



APPENDIX C OF ADDENDUM 12 TO THE REMEDIAL INVESTIGATION WORK PLAN

FIELD SAMPLING PLAN 12C – QUARTER 4, 2024 GROUNDWATER MONITORING

SMURFIT – STONE / FRENCHTOWN MILL SITE Missoula, Montana

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REMEDIAL INVESTIGATION WORK PLAN
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Former Smurfit Stone / Frenchtown Mill Site
Missoula, Montana**

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1.0 INTRODUCTION

Field Sampling Plan (FSP) 12C describes the scope of work related to sampling at the Smurfit-Stone/Frenchtown Mill Site (hereafter referenced as the “Site”) (Figure 12C-1) during Quarter 4 (Q4) 2024. Activities related to sampling include well redevelopment, groundwater monitoring, and surface water and sediment sampling. FSP-12C follows 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, surface water and sediment investigation in Q4 of 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-12C investigates the nature and extent of contaminants of potential concern (COPCs) and contaminants of potential ecological concern (COPECs) in groundwater, surface water, and sediment at the Site, and the mobility of COPCs in groundwater from potential source areas toward downgradient receptors, along paleochannels near the Clark Fork River (CFR), and towards the CFR. Results from FSP-12C will improve the groundwater conceptual site model (GCSM) with additional data to enhance understanding of spatial and temporal groundwater quality patterns and reduce uncertainties in the risk assessment findings. FSP-12C details data collection methods intended to address data quality objectives (DQOs) initially identified in Addendum 11A (NewFields, 2023b), FSP-12A (GSI, 2024b) and FSP-12B (GSI, 2024c). The following DQOs apply the EPA's seven step approach (EPA, 2006) to outline the principal study questions and investigation approach. The DQOs are also summarized in **Table 12C-1**.

2.1 Data Quality Objectives

2.1.1 State the Problem

Nature and Extent:

Additional groundwater, surface water, and sediment data (water levels and water or sediment quality) will help to refine the GCSM for the Site, will supplement the dataset characterizing nature and extent of contamination, and support groundwater quality spatial and temporal trend analysis.

During Quarter 2 2024 groundwater monitoring (GSI, 2024b), GSI noticed decreased performance of several existing monitoring wells prompting an evaluation of the existing monitoring well network for redevelopment criteria described in SOP-12A and SOP-18 (**Attachment 1**). Based on this evaluation, three wells (**Section 3.1**) are recommended to be redeveloped.

Dedicated sample tubing can minimize turbidity, reduce the need for decontamination and reduce disturbance in the monitoring well casing (Yeskis and Zavala, 2002). No Aquifer Unit (AU) 1 monitoring wells at the Site currently have dedicated tubing; the addition of dedicated tubing where feasible (**Section 3.1**) will help improve sampling efficiency and sample quality.

Fate and Transport:

Additional groundwater, surface water, and sediment 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. Upstream surface water and sediment data will serve as a comparison point for water and sediment quality adjacent to the Site and clarify the extent to which groundwater may be contributing to CFR water quality.

Risk Assessment:

The nature and extent of polychlorinated biphenyls (PCBs) in groundwater was previously investigated as Aroclors which represent common commercial mixtures of PCBs sold from approximately 1930 to 1979. PCB congener (individual compounds) data were collected in groundwater monitoring events beginning in Fall 2023; however, additional data is needed to evaluate potential presence or absence of dioxin-like PCB congeners as well as total PCBs above concentrations that contribute to risk at the Site. 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) is present and likely overestimate actual Site risks (EPA, 2022). The collection of additional PCB congener and hexavalent chromium concentration data will decrease uncertainty in the risk assessments.

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 fate and transport 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 will additional groundwater water quality data compare with existing data and supplement the current understanding of the spatial and temporal water quality trends at the Site?

PSQ 2: How will additional surface water and sediment quality data compare with Site groundwater data and upstream surface water and sediment results, and supplement the current understanding of the nature and extent of potential contamination in the CFR?

Fate and Transport:

PSQ 3: Are constituents mobilizing from potential source areas into on-Site groundwater? Are contaminants mobilizing in groundwater laterally (east to west) or vertically and do the existing paleochannels influence this movement?

PSQ 4: How do concentrations of constituents in the CFR upstream of the Site compare to concentrations of constituents in on-Site groundwater and CFR surface water (adjacent to the former wastewater treatment system [WWTS]), and to what degree is Site shallow groundwater (Unit 1) contributing to CFR surface water quality?

Risk Assessment:

PSQ 5: Do the concentrations of dioxin-like PCB congeners, total PCBs, or hexavalent chromium in groundwater, surface water, and sediment reduce uncertainty or otherwise modify the existing Risk Assessment findings?

2.1.3 Identify Information Inputs

PSQ 1: Nature and Extent – groundwater

- Monitor 59 wells including 1 perched zone, 54 Shallow Aquifer Unit 1 (AU1) wells, and four (4) Deep Aquifer Unit 3 (AU3) wells (**Table 12C-2, Figure 12C-2**).
- Record field parameters (pH, conductivity, temperature, oxidation reduction potential, dissolved oxygen, and turbidity) and analyze groundwater samples for total and dissolved metals, common ions, dioxins/furans, PCB Aroclors, and PCB congeners (**Table 12C-2, Table 12C-4, Figure 12C-3**).

- Record groundwater elevation measurements from monitoring wells (manually and/or via transducers where available) across the Site to monitor groundwater flow and gradient and to determine if portions of the former settling ponds and solid waste basins are saturated during high groundwater conditions (**Table 12C-2, Table 12C-3a, Figure 12C-2**).
- Redevelop three AU1 groundwater wells (NFMW7, NFMW9 and NFMW19) to improve the hydraulic connection between the monitoring well and surrounding formation.

PSQ 2: Nature and Extent – surface water and sediment

- Sample surface water and sediment at 13 locations in the CFR and Bitterroot River, including six locations upstream of the former WWTS basins at the Site, six locations adjacent to the former WWTS basins, and one location downstream of the Site. Sample surface water only at one additional location adjacent to the former WWTS basins (**Table 12C-2, Figure 12C-4**).
- Record field parameters and analyze surface water samples for total and dissolved metals, common ions, dioxins/furans, PCB Aroclors, and PCB congeners. Analyze sediment samples for total and dissolved metals, dioxins/furans, PCB Aroclors, PCB congeners, grain size and organic matter (**Table 12C-2, Table 12C-3a, Figure 12C-4**).

PSQ 3: Fate and Transport – constituents mobilizing in groundwater

- Monitor 59 wells including one perched zone, 54 AU1 wells, and four AU3 wells. (**Table 12C-2, Figure 12C-2**).
 - Including monitoring 25 AU1 wells downgradient from potential source areas and 21 AU1 wells located in paleochannels (**Table 12C-2, Figure 12C-2**).
 - Analyze groundwater samples for total and dissolved metals, common ions, dioxins/furans, PCB Aroclors, and PCB congeners (**Table 12C-2, Table 12C-4, Figure 12C-3**).
- Analyze 10 wells for redox species along the C-C' transect (**Table 12C-2, Table 12C-4, Figure 12C-3**).
- Record continuous conductivity, temperature, depth, ORP and/or pH data from transducers and sensors in 20 wells. This includes seven depth and temperature transducers; eight depth, temperature, and conductivity transducers; and five depth, temperature, and conductivity transducers with pH and ORP sensors (**Table 12C-3a**).

PSQ 4: Fate and Transport – constituents in the CFR

- Sample surface water and sediment at 12 locations on the CFR and one location on the Bitterroot River, including six locations upstream of the mill property, six locations adjacent to the mill property, and one location downstream of the mill property. Sample surface water only at one additional location on the CFR adjacent to the mill property (**Table 12C-2, Figure 12C-4**).
- Monitor 59 wells including one perched zone, 54 Unit 1 aquifer, and four Unit 3 aquifer (**Table 12C-2, Figure 12C-2**).
- Record field parameters and analyze samples for total and dissolved metals, common ions, dioxins/furans, PCB Aroclors, and PCB congeners (**Table 12C-2, Table 12C-4, Figure 12C-3**).

- Analyze 10 wells along the C-C' transect and 8 surface water locations adjacent to the mill property for redox species (**Table 12C-2, Table 12C-4, Figure 12C-3, Figure 12C-4**).
- Record continuous conductivity, temperature, depth, ORP and/or pH data from transducers and sensors at three surface water locations. This includes two depth, temperature, and conductivity transducers; and one pressure, temperature, and conductivity transducer with pH and ORP sensor (**Table 12C-3a**).

PSQ 5: Risk Assessment

- Monitor 59 wells and sample 14 surface water and 13 sediment locations (**Table 12C-2, Figure 12C-2, Figure 12C-4**).
- Analyze samples for PCB Aroclors, PCB congeners, and dioxins/furans (**Table 12C-2, Table 12C-4, Figure 12C-3, Figure 12C-4**).
- Analyze samples from 16 monitoring wells, 14 surface water locations and 13 sediment locations for hexavalent chromium (**Table 12C-2, Table 12C-3b, Table 12C-4, Figure 12C-3, Figure 12C-4**) to confirm the range of hexavalent chromium in Unit 1 groundwater and investigate the presence of hexavalent chromium in the CFR. Monitoring wells were selected using the following rationale(s):
 - Two background monitoring wells (County MW and SMW1)
 - Any wells with no previous usable hexavalent chromium results by EPA Method 218.6 (total of six; ATMW6, NFMW5, NFMW7, RE289, SMW1 and SMW17D)
 - Three wells with detectable hexavalent chromium results (SMW16 and SMW17, NFMW3)
 - Two wells downgradient of SMW16 and SMW17 and adjacent to CFR (MW34 and SMW12)
 - Six wells with elevated Total Chromium (NFMW1d, NFMW1s, NFMW9, SMW11, SMW16, SMW17) compared to background concentrations.

2.1.4 Define the Boundaries of the Study

Spatial Boundaries:

The spatial boundaries and groundwater sample locations for this investigation are shown on **Figure 12C-2**. Site groundwater includes AU1 (shallow) and AU3 (deep) groundwater across the Site. The study also includes a perched saturated zone (NFMW1s) location. **Figure 12C-4** shows the spatial boundaries of surface water and sediment sampling locations. These include six locations upstream of the former WWTS basins at the Site, seven locations adjacent to the former WWTS basins, and one location downstream of the Site.

Temporal Boundaries:

Groundwater, surface water and sediment sampling described in this monitoring plan will be conducted in late October to early November 2024 over a period of approximately two weeks. Well redevelopment will be conducted the week prior to the start of sampling. Work will be limited to daylight hours. Constituents in groundwater, surface water and sediment are not expected to change significantly throughout the study period, however, surface water and sediment sampling near the Site will be conducted concurrently with groundwater monitoring of wells located near the CFR to obtain time-coincident data to address PSQ 4. Groundwater levels will be recorded

prior to sample collection and during a single synoptic event at the end of the sampling period. Surface water levels will be recorded via on-Site staff gages during the synoptic event at the end of the sampling period. All continuous monitoring transducers and sensors will also be downloaded during the synoptic event. Additional sampling in 2025 and beyond will be defined in subsequent monitoring plans.

2.1.5 *Develop the Analytic Approach*

PSQ 1: Nature and Extent – groundwater

Combine groundwater results with the current Site-wide dataset and update the range of observations in the current GCSM. Compare Q4 observations to previous observations. Note any new maximums or minimums or substantial differences from the previous data set at individual well locations.

PSQ 2: Nature and Extent – surface water and sediment

Combine surface water and sediment results with the current Site-wide dataset and update the range of observations in the current site conceptual model. Compare Q4 observations to previous observations. Note any new maximums or minimums or substantial differences from the previous data set.

PSQ 3: Fate and Transport – constituents mobilizing in groundwater

Identify constituents detected in groundwater downgradient of potential source areas.

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

Assess geochemical data from transducers and/or sensors (conductivity, ORP, pH, and temperature) particularly along transects A-A', B-B' and C -C' (**Figure 12C-3**) to identify variations that may influence lateral COPC mobility. Investigate the relationship between the detected COPC concentrations and field parameters (i.e., COPC concentrations and conductivity). Compare changes in redox indicator parameters (Iron [Fe] II / Fe III, ORP, DO, and sulfur species) with changes in redox sensitive metals (Fe, Arsenic [As], and Manganese [Mn]) concentrations to determine if a relationship exists and if this relationship changes temporally (between Q4 and Q3 sampling described in FSP-12B; GSI, 2024c).

PSQ 4: Fate and Transport – constituents in the CFR

Compare the range of constituent concentrations upgradient to the Site with the range of constituent concentrations adjacent to the Site. Note significant differences. Compare COPCs observed in the CFR with COPCs observed in Site groundwater. Evaluate the degree of interaction between Site groundwater and the CFR adjacent to the Site using field parameters and indicator ions (sodium and sulfate). Compare the groundwater to surface water gradient of redox sensitive COPCs (Fe, Mn, As) to nonreactive indicator ions (sodium and sulfate). Compare concentrations from MW34 in the hyporheic zone to concentrations from wells further upgradient and to concentrations in the CFR.

PSQ 5: Risk Assessment

If dioxin-like PCB congeners, total PCBs, or hexavalent chromium concentrations in sediment, surface water and/or groundwater affect risk assessment conclusions as determined by the Agencies, then risk assessments may be updated accordingly. Note any analytes that exceed human health or ecological screening levels.

