 55- gallon drums (or roll-off containers if large volumes of cuttings are anticipated), pending further characterization. Alternatively, project personnel may elect to containerize all drill cuttings based on the presence of known contamination and contaminant concentrations. Containerized soil must be disposed in accordance with state and federal regulations based on soil analytical results.

Soil that does not appear to be contaminated based on observations by field personnel and PID screening may be spread on the ground near the point of origin.

If presence of contamination is suspected, but not known, soil core/cuttings should be placed on plastic sheeting or in a drum near the point of origin until analytical data are collected. Once the degree of contamination is known, the soil should be containerized and disposed of properly, or spread on the ground near the point of origin.

GROUNDWATER

Groundwater purged from a well during development or sampling that has a sheen or contains free product must be containerized in an appropriately labeled 55-gallon drum or tank pending receipt of analytical results. A drum should be dedicated to each well sampled so that analytical results of the groundwater sample can be used to characterize the water in the drum. If groundwater from several wells is placed in a drum, the water in the drum should be sampled for adequate characterization. The containerized water must be disposed in accordance with state and federal regulations based on the analytical results. Groundwater that does not have a sheen or does not contain free product may be discharged to the ground surface.

Purpose

Outline the procedure for handling wastes generated during site investigation

Goal and Objective

To employ a method for appropriate handling investigative-derived wastes that limits contamination of the environment

Equipment Needs

PID
Field Forms and Field Book
DOT Approved 55-gallon Drums
Drum Wrench

SOP-36

INCIDENT/ACCIDENT INVESTIGATION AND REPORTING

This guideline establishes procedures for GSI personnel on the reporting of work-related injuries and illnesses and near miss incidents. It applies to all work-related injuries and illnesses which occur to GSI employees at all GSI locations or field sites. Near miss incidents may be reported for prevention purposes.

DEFINITIONS

Injury or Illness - An injury or illness is an abnormal condition or disorder. Injuries include cases such as, but not limited to, a cut, fracture, sprain, or amputation. Illnesses include both acute and chronic illnesses, such as, but not limited to, a skin disease, respiratory disorder, or poisoning. (Note: Injuries and illnesses are OSHA recordable only if they are new, work-related cases that meet one or more of the 29 CFR 1904 recording criteria.)

Near Miss – A near miss is an incident that could have caused employee injury or illness, but did not. It may or may not have caused property damage. Near misses are used to implement control methods for preventing future occurrences.

Physician or Other Licensed Health Care Professional - A physician or other licensed health care professional is an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently perform, or be delegated the responsibility to perform, the activities required.

Purpose

To provide procedures for GSI personnel on the reporting of work related injuries and illnesses and near miss incidents.

Goal and Objective

To provide a record of our work related injuries, illnesses and near miss incidents.

Equipment Needs

Incident Report Form

RESPONSIBILITIES

Human Resources Director (HR) – The HR is responsible for periodic review of the guidelines in this policy. HR is responsible for referring employees for non-emergency medical treatment, maintaining records related to injuries and illnesses that occur from occupational causes, and filing required reports with the Workers Compensation Insurance carrier. HR will maintain any required OSHA 300 logs and will provide information on accidents and near miss incidents to the HSC for prevention of similar incidents.

Project Principles (PP) - PP are responsible for reporting work related injuries and illnesses at all GSI field sites and office locations. The PP is responsible for investigation of accidents and near misses for their projects and for implementing control methods needed to prevent recurrence of the incident.

Office Health and Safety Coordinator (HSC) – The HSC will provide assistance in investigation of accidents and near misses and will provide information to their offices regarding incident experience of other GSI groups.

Employees – Employees are responsible for reporting all work related injuries and/or illnesses immediately to their direct supervisor or the PP. Employees will assist in the completion of required reports and investigations of accidents. Employees will also report near miss incidents to the PP so that an investigation can be completed to implement controls to prevent recurrence of the incident.