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, 2022). 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-12C will investigate nature and extent of contamination, investigate fate and transport of groundwater constituents, and reduce uncertainties in risk assessments. Selected sample locations and analyses are informed by results and observations from previous Site investigations which were last documented in the GCSM (NewFields, 2020) and subsequent groundwater data summary report (NewFields, 2023a)) **Tables 12C-1** and **12C-2** detail the rationale for selected sample locations and analysis. **Figures 12C-2, 12C-3, and 12C-4** show sample locations and analysis. The following outlines the study approach for FSP-12C:

- Redevelop three wells prior to sample collection.
- Dedicate sampling tubing at up to 41 monitoring wells that can be sampled with a peristaltic pump at all water levels (monitoring wells that do not require dedicated pumps).
- Install a staff gage and ctd transducer at CFR6.
- Sample groundwater at 59 well locations (**Table 12C-2**) including:
 - One perched aquifer well,
 - 54 shallow (AU1) wells, and
 - Four deep (AU3) wells.
- Sample surface water and sediment at 13 locations (**Table 12C-2**)
 - Six locations upstream of the former WWTS basins at the Site in the CFR or Bitterroot River, and
 - Six locations adjacent to the former WWTS basins at the Site, and
 - One location downgradient of the Site.
- Sample surface water only at one location on the CFR adjacent to the mill property.
- Analyze groundwater, surface water, and sediment samples for a list of constituents (**Table 12C-4**) and collect field parameters for water samples (**Table 12C-2**).
- Collect manual and continuous (transducer) water level data, and transducer/sensor water quality data (**Table 12C-2, Table 12C-3a**).

3.0 SCOPE OF WORK

Available groundwater, soil, surface water, and sediment data collected between 2014 and 2022 as well as sampling described in FSP-12A (GSI, 2024b) and FSP-12B (GSI, 2024c) informed the approach to FSP-12C. This study focuses on the nature and extent of COPCs in groundwater, surface water, and sediment at the Site, and the mobility of COPCs in groundwater from potential source areas toward downgradient receptors, along paleochannels near the Clark Fork River (CFR), and towards the CFR. **Table 12C-1** summarizes the monitoring rationale and selection criteria associated with each study goal. **Table 12C-2** shows locations that address FSP-12C study objectives. **Table 12C-3a** shows all sample locations for the previous three groundwater sampling events and those selected for Q4 2024, and current transducer locations. **Section 2.1.7** outlines the investigative approach for Q4 2024, and the following subsections provide additional details.

All work will be performed in accordance with sampling methods described in previous EPA-approved planning documents, including the Field Sampling Plan included in the RIWP (NewFields, 2015), and the QAPP (NewFields, 2022¹). GSI will protect its workers and Site visitors in accordance with the approved Health and Safety Plan (HASP; GSI, 2024b), as further discussed in **Section 4.0**. **Attachment 1** includes applicable standard operating procedures (SOPs) for fieldwork, including documentation. **Attachment 2** includes relevant field forms, well completion forms, and chain-of-custody (COC) forms.

3.1 Groundwater Quality Sampling, Well Development, and Equipment Dedication

Groundwater monitoring will be conducted during late October to early November in Quarter 4 2024 in accordance with EPA guidelines (EPA OSWER 542-S-02-001). The groundwater monitoring event will capture seasonally higher groundwater levels near the east side of the site and solid waste basins, and seasonally lower groundwater levels in wells near the CFR. **Table 12C-2** identifies 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 12C-3**. Field staff will sample groundwater in accordance with SOPs-2 through 12B, SOP-24, and SOP-25 (**Attachment 1**). Each groundwater monitoring location will be sampled for total and dissolved metals, common ions, PCBs (Aroclors and congeners), and dioxins/furans (**Table 12C-2**). Locations sampled for redox species in Q3 2024 (FSP-12B; GSI, 2024c) will be sampled for redox species again in Q4 2024. This includes wells along transect C-C'. Sixteen monitoring wells will be sampled for hexavalent chromium. **Table 12C-3b** summarizes hexavalent chromium sampling and analysis to support the approach to sampling in FSP-12C. **Table 12C-4** details analytes, methods, bottles, preservatives, and hold times.

Three groundwater wells will be redeveloped prior to sample collection. Wells NFMW7, NFMW9, and NFMW19 showed reduced performance (wells demonstrated drawdown of more than 0.1 meters at a purge rate of approximately 0.1-0.15 liters per minute or higher in conjunction with elevated turbidity) during the FSP-12A sampling events and need to be redeveloped prior to sampling as part of FSP-12C. Redevelopment will be performed in accordance with previous well development efforts following SOP-18 and with guidance from SOP-12A (**Attachment 1**).

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

In addition, dedicated tubing will be installed in up to 43 AU1 monitoring wells where possible. Dedicated tubing will only be installed in locations that do not require sampling with a bladder pump (wells that can be sampled with a peristaltic pump) and where tubing can be secured. Dedicated tubing may not be feasible where transducers or sensors are present.

3.2 Manual Water 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 measurement in which data are collected as quickly as possible (within two days) during the event. Surface water levels will be recorded via on-Site staff gages during the synoptic event at the end of the sampling period. Synoptic water level data will be used to develop a water table and potentiometric surface maps. Manual groundwater level measurements will be recorded in accordance with SOP-5 (**Attachment 1**).

3.3 Transducers and Sensors

Continuous water level and temperature data is collected with transducers at 23 sample locations. Additionally, conductivity, pH and/or ORP data is collected with transducers and sensors at selected locations (**Table 12C-3a**). Prior to 2024, groundwater levels were monitored using pressure/temperature (“pt”) transducers in 16 locations (13 groundwater and three surface water locations). As part of FSP-12A (GSI, 2024b) and FSP-12B (GSI, 2024c), eight of the 16 locations were converted to pressure/temperature/conductivity (“ctd”) transducers, seven ctd transducers were added to new locations, and pH/ORP sensors were added to three new groundwater locations. In Q4 GSI will install a staff gage and ctd transducer at CFR6. Transducers and sensors are programmed to record every 6 hours (for groundwater locations) or every 1 hour (for surface water locations). The transducers and sensors will be downloaded on a semiannual basis and the utility of the pH/ORP sensors will be evaluated on a quarterly basis.

In Q4 2024, GSI personnel will download all transducer and sensor data at the end of the monitoring event during manual water level monitoring. Transducer and sensor data will be compared with water quality results and manual water levels.

3.4 Surface Water and Fine Sediment Quality Sampling

Surface water and fine sediment quality sampling will be conducted during low CFR water levels in Q4 to ensure sampling locations are accessible and to capture water quality during low water conditions. **Table 12C-2** identifies specific sampling locations and corresponding analytical parameters for each location. A spatial representation of the surface sampling program is shown on **Figure 12C-4**. Field staff will sample surface water and fine sediment in accordance with SOPs- 7 through 11, SOP-19, SOP-20, SOP-24, and SOP-25 (**Attachment 1**). Fine sediment sampling will target the finest fraction of bed sediment from depositional areas of the river. Fine sediment will be collected from depths shallow enough to reach the streambed with a gloved hand and according to the USGS method described in Clark Et. al (2022) as detailed in SOP-20. Each location will be sampled for total and dissolved metals, hexavalent chromium, common ions, grain size (sediment only), total organic carbon (TOC), PCBs (Aroclors and congeners), and dioxins/furans (**Table 12C-2**). Grain size and TOC analysis will allow for sediment results to be normalized to organic carbon and avoid any potential bias due to grain size differences between locations. Additionally, samples will be collected to test iron and sulfur redox species in surface

water at Site-adjacent locations CFR6, 5, 4a, 4b, 4c, 3, 2, and 0. **Table 12C-4** details analytes, methods, bottles, preservatives, and hold times for water and sediment samples.

3.5 Field Documentation and Sample Handling

GSI personnel will document activities associated with this sampling 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**.

3.6 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).

3.7 Investigation-Derived Waste

Investigation-Derived Waste (IDW) 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.

3.8 Reporting

The field investigation will be documented in accordance with SOP-1 (**Attachment 1**) using the corresponding field forms (**Attachment 2**). Following completion of the Q4 2024 event, 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, 2022). A draft of the data summary report will be provided to agencies within 30 days following final result validation. The data summary report will include the following components, as applicable:

- Summary of observations, measured values, and laboratory results.
- Deviations from governing documents and potential impacts to data usability and quality.
- Comparison of new data with currently understood concentration ranges.
- Recommended updates to the GCSM.
- Recommendations for additional data collection, if deemed necessary.

Report format and content will be discussed prior to development and will reflect recent data presentations that included figures created by the Agencies to support data interpretation. Outside of figures, the report format and content will be similar to previous reports approved by EPA and consistent with the RIWP (NewFields, 2015). The GCSM for the Site may also be updated to reflect any new findings.

4.0 HEALTH AND SAFETY

Field staff involved in monitoring and sampling activities will complete work in accordance with the current HASP (GSI, 2024a). This HASP updates and replaces NewFields (2018a). GSI will include Job Safety Analysis (JSA) worksheets in the HASP to address safety concerns related to sampling and water level monitoring. At the beginning of each workday, field team leaders will conduct daily staff safety meetings guided by the HASPs and JSAs. SOP-36 and SOP-38 address incidents, accidents, and emergency procedures. The HASPs detail the responsibilities of health and safety officers. Dan Hoffman will serve as the Project Health and Safety Officer. Pat Moffitt, Dan Hoffman, and India Phillips will be the Site Safety Officers during the sampling activities.

5.0 SCHEDULE

GSI anticipates finalization and regulatory approval of this FSP 12C by early October. Based on the assumed authorization schedule, the fieldwork detailed in this FSP 12C will occur in late October to early November of 2024. The event will include well redevelopment, groundwater monitoring, and surface water and sediment sampling. **Attachment 3** outlines a draft field schedule.

6.0 REFERENCES

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- NewFields, 2018a. Health and Safety Plan, Former Frenchtown Mill Site, Frenchtown, Montana. Version 3. November 20. NewFields, 2018b. Geotechnical Evaluation of the Clark Fork River Berm, Former Smurfit-Stone/Frenchtown Mill, Missoula County, Montana. Version 2. December 11.
- NewFields, 2020. Groundwater Conceptual Site Model, Former Smurfit Stone/Frenchtown Mill Site Remedial Investigation, Missoula County, Montana. Version 3. June 26.
- NewFields, 2022. Quality Assurance Project Plan (QAPP) for the Former Smurfit Stone/Frenchtown Mill Site, Missoula County, Montana. Included as Appendix E of the Remedial Investigation Work Plan. Version 4.
- NewFields, 2023a. 2022 Annual Groundwater Data Summary Report. Former Smurfit Stone/Frenchtown Mill Site Remedial Investigation, Missoula County, Montana. Version 2. June 30.

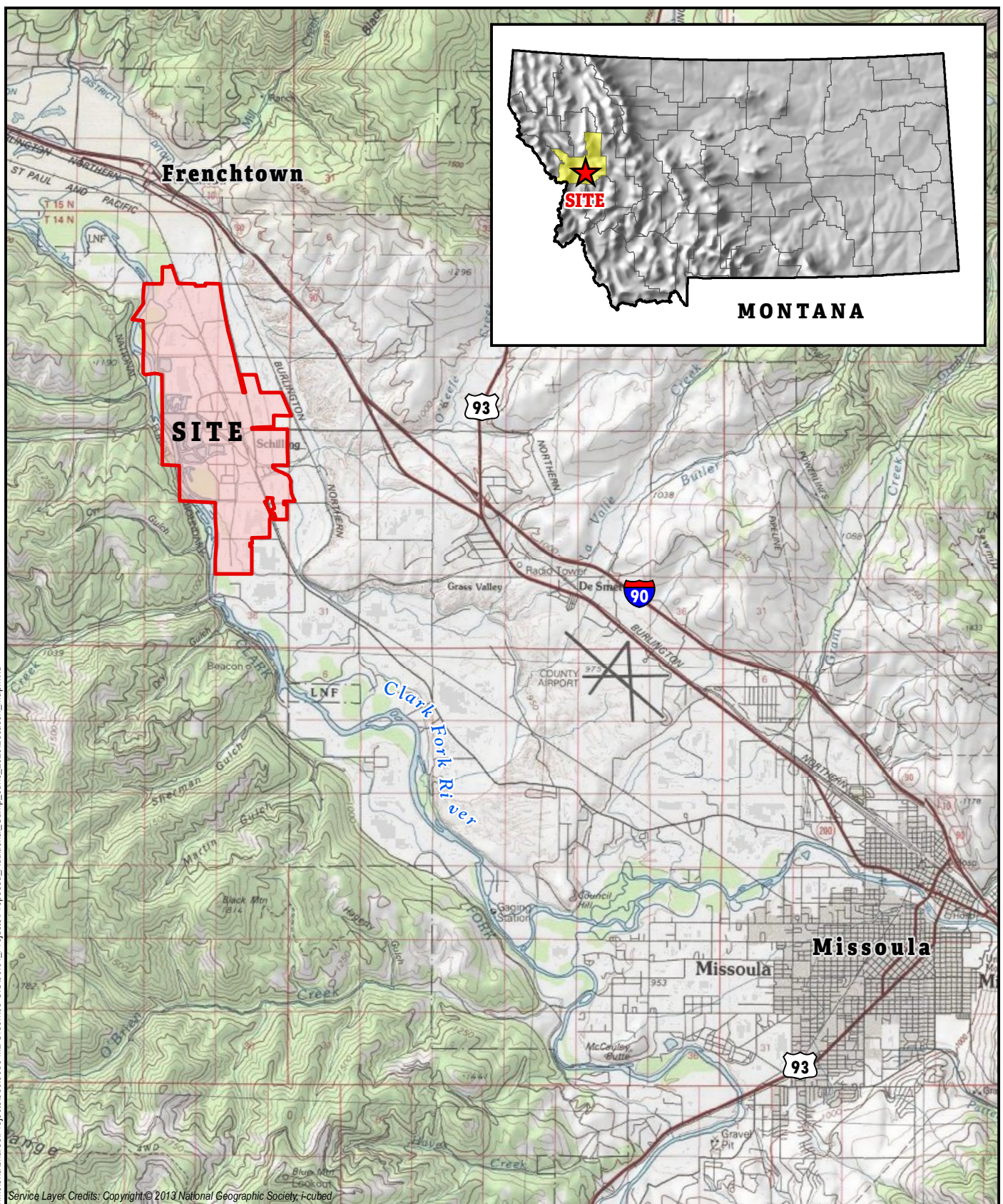
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Yeskis, D. and Zavala, B., 2002. Groundwater Sampling Guidelines for Superfund and RCRA Project Managers. Groundwater Forum Issue Paper. EPA 542-S-02-001. May.

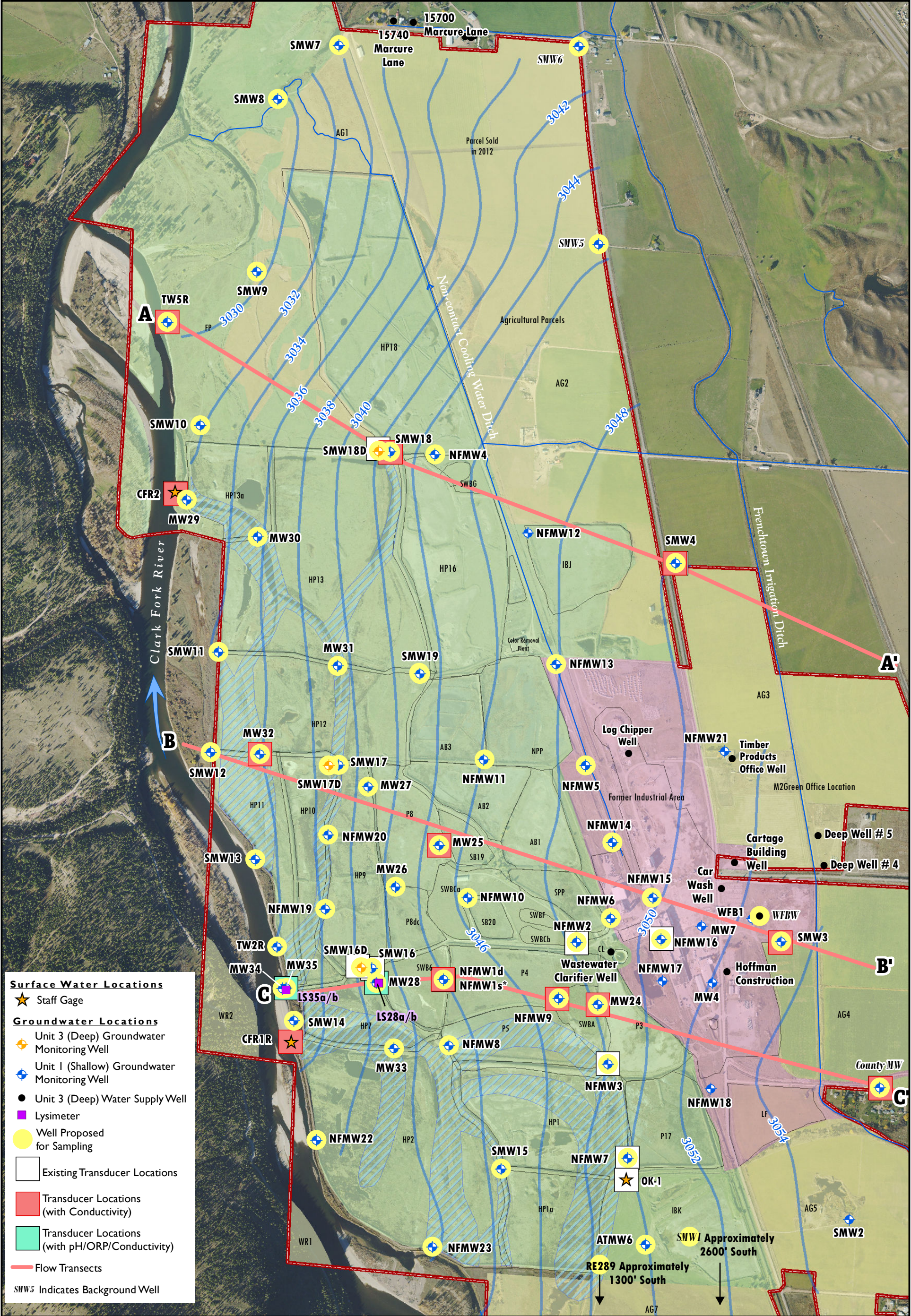
FIGURES

- Figure 12C-1 Site Location Map
- Figure 12C-2 Groundwater Monitoring Locations
- Figure 12C-3 Groundwater Sample Parameters
- Figure 12C-4 Surface Water and Sediment Monitoring Locations

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

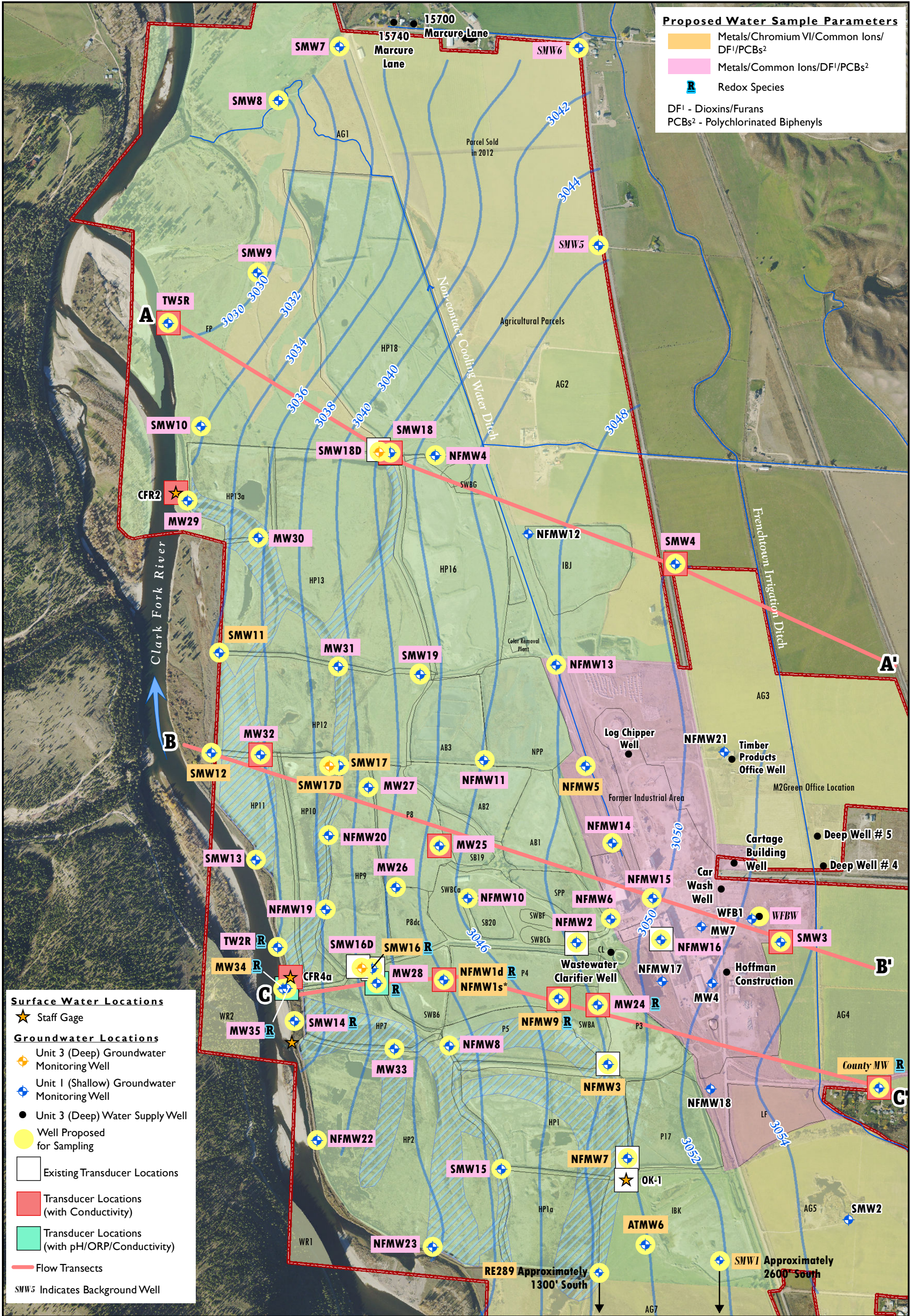


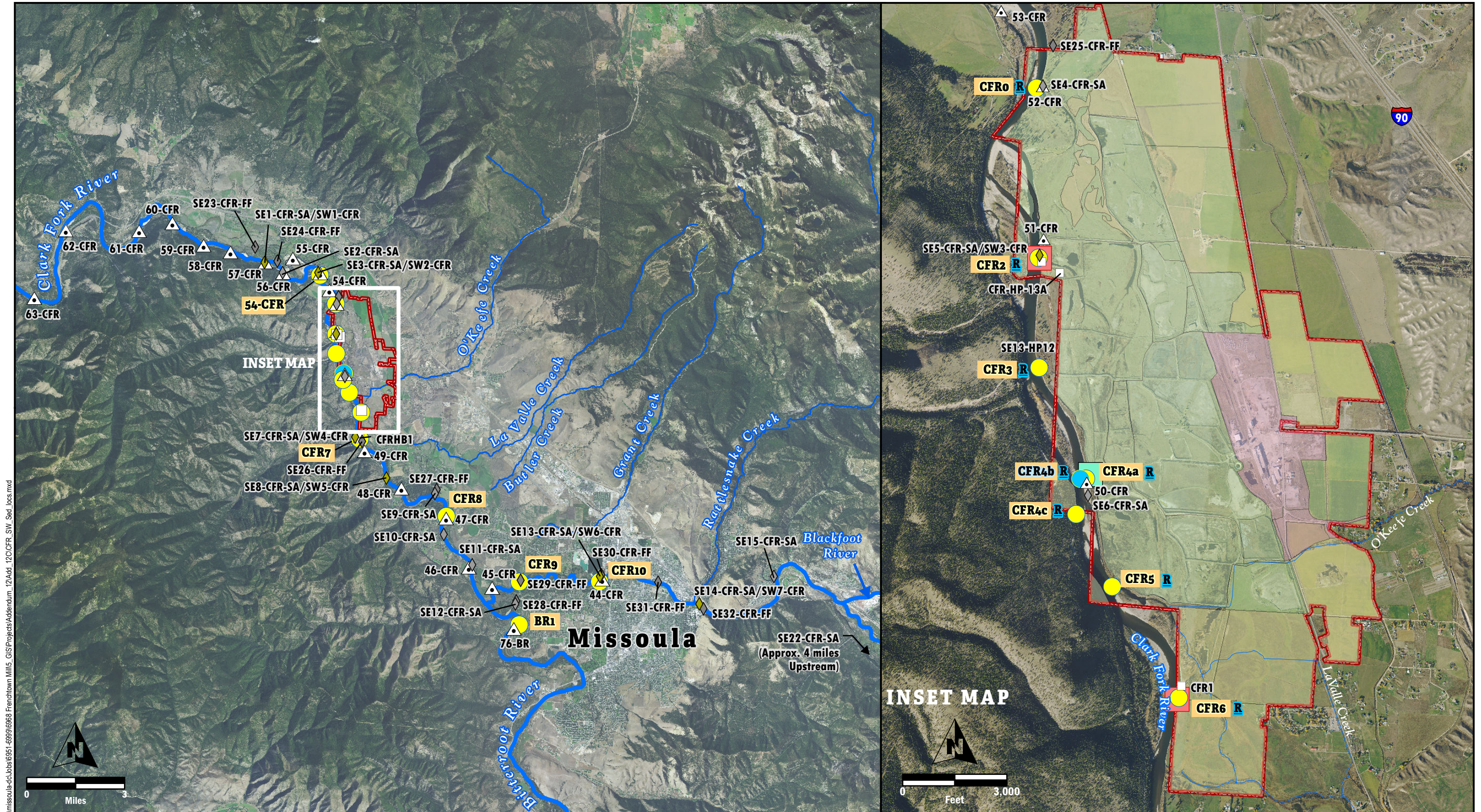
Mill Site Boundary

CFR Paleochannel (estimated)

October 2023 Shallow Groundwater Contours (feet amsl))

* - NFMW1s is completed in a perched zone





\\missoula-cd\cbs\6951-6999\6968 Frenchtown Mill\5_GIS\Projects\Addendum_12\Add_12\CFR_SW_Sed_locs.mxd

Operable Units

- OU1 - Agricultural Lands
- OU2 - Industrial Area
- OU3 - Wastewater Treatment and Storage Areas

Existing CFR Sample Locations

- 2018 CFR Surface Water and Sediment Sample Location
- 2018 High Water Berm Assessment Reinforcement Surface Water Sample Locations
- 2015 Sediment Sample Location
- 2015 Sediment and Surface Water Sample Location

Proposed Sample Parameters

- Metals/Chromium VI/ Common Ions/ DF/PCBs²
- Redox Species
- DF¹ - Dioxins/Furans
- PCBs² - Polychlorinated Biphenyls

Legend

- Mill Site Boundary
- Proposed Surface Water/ Sediment Sampling Location
- Proposed Surface Water Only Sampling Location
- Transducer Location (with Conductivity)
- Transducer Location (with pH/ORP/Conductivity)

Proposed CFR Surface Water and Sediment Monitoring Locations

Remedial Investigation Workplan Addendum 12C

Former Smurfit-Stone/Frenchtown Mill Site

Missoula County, Montana

FIGURE 12C-4

TABLES

Table 12C-1	Groundwater, Surface Water, and Sediment Monitoring Evaluation Criteria
Table 12C-2	Sampling Summary – Quarter 4 2024
Table 12C-3a	Recent Sampling and Transducer Locations
Table 12C-3b	Hexavalent Chromium Sampling and Analysis Summary – 2023-2024
Table 12C-4	Analytes, Bottle Types, Preservatives and Holding Times

Table 12C-1. FSP 12C Groundwater, Surface Water, and Sediment Sampling Evaluation Criteria
Addendum 12C of the Remedial Investigation Work Plan, Former Smurfit-Stone/Frenchtown Mill
October 2024