GUIDELINES

Accident Response

1. Employees must report any incidents or near misses immediately to the PP and the HSC.
2. If medical attention is required, the employee is to follow the guidelines listed in SOP #8 (Emergency Action Plan) or site-specific HASP for the nearest medical facility or call 911 for emergency medical personnel.
3. Unless federal, state or local laws require differently, the PP will complete an “Incident Report” (Appendix A or equivalent) within 24 hours for each injury or illness to personnel or accidental damage to property. Vehicular accidents will be reported for company vehicles and personal vehicles used for business if the accident occurred during company business. For vehicular incidents, a copy of the police report must be attached.
4. A copy of the written report will be sent immediately to the Human Resources Director (HR)
5. The HR will notify the appropriate insurance company. Injuries and illnesses will be reported to the Workers Compensation insurance carrier, vehicular accidents will be reported to the vehicle insurance carrier. The owner of a personal vehicle will report an accident to their personal auto insurance carrier.

Near Misses

Near misses should be reported in the same manner as an accident using the “Incident Report Form” in Appendix A. While near misses will not be reported to the insurance carrier, they are valuable in the prevention of injuries. Employees may complete the report form and provide a copy to the PP and HSC. The PP will investigate the incident and determine appropriate control measures with the assistance of the HSC. The PP will document the corrective action taken on the incident form, or by memo and forward a copy to HR. HR will provide appropriate information to other HSC to improve prevention of similar accidents.

Incident Investigation

The PP should investigate all incidents and near misses for the root causes and to identify appropriate corrective actions. Responsibilities should be assigned for each corrective action as well as target dates for completion. Completed corrective action will be documented and the forwarded to the Human Resources Director.

Reporting of a Catastrophe or Fatality

OSHA requires that the employer verbally report by phone any occupationally caused fatality (except vehicular or public/commercial transportation) and any single incident that results in the hospitalization of three or more individuals (catastrophe) within 8 hours of receiving the information. This includes any fatality or hospitalization of three or more individuals up to 30 days after the initial incident. Any fatality or catastrophe will be reported as soon as possible to the PP. GSI Management will report such incidents to OSHA when required.

REFERENCE

29 CFR 1904

APPENDIX A - INCIDENT REPORT FORM

Incident Type: Check all that apply.

Injury/Illness: ☐ Disabling ☐ Restricted Duty ☐ Recordable ☐ First Aid ☐
Vehicle/Property Damage ☐ Air Emission ☐ Spill ☐ Near Miss ☐
Third Party Involved ☐ Other ☐

WHO WAS INJURED?

Name _____ Date and Time of Incident: Date _____ Time _____
Home Address _____ Home Telephone Number _____

Date reported: _____
Supervisor on Duty _____
Shift/Time Started: _____ Witness (es) _____
Job Classification: _____
Location of Incident: _____
Length of service with company years _____ months _____
Time spent on present job _____

Nature of Injury _____

Task being performed (Brief description of the task being performed and equipment used.)

MEDICAL INFORMATION/ INJURY CLASSIFICATION

Medical Treatment - Where: _____ Date: _____

Treated by: _____ (Doctors Name & telephone)

If employee is placed on restricted duty, provide details of the restriction.

If employee is placed off duty, provide the next scheduled doctor visit (Doctor and date)

If employee is hospitalized provide the name and address of the hospital.

DESCRIBE INCIDENT (What was the work assignment; nature of the incident; result of the incident?)

WHAT HAPPENED? (Tell exactly what happened; give exact location.)

WHY DID IT HAPPEN? (What were the contributing factors, root causes?)

DESCRIBE CORRECTIVE ACTIONS TAKEN

Employee Signature _____

Date _____

Project Manager Signature _____

Date _____

Partner Signature _____

Date _____

SOP-38

EMERGENCY ACTION PLAN

This purpose of this Emergency Action Plan is to establish guidelines for GSI employees to respond to emergencies. This SOP applies to GSI office and field locations. Subcontractors are required to develop their own Emergency Action Plan and to coordinate their plan with GSI's SOP.

DEFINITIONS

- AED – Automated External Defibrillator is life saving equipment that is used to shock the heart into proper rhythm.
- Clean-up Operation – An operation where hazardous substances are removed, contained, or cleaned up with the goal of minimizing the impact to people and the environment.
- Decontamination – A process involving the removal of hazardous substances through physical means or neutralization.
- Employee Alarm System – A verbal or audible method of alerting personnel of an emergency situation.
- Hazardous Material Emergency Response – A response effort by employees from outside the immediate release area or by other designated responders, to an occurrence which results, or is likely to result in an uncontrolled release of a hazardous substance.