Primary Purpose		Objectives	Applicable Analyte Group(s)	Approach
1a	Confirm Nature and Extent of Contamination	Confirm baseline water quality.	Metals Common Ions Dioxins/Furans PCBs ²	Monitor background surface water and sediment locations in the CFR upgradient to the former WWTS Site Boundary (CFR6, CFR7, CFR8, CFR9, CFR10, BR1) for comparison to surface water and sediment in the CFR adjacent to the former WWTS basins. Monitor designated background groundwater locations (CountyMW, SMW1, SMW5, SMW6, WFBW) ¹ to compare to groundwater quality below and downgradient from the former WWTS basins.
1b		Confirm nature and extent of contamination near solid waste basins (SWBs)		Monitor wells adjacent to solid waste basins (SWBs) (Table 12C-2).
1c		Confirm nature and extent of contamination in Aquifer Unit 3.		Monitor wells completed in Aquifer Unit 3 and background Aquifer Unit 3 well (WFBW).
1d		Expand the investigation of changes in water quality over time.		Monitor wells that were sampled for limited analytes at a limited frequency and do not have enough data to evaluate changes in water quality over time. Continue to monitor transducer network (includes conductivity data loggers) to improve temporal (seasonal and long term) water quality analysis.
1e		Confirm currently understood long term changes to ionic signature.		Monitor wells that demonstrate changes to ionic signature over time (based on the GCSM evaluation (NewFields, 2020; Table 12C-2).
2a	Investigate Potential for Mobilization of Groundwater Constituents	Investigate mobilization from a potential source area ³ .	Metals Common Ions Dioxins/Furans PCBs ²	Monitor locations downgradient from potential source areas or where PCB Aroclors were detected; see Table 12C-2 for specific wells.
2b		Investigate mobilization along CFR paleochannels.		Monitor wells located within historic CFR channel in floodplain, based on channel mapping from LiDAR imagery and historic aerial photographs (NewFields, 2017 and NewFields, 2018b); see Table 12C-2 for specific wells.
2c		Investigate potential for constituents to mobilize into the CFR.		Sample surface water and sediment in CFR locations adjacent to the Site.
2d		Investigate the lateral migration of constituents from east to west toward the CFR with respect to changes in hydrogeochemical conditions.	Metals Common Ions Dioxins/Furans PCBs ² Redox Species	Evaluate changes in water quality along transects A, B and C in Figure 12C-2 . Use field parameters and transducer measurements to evaluate changes in hydrogeochemical conditions along the flow path over time, and use lab results to monitor COPC mobilization. Determine if a relationship exists between water quality and hydrogeochemical conditions. Analyze wells along transect C for redox species to improve temporal understanding of redox conditions.
3a	Reduce Uncertainties in Risk Assessments	Expand investigation of risk from PCBs to PCB congeners	PCBs ²	Sample locations which previously had PCB Aroclor detections or are new locations as of 2024 (Table 12C-2).
3b		Evaluate locations where risk assessments may require updates with combined Dioxins/Furans TEQ and Dioxin-like PCB TEQ results.	Dioxins/Furans PCBs ²	Monitor locations with maximum detected Dioxins/Furans TEQ 1/2DL (2014-2022) greater than Montana DEQ-7 water quality standard (2 pg/L) ⁴ and new locations as of 2024 (Table 12C-2).
3c		Reduce uncertainty in risk from chromium in risk assessments	Cr (VI)	Sample locations that have not previously been sampled for Cr (VI) and a range of additional locations to confirm preliminary (2023-2024) Cr (VI) results (Table 12C-3b).

Notes:

1 - Designated background wells are italicized in Table 12C-2. Upgradient wells also include SMW4 and SMW3, which are not designated background wells but are located upgradient of potential source areas.

2 - Polychlorinated Biphenyl (PCB) congener and Aroclor analysis to confirm nature and extent of PCBs.

3 - Typically refers to primary settling basins, spoils basins, and/or solid waste basins or areas where former industrial operations occurred.

4 - Using data from NewFields (2023a), TEQ 1/2DL (3b criteria) results were compared to the DEQ7 standard. Locations with TEQ > 2ppq are checkmarked accordingly in Table 12C-2a.

Acronyms and Abbreviations:

CFR - Clark Fork River

COPC - constituent of potential concern

LiDAR - Light detection and ranging

PCBs - polychlorinated biphenyls

SWB - solid waste basins

TEQ - toxicity equivalence

ug/L - micrograms per

WWTS - waste water treatment system

1/2DL - TEQ calculated one half the detection limit for congener concentrations reported below detection limits

References:

NewFields, 2017. Addendum 6 to Remedial Investigation Work Plan, Geotechnical Stability Evaluation of the Clark for River Berm, November.

NewFields, 2018. Geotechnical Evaluation of the Clark Fork River Berm, Version 2, December.

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

NewFields, 2023a. Annual Groundwater Data Summary Report. Former Smurfit Stone/Frenchtown Mill Site Remedial Investigation, Missoula County, Montana. Version 2. June 30.

Table 12C-2. Sampling Summary - Quarter 4 2024
Addendum 12C of the Remedial Investigation Work Plan, Former Smurfit-Stone/Frenchtown Mill
October 2024

Rationale: Confirm Nature and Extent of Contamination						Rationale: Investigate Potential for Mobilization of Groundwater Constituents				Rationale: Reduce Uncertainties in Risk Assessments			Transducer Locations	Proposed Dedicated Tubing Location	FSP 12C: Monitoring Location	Proposed Analytes							
Location	1a. Baseline water quality	1b. Solid Waste Basins	1c. Aquifer Unit 3	1d. Temporal changes	1e. Notable long-term changes to ionic signature	2a. Potential Source Area ¹	2b. Paleochannel Location	2c. Clark Fork River	2d. Lateral migration	3a. Update PCB risk	3b. Update TEQ risk	3c. Update Cr (VI) risk				Field Parameters ²	Metals ³	Cr (VI) ⁴	Common Ions/ General Chemistry ⁵	Dioxins/ Furans ⁶	PCBs ⁷	Redox Species ⁸	
Perched Zone/Vadose																							
NFMW1s						X					X	X		X	X	X	X	X	X				
LS28a																							
LS28b																							
LS35a																							
LS35b																							
Aquifer Unit 1																							
ATMW6											X	X		X	X	X	X	X	X				
County/MW	X								X		X	X	X		X	X	X	X	X	X			
NFMW1d		X				X			X		X	X			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	X				
NFMW4						X		X			X			X	X	X	X	X	X				
NFMW5						X						X		X	X	X	X	X	X				
NFMW6						X						X		X	X	X	X	X	X				
NFMW7						X	X				X	X	X	X	X ⁹	X	X	X	X				
NFMW8						X	X							X	X	X	X	X	X				
NFMW9		X				X			X		X	X	X		X ⁹	X	X	X	X	X			
NFMW10		X				X					X				X	X	X	X	X	X			
NFMW11						X					X				X	X	X	X	X				
NFMW12																							
NFMW13						X							X	X	X	X	X	X	X				
NFMW14						X							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													X	X									
NFMW18																							
NFMW19						X	X						X	X	X ⁹	X	X	X	X				
NFMW20						X	X				X			X	X	X	X	X	X				
NFMW21											X			X	X								
NFMW22											X			X	X	X	X	X	X				
NFMW23							X				X			X	X	X	X	X	X				
RE289											X	X		X	X	X	X	X	X				
SMW1	X											X		X	X	X	X	X	X				
SMW2												X											
SMW3	X								X				X	X	X	X	X	X	X				
SMW4	X				X				X				X	X	X	X	X	X	X				
SMW5	X												X	X	X	X	X	X	X				
SMW6	X												X	X	X	X	X	X	X				
SMW7					X								X	X	X	X	X	X	X				
SMW8											X		X	X	X	X	X	X	X				
SMW9											X		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				
SMW12					X		X		X		X	X			X	X	X	X	X				
SMW13							X				X			X	X	X	X	X	X				
SMW14							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	X			
SMW17							X			X	X	X	X	X	X	X	X	X	X				
SMW18					X		X		X		X		X	X	X	X	X	X	X				
SMW19						X					X		X	X	X	X	X	X	X				
SMW20																							
TW2R							X				X				X	X		X	X	X			
TW5R									X				X		X	X		X	X				
MW24	X			X		X				X	X		X		X	X		X	X	X			

Table 12C-2. Sampling Summary - Quarter 4 2024 Addendum 12C of the Remedial Investigation Work Plan, Former Smurfit-Stone/Frenchtown Mill October 2024																						
Location	Rationale: Confirm Nature and Extent of Contamination					Rationale: Investigate Potential for Mobilization of Groundwater Constituents				Rationale: Reduce Uncertainties in Risk Assessments			Transducer Locations	Proposed Dedicated Tubing Location	FSP 12C: Monitoring Location	Proposed Analytes						
	1a. Baseline water quality	1b. Solid Waste Basins	1c. Aquifer Unit 3	1d. Temporal changes	1e. Notable long-term changes to ionic signature	2a. Potential Source Area ¹	2b. Paleochannel Location	2c. Clark Fork River	2d. Lateral migration	3a. Update PCB risk	3b. Update TEQ risk	3c. Update Cr (VI) risk				Field Parameters ²	Metals ³	Cr (VI) ⁴	Common Ions/ General Chemistry ⁵	Dioxins/ Furans ⁶	PCBs ⁷	Redox Species ⁸
Aquifer Unit 1 (continued)																						
MW25		X		X		X			X	X	X		X	X	X	X	X		X	X	X	
MW26		X		X		X				X	X			X	X	X	X		X	X	X	
MW27		X		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	X	X	X
MW29				X					X	X	X			X	X	X	X		X	X	X	
MW30				X			X			X	X			X	X	X	X		X	X	X	
MW31				X			X			X	X			X	X	X	X		X	X	X	
MW32				X			X		X	X	X		X	X	X	X	X		X	X	X	
MW33				X			X		X	X	X		X	X	X	X	X		X	X	X	
MW34				X			X			X	X	X	X	X	X	X	X	X	X	X	X	X
MW35				X			X			X	X	X	X	X	X	X	X	X	X	X	X	X
Aquifer Unit 3																						
WFBW	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	X	X	
SMW18D			X								X		X		X	X	X		X	X	X	
Surface Water and Sediment Locations																						
OK1													X									
54-CFR										X	X	X			X	X	X	X	X	X		
CFR0								X		X	X	X			X	X	X	X	X	X	X	
CFR2								X		X	X	X	X		X	X	X	X	X	X	X	
CFR3								X		X	X	X			X	X	X	X	X	X	X	
CFR4a								X		X	X	X	X		X	X	X	X	X	X	X	
CFR4b ¹⁰								X		X	X	X			X	X	X	X	X	X	X	
CFR4c								X		X	X	X			X	X	X	X	X	X	X	
CFR5								X		X	X	X			X	X	X	X	X	X	X	
CFR6	X									X	X	X	X ¹¹		X	X	X	X	X	X	X	X
CFR7	X									X	X	X			X	X	X	X	X	X	X	
CFR8	X									X	X	X			X	X	X	X	X	X	X	
CFR9	X									X	X	X			X	X	X	X	X	X	X	
CFR10	X									X	X	X			X	X	X	X	X	X	X	
BR1	X									X	X	X			X	X	X	X	X	X	X	
Total Natural Water Sample Locations	13	10	4	12	7	25	21	7	14	29	55	30	24	41	73	73	73	30	73	73	73	18
Total Natural Sediment Locations	6	0	0	0	0	0	0	7	0	14	14	14	NA	NA	13 ¹⁰	0	13 ¹⁰	13 ¹⁰	13 ¹⁰	13 ¹⁰	13 ¹⁰	0
Quality Control Samples																						
MS/MSD (Groundwater)																NA	3	1	3	NA	3	1
MS/MSD (Surface water)																NA	1	1	1	NA	1	1
MS/MSD (Sediment)																NA	1	1	1	NA	1	NA
Replicates (Groundwater)																NA	3	1	3	3	3	1
Replicates (Surface water)																NA	1	1	1	1	1	1
Replicates (Sediment)																NA	1	1	1	1	1	NA
Equipment Rinse Blanks (Groundwater)																NA	3	1	3	3	3	1
Equipment Rinse Blanks (Sediment)																NA	1	1	1	1	1	NA
Field Blank																NA	1	1	1	1	1	1
Total Water Samples															73	73	85	36	85	81	85	24
Total Sediment Samples															13	0	15	15	15	15	15	0

Notes:

X Monitoring rationale, location or analyte

SMW1 [Background well sampling locations are in *italics*]

gray 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.

NA Not applicable

Acronyms and Abbreviations:

Cr (VI) - hexavalent chromium

DIF - dioxins/furans

EPA - Environmental Protection Agency

FSP - Field Sampling Plan

MS(D) - matrix spike (duplicate)

NA - not applicable

PCBs - polychlorinated biphenyls

ppq - parts per quadrillion

S - sulfur

TEQ - toxicity equivalence

TOC - total organic carbon

1 - Typically refers to investigation locations downgradient from primary settling basins, spoils basins, solid waste basins, or areas where former industrial operations occurred.

2 - Field Parameters include: pH, specific conductance, temperature, dissolved oxygen, oxidation-reduction potential, and turbidity

3 - Total and Dissolved Metals (Al, Sb, As, Be, Ba, Cd, Cr, Co, Cu, Fe, Pb, Mn, Ni, Se, Ag, Tl, V, Zn) by EPA Method 6020/6010, and Hg by EPA Method 7470/7471

4 - Hexavalent Chromium by EPA Method 218.6 (water) or 7199 (sediment)

5 - Common ions and general chemistry includes Ca, Mg, K, and Na (EPA Method 6010/6020); total sulfur (EPA Method 6010 - sediment only); Nitrate and Nitrite (EPA Method 353.2 - water only); Total Phosphorus (Method SM4500-H-2011 - water only); TOC (Method SM 5310C for water or EPA Method 9060 for water or sediment); Sulfate, Chloride, and Fluoride (EPA Method 300.0 - water only); Total Dissolved Solids (Method SM 2540-C - water only); pH (Method SM 4500-H+B - water, SM 2510B - sediment); Alkalinity (Total, Bicarbonate, Carbonate) (Method SM 2320B - water only); pH (Method SM 4500-H+B); and Specific Conductance (SM2510 - water only); Grain Size (ASTM D422 - sediment only); Percent Moisture/Total Solids (SM 2540G - sediment only)

6 - Dioxins/Furans by EPA Method 8290

7 - PCBs - Polychlorinated Biphenyls by EPA Methods 8082 (Aroclors) and 1668 (209 congeners)

8 - Redox species for water samples include Iron (total, ferrous - Fe II [calculated], ferric - Fe III; field measurement by HACH Method SM3500-Fe B), Total Sulfur (SW846 6010D), Sulfate and Thiosulfate(EPA Method 300.0), and Sulfide (SM4500S2-F / SW846 9034)

9 - Well will be redeveloped due to reduced performance observed in previous sampling events. See text for more details.