RESPONSIBILITIES

- Human Resources Director (HR) – HR will review reports of emergency incidents and will update this SOP as needed.
- Project Principal – The PP is responsible for providing appropriate resources in personnel and equipment required to complete the operations safely. They are also responsible for making available required training to affected employees. The PP is responsible for determining that an appropriate Emergency Action Plan is in operation at all GSI field sites and that GSI employees have been properly trained in the requirements of the plan. They are responsible for initiating evacuation or other response and making notifications as needed.

Purpose

To establish guidelines for GSI employees to respond to emergencies.

Goal and Objective

The Emergency Action Plan addresses potential emergencies that could be reasonably expected on a site. This SOP applies to GSI offices and field locations.

Equipment Needs

- Fire extinguishers suitable for extinguishing ABC class fires
- First aid kit/Bloodborne pathogens kit
- CPR kit
- Self contained eye wash tank (when potential for eye contact exists)
- Personal Protective Equipment
- Air horns or equivalent signal device

- Health and Safety Coordinator (HSC) –The HSC has the responsibility for the development and implementation of a site specific Emergency Action Plan for each office location in compliance with this SOP. They are responsible for initiating or coordinating evacuation drills for their sites.
- Employees – All employees will observe all emergency procedures appropriate to the site. In the event of an evacuation, employees are to follow the instructions provided by the PP/HSC and proceed to the muster point.

GUIDELINES

- Emergency situations can be characterized as a fire, explosion, serious weather condition, a hazardous environmental release, or accident with injury to personnel.

Emergency Action Planning

Each GSI office and field site must have an Emergency Action Plan in place and the plan must be communicated to all employees on the site. The Emergency Action Plan must address potential emergencies that could be reasonably expected on a site. The Emergency Action Plan includes the following:

- Reasonably anticipated emergencies and the actions required by employees
- Evacuation procedures and designated emergency escape routes and muster points (Appendix A)
- Duties and procedures for GSI employees
- Procedures to account for all employees after emergency evacuation has been completed
- Emergency rescue procedures including emergency phone numbers, contact people and routes of entry for emergency vehicles
- A chain of command list, including each person's name, title and phone number
- An employee alarm system
- Evacuation drills

Types of Emergencies

There are a wide variety of potential emergency situations that may occur on any site. These should all be considered when completing the initial H&S Checklist or site-specific HASP for a field site. However, emergencies can also happen at office locations. They can include, but are not limited to:

- Fire
- Explosion
- Chemical Release
- Medical Emergency
- Bomb Threat
- Severe Weather

- Civil Disturbance
- Workplace Violence
- Terrorist Action

Preplanning and practice for emergencies help to prevent or reduce injury and damage in these situations.

Emergency Notification Procedures

The PP is responsible for any emergency notifications required. These notifications may involve emergency response agencies, other organizations on the site, and regulatory agencies.

When notifying outside emergency response agencies of the emergency, it is important to assure the rapid and accurate transfer of information to appropriate personnel. When calling the police, fire department, or medical emergency personnel, the following information should be provided to the dispatcher:

- Caller's full name
- The nature of the incident (i.e. "Fire")
- The location of the incident (i.e. "Street location and nearest intersection"). The more specific the better.
- What you need (i.e. "Fire Department and First Aid").
- If you are able, where you will meet emergency responders (i.e. at end of West Street, near train tracks).
- If applicable, a call back number or your pager number (e.g. "I'll be at the scene; my pager number is 123-4567").
- Status of the situation (e.g., is the situation stabilized or "I have the fire under control").
- If anyone is injured or in need of emergency assistance (e.g. "A mechanic working on a pump was burned.").

Additional regulatory agencies may need to be notified during or after the emergency, such as EPA for a hazardous material spill, or OSHA for a fatality. Consult with the PP and HR before calling these agencies to maintain compliance with the regulations.

Reporting

GSI PP and Human Resources will be notified when:

1. Any employee, contractor, or third party employee suffers a fatality or serious occupational injury or illness. Serious injuries or illnesses include those that involve amputation, crushing injury, hospitalization, or work-related toxic material exposure, even if no lost workdays are experienced. Transportation incidents will be reported if the person was on Company business.
2. Damage from fires, explosions or a natural disaster in excess of US \$50,000 occurs to Company buildings or equipment.

3. Regulatory inspections, notices, citations, orders, or requests for information involving occupational health, safety or environmental issues alleged non-compliance with laws, regulations, permits, licenses, etc. civil liability, criminal liability, or that work conditions endanger the lives or health and safety of employees, contractors, or the community.
4. Spills or releases of hazardous substances may require governmental agency notification.
5. Legal action regarding an occupational health, safety or environmental issue is being taken or is threatened by any party, including public and private entities.

Measures to Review and Follow-up Incident Reports

For any emergencies that occur at a GSI site, the PP or HSC will provide a report to HR describing the following:

- The event (including date and time) that necessitated the response and the basis for that decision
- Date, time, and names of all persons/agencies notified and their response.
- Resolution of the incident (including duration) and the method/corrective action involved.

This report will be reviewed by HR to determine if changes to this SOP are needed.

Personnel Injury

Personnel injury may occur at any location, and medical treatment may range from first aid to life-saving techniques. If medical attention is needed an ambulance/rescue squad should be contacted for transport, in most cases. Some situations may require transport of an injured party by company personnel. The nearest hospital and driving directions for the hospital route are located in the site- specific HASP or site Emergency Action Plan. Please refer to SOP #12 First Aid and CPR and SOP # 17 Incident/Accident Reporting and Investigation.

Evacuation

In most emergency situations all personnel will evacuate the building or area and assemble at their designated muster point. Each office and field location will have a written evacuation plan (Appendix A) that includes an employee signal and appropriate muster points for personnel to meet outside the building/area and a map of exit routes. Many municipalities require an exit route map to be posted in the employee areas.

Designated personnel will be responsible for accounting for personnel at muster points. No unauthorized person will be allowed back into the area/building once the emergency signal has been given.

Employees

New employee orientation will include review of emergency procedures. New employees will be briefed on alarm signals, appropriate responses to the signals, lines of authority, evacuation routes and muster points.

Initial field site briefings will include emergencies procedures, alarm signals and the designation of the safe refuge during a site evacuation. All employees are required to gather at the designated refuge site after hearing the emergency signal.

Subcontractors

Subcontractors working on GSI project sites will identify the appropriate refuge for their workers. Each subcontractor will identify one person to account for their personnel and report their status.

Drills

All locations will conduct evacuation drills at least annually. These drills may be scheduled. Drills must include the sounding of appropriate alarms, evacuation of all personnel, accounting for personnel at muster points, and evaluation of drill effectiveness. Any deficiencies should be noted in a report to the HR and improvements should be made to the location's evacuation drill.

Fire Fighting Procedures

When a fire is detected, the fire department will be contacted immediately by activating the office alarm system or calling 911 (see Emergency Notification 5.2). A fire extinguisher meeting the requirements of 29 CFR Part 1910 Subpart L, as a minimum, will be accessible to control small incipient fires. Appropriate fire extinguishers will be located in each office area and all company vehicles. Only personnel with appropriate training in the use of fire extinguishers should use this equipment. GSI employees are not expected to fight fires.

Chemicals Releases

Releases may involve gases, liquid, or solids. The release area should be blocked off to avoid the spread of the spilled material and contact with personnel, equipment or vehicles. Minor chemical spills may be cleaned up utilizing the appropriate absorbent material. The location of any spill clean up equipment will be included in the initial site briefing. Only trained and qualified personnel may address a large spill or one of a highly toxic nature. Therefore, if a large spill or one of a highly toxic nature occurs, all GSI personnel will evacuate the area and the Emergency Response personnel will be notified.

Severe Weather Conditions

Severe weather conditions may include, snow storms, blizzards, hurricanes, tornados, lightning, thunderstorms, high winds and heavy rain. Severe weather may cause significant hazards for field operations, depending on the tasks being performed and the available shelter. In some cases, severe weather may affect the safety of personnel in office locations as well. It is the responsibility of the PP to determine when work will cease and employees should proceed to shelter.