10 - CFR4b will be sampled for surface water only. This location has insufficient fine sediment for a sediment analytical sample

11 - Transducer to be installed during Addendum 12C field execution

Table 12C-3a. Recent Sampling and Transducer Locations

Addendum 12C of the Remedial Investigation Work Plan, Former Smurfit-Stone/Frenchtown Mill

October 2024

Location	Sampling Event				Transducer Locations and Types ¹
	Fall 2023	Q2 2024	Q3 2024	Q4 2024	
Perched Zone/Vadose					
NFMW1s		X		X	
LS35a			X		
LS35b					
LS28a			X		
LS28b			X		
Aquifer Unit 1					
ATMW6		X		X	
CountyMW	X	X	X	X	CTD ² , pH/ORP
NFMW1d	X	X	X	X	CTD
NFMW2	X	X		X	TD
NFMW3	X	X		X	TD
NFMW4		X		X	
NFMW5		X		X	
NFMW6	X	X		X	
NFMW7	X	X		X	TD
NFMW8	X	X		X	
NFMW9	X	X	X	X	CTD, pH/ORP
NFMW10	X	X		X	
NFMW11	X	X		X	
NFMW12					
NFMW13		X		X	
NFMW14		X		X	
NFMW15	X			X	
NFMW16	X	X		X	TD
NFMW17					
NFMW18					
NFMW19	X	X		X	
NFMW20	X	X		X	
NFMW21					
NFMW22	X	X		X	
NFMW23	X	X		X	
RE289		X		X	
SMW1		X		X	
SMW2					
SMW3		X		X	CTD
SMW4	X	X		X	CTD
SMW5		X		X	
SMW6		X		X	
SMW7	X	X		X	
SMW8	X	X		X	
SMW9	X	X		X	

Table 12C-3a. Recent Sampling and Transducer Locations

Addendum 12C of the Remedial Investigation Work Plan, Former Smurfit-Stone/Frenchtown Mill

October 2024

Location	Sampling Event				Transducer Locations and Types ¹
	Fall 2023	Q2 2024	Q3 2024	Q4 2024	
Aquifer Unit 1 (continued)					
SMW10	X	X		X	
SMW11	X	X		X	
SMW12	X	X		X	
SMW13	X	X		X	
SMW14	X	X	X	X	
SMW15	X	X		X	
SMW16	X	X	X	X	TD
SMW17	X	X		X	
SMW18	X	X		X	CTD
SMW19	X	X		X	
SMW20					
TW2R	X	X	X	X	
TW5R	X	X		X	CTD
MW24		X	X	X	CTD
MW25		X		X	CTD
MW26		X		X	
MW27		X		X	
MW28		X	X	X	CTD, pH/ORP
MW29		X		X	
MW30		X		X	
MW31		X		X	
MW32		X		X	CTD
MW33		X		X	
MW34			X	X	CTD, pH/ORP
MW35			X	X	CTD, pH/ORP
Aquifer Unit 3					
WFBW	X	X		X	
SMW16D	X	X		X	TD
SMW17D	X	X		X	
SMW18D	X	X		X	TD
Surface Water Locations					
OK1					TD
54-CFR				X	
CFR0				X	
CFR2				X	CTD
CFR3				X	
CFR4a			X	X	CTD, pH/ORP
CFR4b			X	X	
CFR4c				X	
CFR5				X	

Table 12C-3a. Recent Sampling and Transducer Locations

Addendum 12C of the Remedial Investigation Work Plan, Former Smurfit-Stone/Frenchtown Mill

October 2024

Location	Sampling Event				Transducer Locations and Types ¹
	Fall 2023	Q2 2024	Q3 2024	Q4 2024	
Surface Water Locations (continued)					
CFR6				X	CTD ³
CFR7				X	
CFR8				X	
CFR9				X	
CFR10				X	
BR1				X	
Total Locations	36	56	15	73	24

Location	Pressure Temperature	Pressure Temperature Conductivity	Pressure Temperature Conductivity ORP pH	Total
Unit 1 Aquifer	5	8	5	18
Unit 3 Aquifer	2			2
CFR		2	1	3
O'Keefe Creek	1			1
Total:	8	10	6	24

Notes:

grey locations - Sampling these locations does not address any Addendum 11A, 12A, 12B, or 12C objectives.

X - Sampled location or proposed sampling location

Xi - Location sampled and installed during indicated sampling event

1 - Transducer types: TD - temperature/depth; CTD - conductivity/temperature/depth; pH/ORP - pH and ORP se Q2 - second quarter

2 - Missoula County maintains a temperature/depth (TD) transducer. A conductivity/temperature/depth (CTD) Transducer was added as part of FSP-12A (Q2 2024 event)

3 - Transducer to be installed during Addendum 12C field execution

Acronyms and Abbreviations:

CFR - Clark Fork River

FSP - field sampling plan

ORP - Oxidation Reduction Potential

Q2 - second quarter

Q3 - third quarter

Q4 - fourth quarter

Table 12C-3b. Hexavalent Chromium Sampling and Analysis Summary - 2023-2024
Addendum 12C of the Remedial Investigation Work Plan, Former Smurfit-Stone/Frenchtown Mill
October 2024

Location	Fall 2023 ¹		Q2 2024 ^{2,3}	Q3 2024 ^{2,3}	Q4 2024 ²	Total Expected Cr (VI) Results Following Q4 2024
	Date Sampled	Result Usability	Date Sampled ⁴	Date Sampled	Proposed for Sampling	
Perched Zone/Vadose						
NFMW1s	--	--	5/1/2024	--	X	2
LS28a	--	--	--	--	--	0
LS28b	--	--	--	--	--	0
LS35a	--	--	--	--	--	0
LS35b	--	--	--	--	--	0
Aquifer Unit 1						
ATMW6	--	--	--	--	X	1
CountyMW	9/19/2023	Y ⁵	--	7/29/2024	X	2
NFMW1d	9/19/2023	Y	5/1/2024	--	X	3
NFMW2	9/20/2023	Y	4/24/2024	--	--	1
NFMW3	9/19/2023	Y	4/30/2024	--	X	2
NFMW4	9/18/2023	N	5/2/2024	--	--	1
NFMW5	9/27/2023	N	--	--	X	1
NFMW6	9/19/2023	N	4/29/2024	--	--	1
NFMW7	9/19/2023	N	--	--	X	1
NFMW8	9/21/2023	N	4/30/2024	--	--	1
NFMW9	9/21/2023	Y	5/6/2024	--	X	3
NFMW10	--	--	5/2/2024	--	--	1
NFMW11	--	--	5/2/2024	--	--	1
NFMW12	--	--	--	--	--	0
NFMW13	--	--	4/23/2024	--	--	1
NFMW14	--	--	4/23/2024	--	--	1
NFMW15	9/20/2023	Y	4/30/2024	--	--	2
NFMW16	9/21/2023	Y	4/30/2024	--	--	2
NFMW17	--	--	--	--	--	0
NFMW18	--	--	--	--	--	0
NFMW19	9/25/2023	N	4/25/2024	--	--	1
NFMW20	9/25/2023	N	4/25/2024	--	--	1
NFMW21	--	--	--	--	--	0
NFMW22	9/27/2023	N	5/2/2024	--	--	1
NFMW23	9/27/2023	Y	5/2/2024	--	--	2
RE289	--	--	--	--	X	1
SMW1	--	--	--	--	X	1
SMW2	--	--	--	--	--	0
SMW3	--	--	5/3/2024	--	--	1
SMW4	9/27/2023	Y	5/3/2024	--	--	2
SMW5	--	--	4/24/2024	--	--	1
SMW6	--	--	4/24/2024	--	--	1
SMW7	9/28/2023	N	5/6/2024	--	--	1
SMW8	9/28/2023	N	5/6/2024	--	--	1
SMW9	9/28/2023	Y	5/6/2024	--	--	2
SMW10	9/28/2023	N	5/3/2024	--	--	1
SMW11	9/28/2023	N	5/3/2024	--	X	2
SMW12	9/26/2023	Y	5/3/2024	--	X	2
SMW13	9/26/2023	Y	4/25/2024	--	--	2
SMW14	9/26/2023	Y	5/3/2024	--	--	2
SMW15	9/27/2023	N	5/2/2024	--	--	1
SMW16	9/18/2023	Y ⁵	5/2/2024	--	X	3
SMW17	9/20/2023	Y	5/1/2024	--	X	3
SMW18	9/25/2023	N	5/1/2024	--	--	1
SMW19	9/21/2023	N	5/2/2024	--	--	1
SMW20	--	--	--	--	--	0
TW2R	9/26/2023	N	4/25/2024	--	--	1
TW5R	9/28/2023	Y	5/6/2024	--	--	2
MW24	--	--	5/3/2024	--	--	1
MW25	--	--	5/7/2024	--	--	1
MW26	--	--	5/7/2024	--	--	1
MW27	--	--	5/7/2024	--	--	1
MW28	--	--	5/6/2024	--	--	1
MW29	--	--	5/8/2024	--	--	1
MW30	--	--	5/8/2024	--	--	1
MW31	--	--	5/8/2024	--	--	1
MW32	--	--	5/7/2024	--	--	1
MW33	--	--	5/8/2024	--	--	1

Table 12C-3b. Hexavalent Chromium Sampling and Analysis Summary - 2023-2024
Addendum 12C of the Remedial Investigation Work Plan, Former Smurfit-Stone/Frenchtown Mill
October 2024

Location	Fall 2023 ¹		Q2 2024 ^{2,3}	Q3 2024 ^{2,3}	Q4 2024 ²	Total Expected Cr (VI) Results Following Q4 2024
	Date Sampled	Result Usability	Date Sampled ⁴	Date Sampled	Proposed for Sampling	
Aquifer Unit 1 (continued)						
MW34	--	--	--	7/31/2024	X	2
MW35	--	--	--	7/31/2024	--	1
Aquifer Unit 3						
WFBW	9/27/2023	Y	5/3/2024	--	--	2
SMW16D	9/18/2023	Y ⁵	4/29/2024	--	--	2
SMW17D	9/20/2023	Y	--	--	X	2
SMW18D	9/25/2023	N	5/1/2024	--	--	1
Surface Water and Sediment Locations						
OK1	--	--	--	--	--	0
54-CFR	--	--	--	--	X	1
CFR0	--	--	--	--	X	1
CFR2	--	--	--	--	X	1
CFR3	--	--	--	--	X	1
CFR4a	--	--	--	--	X	1
CFR4b	--	--	--	--	X	1
CFR4	--	--	--	--	X	1
CFR5	--	--	--	--	X	1
CFR6	--	--	--	--	X	1
CFR7	--	--	--	--	X	1
CFR8	--	--	--	--	X	1
CFR9	--	--	--	--	X	1
CFR10	--	--	--	--	X	1
BR1	--	--	--	--	X	1
Total Cr (VI) Sample Locations	36		44	3	30	98

Notes:

X Monitoring well proposed for Cr (VI) analysis in Q4 2024
SMW1 [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.

Y - Result is usable/reportable

N - Result is not usable/reportable (rejected during validation)

-- Well not sampled or sample not analyzed for Cr (VI)

1 - Cr (VI) analyzed by SM3500CR-B

2 - Cr (VI) analyzed or proposed to be analyzed by EPA Method 218.6

3 - Results from Q2 and Q3 have been received but validation is not complete; data usability subject to change during validation

4 - Several additional locations were sampled during Q2 2024 but hexavalent chromium aliquots were lost during shipping; only sample dates for locations with results are shown.

5 - Cr (VI) results usable but total chromium results rejected

Abbreviations:

Cr (VI) - hexavalent chromium

Q3 - third quarter

Q2 - second quarter

Q4 - fourth quarter

Table 12C-4. Analytes, Bottle Types, Preservatives, and Holding Times																					
Addendum 12C of the Remedial Investigation Work Plan, Former Smurfit-Stone/Frenchtown Mill																					
October 2024																					
Analytical Method(s) for Water	Analytical Method(s) for Sediment	Target Analyte	CAS	Water					Sediment			Water			Sediment						
				Target Laboratory Reporting Limit ¹	Groundwater RBC ²	Surface Water Screening Level ³	DEQ-7 Groundwater Quality Standard ⁴	Units	Target Laboratory Reporting Limit ¹	Sediment Screening Level ⁵	Units	Bottle Type ⁶	Preservation	Holding Time	Bottle Type ⁶	Preservation	Holding Time				
Target Analyte List Metals																					
EPA Method 218.6	EPA Method 7199	Chromium (VI)	18540-29-9	0.5	0.035	0.37	100	µg/L	0.5	2.20	mg/kg	1x40mL HDPE tube	Cool to <4°C; (NH ₄) ₂ SO ₄ to pH 9-9.5	28 days	1 x 4-oz clear glass jar	Cool to <6°C	30 days to extract, 7 to analyze				
EPA 7470/7471 (CVAA)	EPA 7470/7471 (CVAA)	Mercury	7439-97-6	0.2	0.57	0.77	2	µg/L	0.02	0.18	mg/kg	2 x 250mL HDPE bottles (one field filtered)	Cool to <6°C; nitric acid to pH < 2	28 days	1 x 4-oz clear glass jar	Cool to <6°C	28 days				
EPA 6010/6020 (ICP-MS)	EPA 6010/6020 (ICP-MS)	Aluminum	7429-90-5	30	2000	87	--	µg/L	30	25500	mg/kg			6 months			1 x 4-oz clear glass jar	Cool to <6°C	6 months		
		Antimony	7440-36-0	0.5	0.78	6	6	µg/L	1	12	mg/kg										
		Arsenic	7440-38-2	0.5	0.052	0.38	10	µg/L	0.5	4.9	mg/kg										
		Barium	7440-39-3	0.3	380	4	1000	µg/L	0.3	11000	mg/kg										
		Beryllium	7440-41-7	0.2	2.5	0.66	4	µg/L	0.2	110	mg/kg										
		Cadmium	7440-43-9	0.08	0.92	0.25	5	µg/L	0.08	0.99	mg/kg										
		Chromium	7440-47-3	2	0.035	0.37	100	µg/L	2.0	2.2	mg/kg										
		Cobalt	7440-48-4	0.5	0.6	4.4	--	µg/L	0.5	17	mg/kg										
		Copper	7440-50-8	1	80	9.0	1300	µg/L	1	31.6	mg/kg										
		Iron	7439-89-6	50	1400	1000	--	µg/L	50	40000	mg/kg										
		Lead	7439-92-1	0.5	15	2.5	15	µg/L	0.5	35.8	mg/kg										
		Manganese	7439-96-5	0.5	43	120	--	µg/L	0.5	631	mg/kg										
		Nickel	7440-02-0	0.5	39	52	100	µg/L	0.5	22.7	mg/kg										
		Selenium	7782-49-2	0.5	0.74	1.5	50	µg/L	0.5	0.9	mg/kg										
		Silver	7440-22-4	0.5	9.4	0.34	100	µg/L	0.5	1	mg/kg										
		Thallium	7440-28-0	0.1	0.02	0.15	2	µg/L	0.1	0.57	mg/kg										
		Vanadium	7440-62-2	1	8.6	20	--	µg/L	1	290	mg/kg										
Zinc	7440-66-6	5	600	120	2000	µg/L	5	121	mg/kg												
Common Ions and General Chemistry																					
EPA 6020 (ICP-AES)	EPA 6010 (ICP-AES)	Calcium	7440-70-2	500	440000	120000	--	µg/L	25	--	mg/kg	2 x 250mL HDPE bottles (one field filtered)	Cool to <6°C; nitric acid to pH < 2	6 months	1 x 4-oz clear glass jar	Cool to <6°C	6 months				
		Magnesium	7439-95-4	500	130000	82000	--	µg/L	25	--	mg/kg	1 x 1-liter HDPE bottle	Cool to <4°C	15 minutes	same as above	Cool to <4°C	15 minutes				
		Potassium	7440-09-7	2500	1900000	53000	--	µg/L	125	--	mg/kg			28 days							
		Sodium	7440-23-5	1000	560000	680000	--	µg/L	50	--	mg/kg			28 days							
---	EPA 6010 (ICP-AES)	Total Sulfur	7704-34-9	--	--	--	--	µg/L	0.05	--	mg/kg			7 days							
SM 4500-H+B	SW846 9045	pH	PH	0.01	--	--	--	s.u.	0.01	--	s.u.			28 days							
EPA 300.0	--	Chloride	16887-00-6	1.2	310	--	--	mg/L	--	--	--			2 x 500 mL HDPE bottles			Cool to <4°C	28 days	1 x 4-oz clear glass jar	--	none
	--	Fluoride	7782-41-4	0.05	350	590	4	mg/L	--	--	--										
	--	Sulfate	18785-72-3	1.2	--	--	--	mg/L	--	--	--										
SM 2510	--	Specific Conductance	SC	0.1	--	--	--	µS/cm	--	--	--			2 x 500 mL HDPE bottles			Cool to <4°C	28 days	1 x 4-oz clear glass jar	--	none
SM 2320B	--	Alkalinity (Total, Bicarbonate, Carbonate)	ALK	5	--	--	--	mg/L	--	--	--										
SM 2540C	--	Total Dissolved Solids	TDS	10	--	--	--	mg/L	--	--	--										
--	SM 2540 G-2011	Total Solids or Percent Moisture	SOLIDS	--	--	--	--	--	--	--	%	--	--	28 days	1 x 4-oz clear glass jar	--	none				
--	ASTM D422	Grain Size Analysis	--	--	--	--	--	--	--	--	%										
SM-4500P-H-2011 or EPA 365.4	--	Total Phosphorus	7723-14-0	0.01	130000	--	--	mg/L	--	--	mg/kg	1 x 500-mL HDPE bottle	Cool to <4°C; sulfuric acid to pH<2	28 days	--	--	--				
EPA 353.2	--	Nitrate+Nitrite	NO3+NO2	0.1	10	10000	--	mg/L	--	--	--	--	--	28 days	--	--	--				
EPA Method 9060; SM 5310C	EPA 9060A	Organic Carbon, Total (TOC)	TOC	1	--	--	--	mg/L	0.1	--	percent	2x100mL amber jars	Cool to <4°C; HCl to pH < 2	28 days	1 x 4-oz clear glass jar	Cool to <6°C	14 days				
Redox Species																					
HACH Method (SM3500-Fe B)	--	Ferrous Iron (Fe II, field)	15438-31-0	0.007	--	--	--	mg/L	--	--	--	1 x 250 mL bottle or Whirl-Pak bag	--	--	--	--	--				
HACH Method (SM3500-Fe B)	--	Total Iron (field)	7439-89-6	0.007	1400	--	--	mg/L	--	--	--	Analyze in field	Cool to <4°C; nitric acid to pH<2	100 days							
HACH Method (SM3500-Fe B)	--	Ferric Iron (Fe III, calculation)	1317-63-1	--	--	--	--	mg/L	--	--	--										
SW846 6010D	--	Total Sulfur (lab)	7704-34-9	0.1	--	--	--	mg/L	--	--	--	1 x 250mL bottle	Cool to <4°C; nitric acid to pH<2	100 days	1 x 4-oz amber glass jar (at least 10 grams)	Cool to <6°C	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.				
EPA 300.0 / SW846 9056	--	Sulfate (lab)	18785-72-3	0.25	--	--	--	mg/L	--	--	--	1 x 250mL bottle	Cool to <4°C	28 days							
EPA 300.0	--	Thiosulfate (lab)	14383-50-7	0.06	--	--	--	mg/L	--	--	--	1 x 250mL bottle	Cool to <4°C; zinc acetate to pH<9	28 days							
SM4500S2-F / SW846 9034	--	Sulfide (lab)	18496-25-8	1	--	--	--	mg/L	--	--	--	1 x 250mL bottle	Cool to <4°C; zinc acetate to pH<9	28 days							
Dioxins / Furans																					
EPA 8290 High Resolution	EPA 8290 High Resolution	2,3,7,8-TCDD	1746-01-6	0.3	--	--	--	pg/L	0.03	--	ng/kg	2x1-Liter amber glass	Cool to <6°C	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.	1 x 4-oz amber glass jar (at least 10 grams)	Cool to <6°C	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.				
		1,2,3,7,8-PeCDD	40321-76-4	0.5	--	--	--	pg/L	0.05	--	ng/kg										
		1,2,3,6,7,8-HxCDD	57653-85-7	0.2	--	--	--	pg/L	0.05	--	ng/kg										
		1,2,3,4,7,8-HxCDD	39227-28-6	0.2	--	--	--	pg/L	0.05	--	ng/kg										
		1,2,3,7,8,9-HxCDD	19408-74-3	0.2	--	--	--	pg/L	0.05	--	ng/kg										
		1,2,3,4,6,7,8-HpCDD	35822-46-9	0.5	--	--	--	pg/L	0.05	--	ng/kg										
		OCDD	3268-87-9	1	--	--	--	pg/L	0.09	--	ng/kg										
		2,3,7,8-TCDF	51207-31-9	0.2	--	--	--	pg/L	0.02	--	ng/kg										
		1,2,3,7,8-PeCDF	57117-41-6	0.2	--	--	--	pg/L	0.03	--	ng/kg										
		2,3,4,7,8-PeCDF	57117-31-4	0.2	--	--	--	pg/L	0.03	--	ng/kg										
		1,2,3,6,7,8-HxCDF	57117-44-9	0.2	--	--	--	pg/L	0.03	--	ng/kg										
		1,2,3,7,8,9-HxCDF	72918-21-9	0.2	--	--	--	pg/L	0.04	--	ng/kg										
		1,2,3,4,7,8-HxCDF	70648-26-9	0.2	--	--	--	pg/L	0.03	--	ng/kg										
		2,3,4,6,7,8-HxCDF	60851-34-5	0.2	--	--	--	pg/L	0.03	--	ng/kg										
		1,2,3,4,6,7,8-HpCDF	67562-39-4	0.3	--	--	--	pg/L	0.03	--	ng/kg										
		1,2,3,4,7,8,9-HpCDF	55673-89-7	0.2	--	--	--	pg/L	0.04	--	ng/kg										
		OCDF	39001-02-0	0.7	--	--	--	pg/L	0.08	--	ng/kg										
WHO 2005 TEF Calculation	WHO 2005 TEF Calculation	TEQ	--	--	0.12 ⁷	4.4 ⁷	2	pg/L	--	0.85 ⁷	ng/kg	--	--	--	--	--	--				

Table 12C-4. Analytes, Bottle Types, Preservatives, and Holding Times																	
Addendum 12C of the Remedial Investigation Work Plan, Former Smurfit-Stone/Frenchtown Mill																	
October 2024																	
Analytical Method(s) for Water	Analytical Method(s) for Sediment	Target Analyte	CAS	Water					Sediment			Water			Sediment		
				Target Laboratory Reporting Limit ¹	Groundwater RBC ²	Surface Water Screening Level ³	DEQ-7 Groundwater Quality Standard ⁴	Units	Target Laboratory Reporting Limit ¹	Sediment Screening Level ⁵	Units	Bottle Type ⁶	Preservation	Holding Time	Bottle Type ⁶	Preservation	Holding Time
Polychlorinated Biphenyls (PCBs)																	
EPA Method 8082A	EPA Method 8082A	Aroclor-1016	12674-11-2	0.1	0.14	1	--	µg/L	0.033	--	mg/kg	2x100mL amber glass	Cool to <6°C but above freezing	Extract within 1 year of sample collection. Analyze within 40 days of extraction	1 x 4-oz amber glass jar	Cool to <6°C but above freezing	Extract within 1 year of sample collection. Analyze within 40 days of extraction
		Aroclor-1221	11104-28-2	0.1	0.0047	0.07	--	µg/L	0.033	--	mg/kg						
		Aroclor-1232	11141-16-5	0.1	0.0047	0.07	--	µg/L	0.033	--	mg/kg						
		Aroclor-1242	53469-21-9	0.1	0.0078	0.053	--	µg/L	0.033	--	mg/kg						
		Aroclor-1248	12672-29-6	0.1	0.0078	0.081	--	µg/L	0.033	--	mg/kg						
		Aroclor-1254	11097-69-1	0.1	0.0078	0.033	--	µg/L	0.033	--	mg/kg						
		Aroclor-1260	11096-82-5	0.1	0.0078	0.28	--	µg/L	0.033	--	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	EPA Method 1668 ⁸	PCB-1 through PCB-209	--	--	--	--	pg/L	--	--	pg/g	2x1-Liter amber glass	same as above	same as above	1 x 4-oz amber glass jar	same as above	same as above	
Calculation ⁹	Calculation ⁸	Total PCBs	--	--	0.044 ⁹	0.014 ¹⁰	0.5	µg/L	0.23 ⁹	0.0598 ¹¹	pg/g						

Notes:

1 - Target reporting limits are from SGS Analytical Laboratories, Pace Analytical, Alpine Analytical, and the Quality Assurance Project Plan (QAPP; NewFields, 2022), except for redox reporting limits. Iron redox reporting limits are based on the methods specified.

2 - Risk-based concentration for groundwater from OU3 HHRA Table 3-17 (EPA, 2022).

3 - Minimum human health or ecological screening level for CFR surface water from OU3 HHRA (RBCs from Table 3-20; EPA, 2022), OU2 and OU3 BERA (surface water ecological screening values from Table 3-1; EPA, 2021), and OU2 and OU3 SLERA (surface water benchmarks from Table 3-7; EPA, 2017)

4 - Human Health Standard for groundwater in DEQ-7 Montana Numeric Water Quality Standards (Montana DEQ, 2019).

5 - Minimum human health or ecological screening level for CFR sediment from OU3 HHRA (risk-based screening level from Table 3-18; EPA, 2022), OU2/3 BERA (sediment benchmarks from Table 3-7; EPA, 2021), and OU2/3 SLERA (sediment benchmarks from Table 3-6)

6 - Actual bottle quantities and volumes may vary from those presented in this table at lab discretion. Due to limited fine sediment availability, bottle sets for sediment may be minimized. A minimum of 4 x 4-oz glass jars should be collected for each sediment sample; if limited sample is available all sample jars should be light-protective glass (amber glass or clear glass and covered with light barrier).

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

8 - 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). To avoid double counting, a QC check confirms that only coeluted congeners have data and not individual contributing congeners. The "Total PCB Congeners" value for a sample is calculated regardless of the number of reported congeners or coeluting pairs. A forward slash (/) is used to designate coeluted congeners (i.e. PCB-106/118).

9 - RBCs from EPA Regional Screening Levels Table (Resident HQ=0.1, Cancer Risk=1E-06, September 2024)

10 - Freshwater criterion continuous concentration (CCC) from National Recommended Water Quality Criteria - Aquatic Life Criteria table (September 2024)

11 - Consensus based sediment quality guidelines from Macdonald et al. (2000)

Acronyms and Abbreviations:					
AES - atomic emission spectroscopy	EPA - United State Environmental Protection Agency	mg/L - milligrams per liter	PCB - polychlorinated biphenyl	µg/L - micrograms per liter	
BERA - Baseline Ecological Risk Assessment	HHRA - Human Health Risk Assessment	mL - milliliters	RBC - Risk-Based Concentration	µS/cm or eq. - microSiemens per centimeter or equivalent	
CAS - Chemical Abstracts Service	ICP - inductively coupled plasma	ng/kg - nanograms per kilogram	SLERA - Screening Level Ecological Risk Assessment	°C - degrees Celsius	
CFR - Clark Fork River	MS - mass spectroscopy	OU - Operable Unit	s.u. - standard units		
CVAA - Cold Vapor Atomic Absorption	mg/kg - milligrams per kilogram	pg/L - picograms per liter	TEQ - toxicity equivalence		

References:

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MacDonald et al. (2000). Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Ecosystems. Arch. Environ. Contam. Toxicol. 39(1):20-31.

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ATTACHMENT 1

Standard Operating Procedures

STANDARD OPERATING PROCEDURES Table of Contents	
#	Description
1	Field Records and Field Sampling Forms
2	Equipment Decontamination
3	Sample Nomenclature, Documentation, and Chain-of-Custody Procedures
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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-preserved 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 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

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

Stopwatch

Rope and Bailer (for backup)

(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. If sediment accumulation at the bottom of the well reduces the screened water column such that purging and sampling is difficult or impossible, re-development should be considered.

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). If a purge rate below or approaching 0.1 Lpm is required to stabilize water level or minimize drawdown and higher purge rates were historically possible, re-development should be considered.

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-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. Existing wells may also need to be redeveloped if well performance has decreased a year (i.e. drawdown, reduced purge rate, or high turbidity) per USEPA guidelines. 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 clear and essentially sand-free, field parameters stabilize (values within 10% for three consecutive readings), turbidity reaches < 10 NTU, and a minimum of 3 casing volumes has been removed. 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.
- General water quality parameters (e.g. pH, conductivity, temperature) may also be monitored with a calibrated meter(s) during development in accordance with SOP-7 and SOP-8 and recorded on the development form. Water quality parameters should be monitored if required by the project or if the well will not be monitored within a month after development.
- Evacuated water should be disposed of 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

This SOP describes the field equipment and sampling methods for collection of surface water samples from shallow fresh-water bodies. Review project specific Field Sampling Plans (FSP) in addition to this SOP.

GRAB SAMPLING

- When sampling in rivers, field personnel should always start downstream and work upstream to avoid contaminating unsampled areas with sediment suspended by working in the river.
- If sampling is to occur in a water body without a current (such as a pond or lake) the field team must take care to minimize the amount of sediment that is disturbed.
- Sampling can be conducted using a dip sampler for more difficult to reach or higher current areas. A dip sampler consists of a container attached to the end of a pole using an adjustable clamp.
- Sampling can be conducted by hand if conditions permit.
- When collecting a grab sample of surface water, attempt to collect the sample at the interval in the stream which exhibits the largest volume of flow and/or highest velocity. More than one interval may be sampled.
- If required, field parameters should be measured in accordance with the applicable SOP (SOPs 7 through 10) prior to collecting a sample for analytical testing. Take care to collect measurements from the same locations in the stream as the grab sample.

Note: Ensure that the sample container used for collection has not been pre-preserved. In this case, a decontaminated clean sampling container should be used to collect the sample and then transferred to the appropriate container with the preservatives.

- To collect a sample, submerge the appropriate container such that mouth of bottle is submerged below the water surface 2 to 3 inches, if possible. If sampling inorganics, allow bottle to fill partially; rinse bottle by shaking and discharge this water away from sample site. Repeat this procedure three times. Do not rinse sample bottles for organics analysis. Pour collected water into pre-labeled sampling 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 pre-labeled sampling

Purpose

To provide field sampling methodologies for surface water

Goal and Objective

To ensure surface water samples are collected consistently in the field

Equipment Needs

Decontamination equipment and fluids

Latex or Nitrile gloves

pH, conductivity, temperature meter

Coolers and ice

Sample bottles Preservatives

Indelible marker

Field sampling Form

Chain-of-custody

bottles.

- Where multiple chemical analyses are required, fill sample containers in the following order: VOCs, semi-volatile organics, inorganics, then water quality parameters.
- Once the sample container is filled, add preservative (if necessary), and close the container.
- Wrap all glass sampling containers in a sufficient amount of bubble wrap and place all individual containers in a resealable bag. Place all containers on ice or frozen gel-packs in accordance with SOP-4.
- Fill out appropriate field form(s) documenting sample location, time, and other relevant information prior to leaving sampling site in accordance with SOP-1. Decontaminate all field sampling equipment (SOP-2)

SAMPLING FREE PRODUCT ON SURFACE WATER

This sampling procedure to be used when sampling for free phase organic constituents floating on top of water is described below.

- Decontaminate sample container in accordance with appropriate SOP.
- Using a wide mouth jar, submerge the sample container in such a manner that leaves the mouth of the container half-way out of the water. Wait for the container to fill.
- Transfer directly into sampling bottles.
- Fill out appropriate field form(s) documenting sampling location, time, and other pertinent information prior to leaving the sampling site.

SOP-20

SUBAQUEOUS FINE SEDIMENT SAMPLE COLLECTION

This SOP describes the field equipment and sampling methods for collection of fresh-water fine sediment samples in shallow water. Methods explained in this SOP may be different from those identified in the project specific Sampling and Analysis Plan (SAP) or Field Sampling Plan (FSP), and the project specific SAP or FSP should be referenced for additions or deletions to the methods noted below.

SAMPLE COLLECTION

- Locate the site as described in the appropriate SAP/FSP. Search for a fine-grained sediment deposit in low velocity areas such as behind obstructions or in side channels. If possible, collect fine sediment from multiple locations on both sides of the channel.
- Record the sampling position using the GPS. Measure and record the water depth at time of sampling.
- Prior to sample collection and between samples, be sure to decontaminate all non-disposable sampling equipment in accordance with SOP-2.
- Prepare and label sample containers in accordance with the naming conventions outlined in the SAP/FSP and SOP-3.
- Collect the sediment sample in areas shallow enough to wade and reach the channel bed with a gloved hand. Using a stainless-steel scoop or spoon, collect sediment from within the upper 6 inches of the deposit at five or six locations. 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. Collect the sediment sample while facing upstream. Field equipment and sampling methods should be employed to reduce the loss of fines during sample collection. Raising the scoop slowly through the water column while protecting the fine sediment with a gloved hand will limit loss of sample material.
- Repeat the above steps if more volume is required.
- Record observations of sediment characteristics in the appropriate field logbook or field form. Observations may include color, texture, biological organisms, presence of debris, presence of oily sheen or obvious contamination, or odor. Include documentation of the sampling equipment used at each location.

Purpose

To describe field sampling methodology for subaqueous sediment

Goal and Objective

To ensure fine sediment samples are collected consistently in the field

Equipment Needs

Decontamination equipment and fluids

Latex or Nitrile gloves

GPS unit

Stainless-steel scoop, spoon, or trowel for sampling and mixing

Extension pipe (if required)

Stainless-steel mixing bowl

Sample jars with Teflon-lined lids

Munsel color book or geotechnical gauge (if required)

Cooler and ice

Sample jar labels

Field forms and field book

Chain-of-custody forms

Camera/photo board

- Document sample collection and location with photographs.
- Following collection, place the sample in a stainless-steel mixing bowl. Remove any large pieces of cobble, wood waste or other debris greater than 0.5 inches. 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.
- Place the sample containers in a cooler with ice in accordance with SOP-4.
- Complete all appropriate field sampling forms and chain-of-custody forms in accordance with SOP-1 and SOP-3.

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 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
- •n 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.

SOP-40

POREWATER SAMPLING VIA LYSIMETER

This SOP describes field equipment and sampling methods for collection of porewater from lysimeters. See SOP-39 for lysimeter installation. Porewater can be collected from lysimeters seven days after installation, allowing time for the system to stabilize and reach equilibrium.

Prior to initiating lysimeter sampling, all equipment should be inspected for damage and repaired or replaced, if necessary. Check with the project manager to be sure you understand what type of pump(s) will be used to sample porewater.

If applicable, begin sampling at the lysimeter containing the lowest level of contamination, and sample lysimeters in succession based on increasing contaminant concentrations. If the relative degree of concentrations cannot be determined, lysimeters should be sampled in order of increasing proximity to the suspected source of contamination, preferably from the perimeter towards the center of the site. If there are multiple lysimeters in one location, sample the shallowest lysimeter first to minimize potential contamination or disturbances before sampling the deeper lysimeter.

The sampling process involves applying a vacuum to the system to draw moisture into the lysimeter and then applying pressure to drive the sample to the surface. This may be a multi-day process to collect sufficient sample volume for the desired analyses.

INITIAL SET-UP

- Following the lysimeter installation (SOP-39), use the hand pump to create a vacuum of about 50 to 85 centibars (cb). This will create a pressure gradient that draws soil pore moisture into the porous ceramic cup of the lysimeter. The lysimeter should be allowed to sit for approximately seven days following installation.

SAMPLE COLLECTION

- To recover a soil water sample, attach the pressure-vacuum tube to the pressure port of either the hand pump or nitrogen tank. If oxygenating the pore water sample is a concern, then use compressed nitrogen as a source of pressure for sampling the lysimeter.
- Latex or nitrile gloves should be worn when sampling porewater. Decontamination procedures typically are not required for collection of porewater samples, because the sample lines are dedicated to each lysimeter.
- 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 methodologies for collecting porewater samples from lysimeters.

Goal and Objective

To ensure porewater samples are collected correctly and consistently in the field.

Equipment Needs

Latex or Nitrile gloves

Vacuum Hand Pump

Nitrogen Tank and Regulator Assembly

Water Quality Meter for pH, conductivity, temperature

Coolers and Ice

Sample Bottles & Preservatives

Indelible Marking Pen

Field Sampling Form

- Hold discharge tubing above an unpreserved wide mouth 1-liter collection bottle or beaker. Prepare sufficient collection or sample bottles to hold additional sample volume.
- Apply about 25-30 psi for 2-3 minutes, or until water stops flowing. The sample will be discharged from the sample line. Collect the samples in unpreserved sample bottles using care to conserve sample water, then close the valves on the compressed gas regulatory assembly.
 - Field parameters (pH, temperature, conductivity, dissolved oxygen, oxidation-reduction potential) should be measured in a 1-liter collection bottle or beaker in accordance with SOPs 7-10 prior to sample collection for laboratory analysis. Sample volume used for measurement of field parameters can be used to fill sample bottles for laboratory analysis.
 - Collect about 250mL into a Whirl-Pak bag for measuring redox species in the field. Leftover sample volume.
 - Distribute sample water into laboratory sample bottles, filtering according to SOP-11 and/or adding preservatives, if necessary, then cap sample bottles.
- If sample volume is insufficient, it may be necessary to prioritize certain analyses and/or return the following day to collect additional volume. Reference the field sampling plan to determine which bottles/analytes to prioritize and whether to return the following day to collect more sample volume.
 - Lysimeter samples should be collected coincident with adjacent monitoring well samples. Attempt to collect the required additional sample volume within a 5-day period to minimize the time delay between saturated zone and unsaturated zone samples.
- If multiple bottles are needed for the same analyte suite (i.e., dissolved metals and total metals) these should be filled on the same day if possible.
- Place sample containers in a cooler with sufficient ice; sample packaging and shipping procedures are included in SOP-4. Sample documentation and chain-of-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-41

FIELD MEASUREMENT OF FERROUS (Fe II), FERRIC (Fe III) AND TOTAL (Fe_T) IRON

Refer to HACH Method 8146 (Phenanthroline) for ferrous iron (Fe II). Refer HACH method 8008 (FerroVer) for total iron (Fe_T). Fe II and Fe_T analytical range is 0.02 to 3.00 mg/L. Samples may be diluted if anticipated iron concentrations exceed the upper instrument range.

CALIBRATION

- Prepare a series of standards from Fe II standard stock solution (50 mg/L) at the following concentrations (0.05, 0.25, 0.5, 1.5, 3.0). Use the same standard solutions for Fe_T.
- Prepare a blank (see “Blank Preparation”) using DI water.
- Follow the “Field Sample Measurement” procedure for each calibration standard.
- Record concentrations in mg/L and absorbance units on a field sampling form.

SAMPLE COLLECTION

Collect zero headspace, unfiltered samples into clean glass or plastic bottles with tight fitting caps using a peristaltic or bladder pump. Cap immediately after collection. For surface waters, collect a no headspace sample by submerging the sample bottle and capping underwater.

BLANK PREPARATION

Applies to both the HACH 8146 and 8008 methods.

- Rinse the cuvette with DI water and rinse with sample, then fill to the line with DI water.
- Clean the optical faces of the sample cell with a lint-free cloth.
- Insert the blank sample cell into the cell holder.
- Install the instrument cap over the cell holder.
- Select program 255 for Fe II (read at 510 nm) or program 265 for Fe_T (read at 590 nm). Wait for 3 minutes.

Purpose

To quantify ferrous and ferric iron concentrations in water or waste water

Goal and Objective

Measure ferrous iron and total iron concentrations (measure ferric iron by difference) while minimizing the potential for oxidation (changes to ferric iron concentrations)

Equipment Needs

Hach Spectrophotometer
Calibration Standard(s)
Hach 103769 powder pillows (Fe II)
Hach 2105769 powder pillows (Fe_T) or 2507025 AccuVac Ampuls.
Graduated Cylinder
10 mL or 25 mL Cuvettes
Power source
Indelible Ink Pen
Field Sampling Form
Deionized (DI) Water

FIELD MEASUREMENT PROCEDURE

- Rinse the cuvette with sample then fill to the line with sample. Add reagent powder pillow as specified by the method document and swirl the sample to mix.
- Select program 255 for Fe II (read at 510 nm) or program 265 for FeT (read at 590 nm). Wait for 3 minutes.
- Clean the optical surfaces of the cuvette with a lint-free cloth. Insert the cuvette into the holder in an orientation consistent with the blank measurement.
- Install the instrument cap over the cell holder and press the analyze function. Record concentration in mg/L and absorbance units on a field sampling form.
- If the concentration exceeds the calibration range, prepare a dilution of the sample, and repeat the field measurement procedure. Correct the diluted test result for the volume additions and record the dilution and corrected result on the field sampling form.
- Zero the spectrophotometer with DI water and rerun the 0.5 mg/L calibration standard as a quality control sample at least once per 10 samples or once per day, whichever is more frequent.
- Repeat this procedure for ferrous and total iron using Hach Methods 8146 and 8008 respectively.
- Calculate ferric iron (Fe III) by subtracting ferrous from total iron.