If severe weather conditions are expected, the following should be considered prior to work initiation:

- Check the extended forecast for the work area to prepare for possible severe weather situations.

- Coordinate with the local authorities to determine safe areas or public storm shelters that can be used in an emergency.
- For additional information, use an AM/FM radio, NOAA Weather Radio or telephone to get updated information on storms in the area.
- Contact the local National Weather Service office or American Red Cross chapter for updates on storm conditions.
- Keep a lookout for signs of approaching severe weather, such as increasing wind, flashes of lightning and sound of thunder.

If serious weather conditions develop, operations should stop and personnel should proceed to designated shelters.

Emergency Equipment

GSI office locations will maintain, at a minimum:

- Fire extinguishers suitable for extinguishing ABC class fires
- First aid kit/Bloodborne pathogens kit
- CPR kit

GSI field sites will maintain the following equipment for safety and emergency response purposes:

- Fire extinguisher
- First aid kit/ Bloodborne pathogens kit
- Self contained eye wash tank (when potential for eye contact exists)
- Personal Protective Equipment
- Air horns or equivalent signal device

Emergency Communications

Cellular phones will be used for GSI field sites and office locations without paging systems for emergency communications.

TRAINING

All GSI employees will receive, at a minimum, Emergency Awareness training during orientation. Additional training will be completed whenever a change in the Emergency Action Plan or Evacuation Plan occurs. All GSI employees at field sites will be provided site- specific emergency procedures during the initial briefing for the project and whenever there is a change. Training will be documented and will include:

- Employee alarm
- Evacuation Procedures
- Muster points
- Emergency recognition and response

REFERENCES

29 CFR 1910.120 or 1926.65 Hazardous Waste Operations and Emergency Response

29 CFR 1910.39 Emergency Action Plans

APPENDIX A – SITE SPECIFIC EMERGENCY EVACUATION PLAN

Location: _____ Date: _____

Prepared by: _____

Emergency Coordinator: _____

Emergency Phone Numbers: _____

Employee Alarm System (describe sound/light):

Evacuation Plan:

Muster Locations (including those responsible for headcounts):

Exit route maps are attached.

ATTACHMENT 2

Field Forms, Well Completion Forms and Chain of Custody Forms

FIELD FORMS	
#	Description
1	Daily Field Record
2	Exploration Log Key
3	Soil Boring Log
4	Monitoring Well Installation Record
5	Monitoring Well Completion and Lithology Log
6	Groundwater Sampling and/or Development Form
7	Photo Log
8	Incident Report Form
9	SGS Analytical – Chain of Custody

[illegible]

Soil Classifications are based on the Unified Soil Classification System (USCS), ASTM D2187 and D2488. Descriptions are based on visual observation, except where they have been modified to reflect results of laboratory tests as deemed appropriate.

Terms Describing Relative Density and Consistency			Estimated Percentage		Plasticity Description	
Coarse - Grained Soils	Density	SPT blows/foot	Percent by Weight	Modifier	Descriptive Terms	Plasticity Index
	Very Loose	0 to 4	<5	Trace	Non-plastic	0
	Loose	4 to 10	5 to 15	Slightly (sandy, silty, clayey, gravelly)	Low	1-10
	Medium Dense	10 to 30	15 to 30	Sandy, silty, clayey, gravelly)	Medium	11-30
	Dense	30 to 50	30 to 49	Very (sandy, silty, clayey, gravelly)	High	>30
Fine - Grained Soils	Consistency	SPT blows/foot	Dilatancy		Fracturing	
	Very Soft	0 to 2				
	Soft	2 to 4				
	Medium Stiff	4 to 8				
	Stiff	8 to 15				
Very Stiff	15 to 30	None	No visible change in the specimen	Intensity	Size of Pieces (ft)	
Hard	>30	Dilatant	Water appears on the surface on the specimen during shaking	Very little fractured	Greater than 4.0	
					Moderately fractured	0.5 to 1.0
					Closely fractured	0.1 to 0.5
					Intensely fractured	0.05 to 0.1
					Crushed	Less than 0.05
Moisture Content			Strength			
Dry	Absence of moisture, dusty, dry to the touch		Plastic	Very low strength.		
Slightly Moist	Perceptible moisture		Friable	Crumbles easily by rubbing with fingers.		
Moist	Damp but no visible water		Weak	An unfractured specimen of such material will crumble under light hammer blows.		
Very Moist	Water visible but not free draining		Moderately strong	Specimen will withstand a few heavy hammer blows before breaking.		
Wet	Visible free water, usually from below water table		Strong	Specimen will withstand a few heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.		
			Very Strong	Specimen will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.		
Rock Field Hardness			Weathering			
Very Soft	Can be carved with knife. Can be excavated readily with point of rock hammer. Can be scratch readily by fingernail.		The physical and chemical disintegration and decomposition of rocks and minerals by natural processes such as oxidation, reduction, hydration, solution, carbonation, and freezing and thawing.			
Soft	Can be gouged deeply or carved easily with a knife blade.		Deep	Moderate to complete mineral decomposition; extensive disintegration; deep and thorough discoloration; many fractures, all extensively coated or filled with oxides, carbonates and/or clay or silt.		
Moderately hard	Can be readily scratched by a knife; scratch leaves a heavy trace of dust and is readily visible after the powder has been blown away.		Moderate	Slight change or partial decomposition of minerals; little disintegration; cementation little to unaffected. Moderate to occasionally intense discoloration. Moderately coated fractures.		
Hard	Can be scratched with difficulty; scratch produces a little powder and is often faintly visible.		Little	No megascopic decomposition of minerals; little or no effect on normal cementation. Slight and intermittent, or localized discoloration. Few stains on fracture surfaces.		
Very Hard	Cannot be scratched with knife blade; leaves a metallic streak.		Fresh	Unaffected by weathering agents. No disintegration of discoloration. Fractures usually less numerous than joints.		
Drilling Notes						
SPT - Standard Penetration Test, SPT, involves driving a standard thick-walled sample tube (spilt spoon) into the undisturbed ground at the bottom of a borehole by blows from a 140-pound (63.5 kg) slide hammer falling 30 inches (762 mm). The sample tube is driven 6 inches (150 mm) into the ground and then the number of blows needed for the tube to penetrate each 6 inches (150 mm) up to a depth of 24 inches (600 mm) is recorded. The sum of the number of blows required for the second and third 6 inches (150 mm) of penetration is reported as SPT blowcount value, commonly termed "standard penetration resistance" or the "N-value".						
RQD - Rock Quality Designation (RQD) for samples are determined for each core run by summing the length of all sound, hard pieces of core measuring at least two diameters in length, then dividing this number by the total length of the core run. This value, along with the core recovery percentage, is recorded on the drill logs.						
General Notes						
• Descriptions on these boring logs apply only at the specific boring, and at the time of borings were made. These logs are not warranted to be representative of subsurface conditions at other locations or times.						
• Water Levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.						
• Unless otherwise noted, geographic coordinates are approximately determined using a hand-help GPS device. The accuracy of such devices is variable.						
• All tests were run in general accordance with appropriate ASTM Standards and NewFields' SOPs.						
			Exploration Log Key			
			Physical Properties Criteria for Rock and Soil			Page 2 of 2

SAMPLER TYPE	INCHES DRIVEN	INCHES RECOVERED	SAMPLE NO.	SAMPLE DEPTH	OVM/PID/FID READING	BLOW CT PER 6"	SPT N-VALUE	DEPTH IN FEET	LITHOLOGY	SURFACE CONDITIONS:	
								0			
								1			
								2			
								3			
								4			
								5			
								6			
								7			
								8			
								9			
								0			
								1			
								2			
								3			
								4			
								5			
								6			
								7			
								8			
								9			
								0			

MONITORING WELL INSTALLATION RECORD

MONITORING WELL

MONITORING WELL NO.: _____
PROJECT: _____
SITE: _____
BOREHOLE NO.: _____
WELL PERMIT NO.: _____
TOC TO BOTTOM OF WELL: _____

DRILLING INFORMATION

DRILLING BEGAN:
DATE: _____ TIME: _____
WELL INSTALLATION BEGAN:
DATE: _____ TIME: _____
WELL INSTALLATION FINISHED:
DATE: _____ TIME: _____
DRILLING CO.: _____
DRILLER: _____
LICENSE: _____
DRILL RIG: _____
DRILLING METHOD:
☐ HOLLOW STEM AUGER
☐ AIR ROTARY
☐ OTHER: _____