ATTACHMENT 2

Field Forms and Chain of Custody Forms

FIELD FORMS	
#	Description
1	Daily Field Activity Log
2	Low Flow Groundwater Sampling Form
3	Redox Species Sampling Form
4	Static Water Level Form
5	Surface Water Sampling Form
6	Incident Report Form
7	Pace Analytical – Chain of Custody
8	SGS Wilmington – Chain of Custody
9	Alpine Analytical – Chain of Custody

DAILY FIELD ACTIVITY LOG



GSI Job No. _____

Date: _____

Project: _____

Personnel: _____

TIME

ACTIVITY

[illegible]

Site:

Location:

Date:	_____	Weather Conditions:	_____	Depth to Water (ft bmp):	_____
Purge Method:	_____	Water Quality Meter:	_____	Measured Well Depth (ft bmp):	_____
Purge Volume Units:	_____	Casing Material:	_____	Water Column in Well:	_____
Sampling Type:	_____	Casing Diameter (in):	_____	Gallons in Well:	_____
Pump Intake Depth (ft bmp):	_____	Casing Volume to Remove:	_____	Total Volume to Remove:	_____
Comments:	_____				

Field Parameters

Date	Time	Cuml Vol Purged	Temp °C	pH	SC (uS/cm)	ORP (mV)	DO (mg/L)	Turbidity (NTU)	DTW (ft)	Remarks

Sampling Summary

Sample Date:	_____	Odor:	_____
Sample Time:	_____	Analysis:	_____
Sample ID:	_____	COC:	_____
QC Sample ID:	_____	Bottles:	_____
QC Sample Time:	_____	Remarks:	_____

Well Integrity Checklist

Item	Yes	No	NA	Notes
Status				
Type of well head				
Well Secured on initial inspection				
Well accesible?				
Is Well ID Visible?				
Water in the well box				
Sleeve around the well box in good condition				
Any cleanup performed (explain)				
Any repairs/replacement (explain)				
Remarks				

Photos



Redox Sampling Field Form

GSI Job No. _____

Page: _____ of _____

Date: _____

Client: _____

Personnel: _____

Project: _____

Site Conditions: _____

Location: _____

SAMPLE INFORMATION

Sample ID	Date	Time	Ferrous Iron (Fe II)		Total Iron (Fe _T)		Ferric Iron (Fe III) (calculated)	Notes
			Concentration (mg/L)	Absorbance (Au)	Concentration (mg/L)	Absorbance (Au)		
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								



Static Water Level Measurements
Site:

Project No:

Water Levels

Location	Date	Time	Personnel	Depth to Water (ft btoc)	Total Depth (ft btoc)	Remarks

Photos

Site:

Client:

Default Site Location

General Info

Date	_____	Time	_____
Personnel	_____		

Sample Summary

Date	_____	Time	_____
Sample Name	_____	Sample Time	_____
Duplicate Name	_____	Duplicate Time	_____
Sample Method	_____		
Remarks	_____		

Field Parameters

Date	_____	Time	_____
pH (s.u.)	_____	SC ($\mu\text{S}/\text{cm}$)	_____
Temp ($^{\circ}\text{C}$)	_____	DO (mg/L)	_____
ORP (mV)	_____	Turb (NTU)	_____
Turbidity Notes	_____		

Flow Measurement Site

Date	_____
Time	_____
Measurement Quality	_____
Weather	_____
Total Discharge (cfs)	_____
Average Velocity	_____
Measurement Method	_____
Upstream Gage	_____
Downstream Gage	_____



Surface Water Sampling Form

Project No: NA

Site:

Client:

1-inch Flume Total
Discharge (cfs)

8-inch Flume Total
Discharge (cfs)

Comments

Gage Information

Date

Time

Staff Gage Present

Staff Gage Reading (ft)

Transducer at Site

Streamside piezometer
present?

Data Logger Download

Piezometer DTW (ft)

Comments

Photo Checklist

Date

Time

Photo Checklist

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? _____

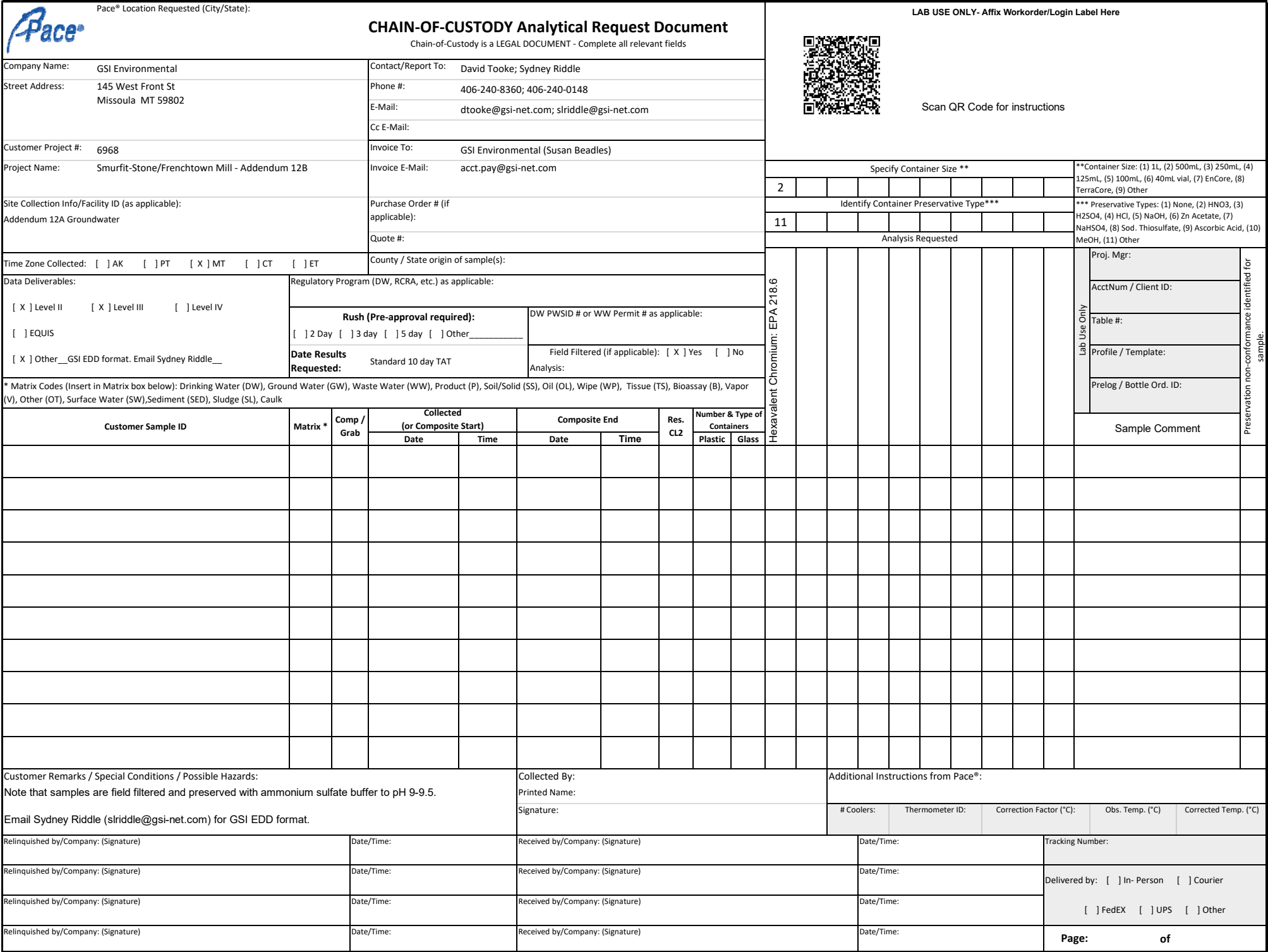
20. Have you returned to work? ☐ Yes ☐ No If so, date returned: _____

21 List anyone else affected by this incident.

22 List any witnesses to this incident.

Signature

Date





PROJECT: **Frenchtown Mill Site**

P.O. #: 6968

QUOTE #:

SITE REF:

TURN AROUND TIME: **Standard**

REPORT LEVEL: ☐ Level I ☐ Level II ☒ Level IV

SPECIAL DELIVERABLES:

☐ DoD ☒ EDD/Version:

☐ State of Origin:**SPECIAL INSTRUCTIONS / COMMENTS****SEND DOCUMENTATION / RESULTS TO**

COMPANY: **GSI Environmental**

CONTACT: **David Tooke/Sydney Riddle**

ADDRESS: 145 West Front St, Missoula, MT

PHONE: _____ EMAIL: _____

INVOICE TO (☐ CHECK IF SAME)

COMPANY:

CONTACT:

ADDRESS:

PHONE: _____ EMAIL: _____

Page ____ of ____

NOTES

SAMPLE ACCEPTANCE POLICY

The Sample Acceptance Policy is a NELAC requirement that outlines the circumstances under which samples are accepted or rejected. Data from any samples that do not meet the following criteria are qualified in a manner that clearly defines the nature and substance of the variation. The most relevant ones are captured on the sample receipt login form.

The following information should be provided, at minimum, as well as other areas of concern:

- Sample identification, date/time and location of collection
- Preservation type
- Collector's name
- Sample type
- Unique ID (indelible ink) on the water-resistant container label
- Use of appropriate containers (Teflon®-lined top glass amber or protected from light)
- Adherence to specified holding times
- Adequate sample volume (enough for a repeat analysis)

When samples are received in condition that could possibly alter the sample integrity including some of the above requirements, SGS will contact the client for resolution of the issues. Generally, SGS will assess the sample condition and offer an opinion on the suitability of the samples submitted for analysis.

Please note that samples will be disposed of 90 days following the issuance of a report unless an archiving request is noted. If samples are archived charges may be assessed after 90 days in the freezer or 12 months in cold storage.

NELAC REQUIREMENTS

Under NELAC, we are required to inform our clients who request analyses by SW846 methodology that either a matrix spike (MS)/matrix spike duplicate (MSD) set, or a MS/sample duplicate (DUP) set be analyzed with each prep batch. The samples chosen for this purpose must be clearly identified on the documentation accompanying the samples.

Our COC is modified so that this identification can be made easily. Indicate by marking "yes" or "X" in the box next to samples which require MS/MSD and/or sample duplicate tests. THESE QC SAMPLES ARE BILLABLE AT THE UNIT RATE.

SGS will provide batch QC for any projects that DO NOT provide the necessary sample volumes if at all possible. SGS will narrate any projects that do not have the required matrix spike (MS)/matrix spike duplicate (MSD) set, or a MS/sample duplicate (DUP) set.

Thank you for your attention and cooperation.

TERMS & CONDITIONS

All services are rendered in accordance with the applicable SGS General Conditions of Service accessible via: <https://www.sgs.com/en/terms-and-conditions>

CONTACTS

SGS NORTH AMERICA INC ENVIRONMENT, HEALTH & SAFETY

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Toll Free: +1 866 846 8290
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ultratrace@sgs.com
www.sgs.com

WHEN YOU NEED TO BE SURE





Chain of Custody

1315 Cherry Ave. Helena, MT 59601
(406) 449-6282

www.alpineanalytical.com

Invoice to:			Report To: (If different than invoice)			Analysis Requested				Project ID									
Address			Address							Site ID									
City State Zip			City State Zip							Sampler (print)									
Phone			Phone							Sampler (signature)									
e-mail			e-mail																
Send Via: Mail ☐ e-mail ☐ Pick-up ☐			Send Via: Mail ☐ e-mail ☐ Pick-up ☐			Report: Yes ☐ No ☐ Copy of Invoice: Yes ☐ No ☐ Lab use only													
Sample Identification		Sample		Type								Matrix		Number of Containers		Comments		LAB ID	
Relinquished by:						Date:		Time:		Received by:				Date:		Time:			
Temperature Received °C / Condition Received						Shipped: FEDEX ☐ UPS ☐ MAIL ☐ HAND DELIVERED ☐ BUS ☐						Remarks:							

** An additional cost may be incurred for samples disposed of by *Alpine Analytical Laboratory*.
 ** An additional weekend cost will be incurred for samples that are read back on a weekend or a Holiday. (ex. Total Coliform, Fecal Coliform, BOD, etc.)

ATTACHMENT 3

Field Schedule

ATTACHMENT 3 (updated 10/16/24)
Addendum 12C Quarter 4, 2024 Field Schedule
Former Frenchtown Mill
Missoula County, Montana



Staff Schedule	9/30	10/1	10/2	10/3	10/4	10/5	10/6	10/7	10/8	10/9	10/10	10/11	10/12	10/13	10/14	10/15	10/16	10/17	10/18	10/19	10/20	10/21	10/22	10/23	10/24	10/25	10/26	10/27	10/28	10/29	10/30	10/31	11/1		
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri		
	Preparations							Preparations							Preparations/Redevelopment							Monitoring							Monitoring						
SW/Sed Sampling Team																																			
Lead	Scouting and preparations																	Equipment Prep						SW/Sed Sampling		Stage gage install									
Support																							SW/Sed Sampling		Stage gage install							WL Tagging			
GW Monitoring Team 1																																			
Lead																Redevelopment							GW Monitoring							GW Monitoring					
Support																							GW Monitoring							GW Monitoring					
GW Monitoring Team 2																																			
Lead																Prep							GW Monitoring							GW Monitoring					
Support																							GW Monitoring							GW Monitoring					
Field Support																																			
Lead																																		WL Tagging	
Office Support																																			
Lead	Bottle receipt							Bottle Prep							Bottle Prep									Sample Shipping					Sample Shipping						
Support																							Sample Shipping					Sample Shipping							
Subcontractors/Agencies																																			
EPA Oversight 1																						GW Oversight							GW Oversight						
EPA Oversight 2																						GW Oversight							GW Oversight						
EPA Oversight 3																							SW/Sed Oversight												

Notes and Abbreviatons:
EPA - Environmental Protection Agency
GW - Groundwater
SW - Surface water
Sed - Sediment
WL - Water level