DIAMETER OF AUGERS:
ID: _____ OD: _____

WELL CASING

☐ SCHEDULE 40 PVC
☐ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: _____ OD: _____
LENGTH OF CASING (TOTAL): _____

**NOTE: IF CASING SEGMENTS OF VARYING LENGTH ARE USED, RECORD ALL SEGMENT LENGTHS ON BACK*

WELL SCREEN

☐ SCHEDULE 40 PVC
☐ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: _____ OD: _____
SLOT SIZE: _____
LENGTH OF SCREEN: _____

BOREHOLE BACKFILL

AMOUNT CALCULATED: _____
AMOUNT USED: _____
☐ BENTONITE CHIPS, SIZE: _____
☐ BENTONITE PELLETS, SIZE: _____
☐ SLURRY: _____
☐ FORMATION COLLAPSE: _____
☐ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
☐ POURED ☐ TREMIE
☐ OTHER: _____

SURFACE COMPLETION

- ☐ FLUSH MOUNT
☐ ABOVE GROUND WITH BUMPER POST
☐ CONCRETE ☐ ASPHALT

SURVEY INFORMATION

TOC ELEVATION: _____
GROUND SURFACE ELEVATION: _____
NORTHING: _____
EASTING: _____
DATE SURVEYED: _____
SURVEY CO.: _____

ANNULAR SEAL

VOLUME CALCULATED: _____
AMOUNT USED: _____
☐ GROUT FORMULA (PERCENTAGES)
PORTLAND CEMENT: _____
BENTONITE: _____
WATER: _____
☐ PREPARED MIX
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
☐ POURED ☐ TREMIE
☐ OTHER: _____

BENTONITE SEAL

VOLUME CALCULATED: _____
AMOUNT USED: _____
☐ PELLETS, SIZE: _____
☐ CHIPS, SIZE: _____
☐ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
☐ POURED ☐ TREMIE
☐ OTHER: _____
AMOUNT OF WATER USED: _____

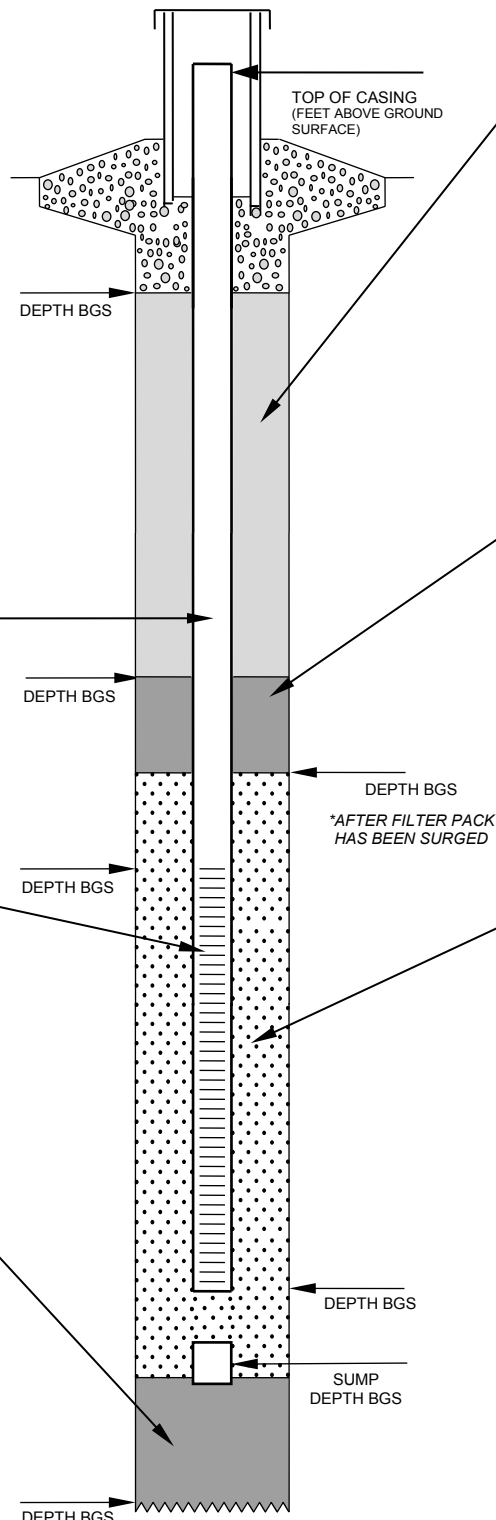
FILTER PACK

☐ PREPACKED FILTER
VOLUME CALCULATED: _____
AMOUNT USED: _____
☐ SAND, SIZE: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
☐ POURED ☐ TREMIE
☐ OTHER: _____
WATER LEVEL: _____
(BTOC AFTER WELL INSTALLATION)

CENTRALIZERS USED?

☐ YES ☐ NO;
CENTRALIZER DEPTHS: _____

BGS – BELOW GROUND SURFACE
BTOC – BELOW TOP OF CASING
N/A – NOT APPLICABLE
NR – NOT RECORDED
TOC – TOP OF CASING



JOB NO: _____		WELL NO: 	
PROJECT: _____		STATE: _____	COUNTY: _____
LEGAL LOCATION: _____		LOGGED BY: _____	
T	R	S	TRACT
DATE STARTED: _____		DATE COMPLETED: _____	DRILLING CO/ DRILLER: _____
DRILLING METHOD: _____		BOREHOLE DIAM (IN): _____	DRILL FLUIDS USED: _____
TOTAL DEPTH DRILLED: _____	TOTAL DEPTH CASED: _____	INTERVAL PERFORATED FROM OR SCREENED (FT.): _____	DIAMETER: _____
METHOD OF PERFORATION: _____		DURING WELL CONSTRUCTION WAS/WERE: _____	YES
_____ Open Hole		_____ Well Developed	NO
_____ Open Bottom		_____ Well Pumped	_____
_____ Saw Slotted		_____ Water Samples Collected	_____
_____ Factory ____ (size)		_____ Material Samples Collected	_____
_____ Other: Roller Perf tool 1/2" x 1"; 4 rows			_____
ANNULAR COMPLETION CHARACTERISTICS			
WELL PROTECTOR: _____	LENGTH: _____	SURFACE SEAL TYPE: _____	FROM: _____ TO: _____
	DIAM: _____	BACKFILL MATERIAL: _____	FROM: _____ TO: _____
LOCK NO: _____		HOLE PLUG: _____	FROM: _____ TO: _____
		FILTER PACK TYPE: _____	FROM: _____ TO: _____
STATIC WATER LEVEL: _____	DATE: _____	MEASURING POINT DESCRIPTION/ ELEVATION: _____	MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) _____
REMARKS: _____			

[illegible]

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: _____

PROJECT: _____

WELL NO: _____

INTERVAL(FT) below ground surface	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS

INCIDENT REPORT

Occupational Accident, Injury, or Illness

1. Employee Name: _____
2. Employee No.: _____ 3. Office location: _____
4. Job title: _____
5. Home address: _____
6. Phone number: _____
7. Sex: ☐ M ☐ F 8. Date of birth: _____
9. Type of incident: ☐ Exposure ☐ Physical injury
10. Address where incident occurred (include county): _____

11. Date and time of incident: _____
12. Date incident was reported: _____ To whom: _____
13. What were you doing when injured? (Be specific identify tools, equipment, or materials you were using.)

14. How did the accident or exposure occur? (Describe events fully. Tell what happened and how it happened. Use additional sheets if needed.)

15. Object or substance that directly injured you:

16. Describe the injury or illness (e.g., cut, strain, fracture, skin rash):

17. Part of body affected: _____

18. Did you receive medical care? ☐ Yes ☐ No If so, when? _____
By whom? (Name and address of physician/paramedic/hospital.)

If hospitalized, name and address of hospital:

19. Did you lose time from work? ☐ Yes ☐ No If so, how much? _____

20. Have you returned to work? ☐ Yes ☐ No If so, date returned: _____

21 List anyone else affected by this incident.

22 List any witnesses to this incident.

Signature

Date



FORM: EHSA-QAC-0027-02-FORM-Wheat Ridge - COC; RV 12/29/22

ATTACHMENT 3

Schedule

