STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Eastern Region Office
4601 North Monroe St., Spokane, WA 99205-1295 • 509-329-3400

April 13, 2026

Lisa Corcoran, C.M.
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Spokane, WA 99224-9438

Marlene Feist
Public Works, City of Spokane
808 West Spokane Falls Boulevard
Spokane, WA 99201

Ben Brattebo
Public Works, Spokane County
1026 West Broadway Avenue
Spokane, WA 99260

**Re**: **Spokane International Airport PFAS Site – Ecology Acceptance of April 3, 2026, Revised Draft Short-Term Interim Action Work Plan**

**Site Name**: Spokane International Airport PFAS
**Cleanup Site ID (CSID)**: 16774
**Facility/Site ID (FSID)**: 6332493

Dear Lisa Corcoran, Marlene Feist, and Ben Brattebo:

On April 3, 2026, the Washington Department of Ecology (Ecology) received the Revised Draft Short-Term Interim Action Work Plan (Work Plan) submitted on behalf of Spokane International Airport (SIA) to fulfill the requirements of Task 4 of Enforcement Order No. DE 22584 (EO) and on behalf of the City of Spokane (City) and Spokane County (County) to fulfill the requirements of Task 4 of Agreed Order No. DE 24355 (AO). Revisions to the Work Plan partially address comments Ecology provided on March 27.

Ecology has completed our review of the Work Plan and believes several components of the work proposed continue to be inadequate and may not meet the bare minimum emergency interim action response requirements. Once again, Ecology notes non-compliance by SIA, the City, and the County (collectively potentially liable persons, or PLPs), with Ecology-required modifications to deliverables for this project. General descriptions of some of the remaining inadequacies within the Work Plan are identified below:

1. In the cover letter, SIA again asserts that SIA is unclear whether they can use airport revenue to implement work required by the EO despite Federal Aviation Administration (FAA) statements in 2024. SIA has not provided Ecology with any guidance from the FAA indicating that funding the cleanup would be a violation of SIA's federal law obligations or impact aviation safety. Ecology believes any perceived limitation of SIA with respect to their federal law obligations certainly would not apply to the City of Spokane or Spokane County in using City and County funds to implement the work required by the AO. If SIA is refusing to conduct or fund the necessary interim action work, this needs to be clearly stated to Ecology, so work can commence with the City and County as lead per the terms in their AO. Until then, Ecology expects SIA to cooperate with the City and County in conducting the interim action as directed by Ecology.

2. Allowing only those residents who are able to self-fill water bottles at the Garden Springs filling station and then transport full bottles to their homes limits who is able to access clean drinking water, and is more likely to have an impact on vulnerable and overburdened populations (for example, the elderly, the infirm, those without transportation, etc.). In addition, Ecology notes that several news articles have quoted PLP representatives indicating the Garden Springs water could be used for outside-of-home uses, while the Work Plan indicates this water is only for in-home use, furthering this service disparity. If outside-of-home uses are permitted, clarification is needed whether people can use their own larger capacity containers and if there will be a limit on usage.

3. Ecology believes the proposed point-of-use filter capacity per residence is inadequate, especially for larger households. Delivered bottled water service would be a far better short-term solution than pitcher and countertop filters or self-filling bottles.

4. More details are needed regarding filter distribution, tracking of recipients, and replacement filter provisioning. Clarification is also requested regarding whether both a 12-cup pitcher AND a 22-cup countertop will be offered, along with two (2) food-grade 5-gallon bottles.

At this time and in the interest of providing relief to impacted residents as soon as possible, Ecology is accepting this Work Plan as meeting the bare minimum requirements outlined in Task 4 of the EO and AO. **Acceptance, however, does not indicate Ecology's full agreement or endorsement regarding the adequacy of the proposed response actions in the Work Plan.** Ecology will soon begin formal public review and comment on the document and will continue to evaluate whether the work outlined complies with all applicable regulations. Based on this acceptance, the schedule outlined within the Work Plan is now effective and enforceable.

If you have any questions regarding this letter, please contact me at 509-724-1164 or at jeremy.schmidt@ecy.wa.gov.

Sincerely,

Jeremy Schmidt, P.E.
Site Manager
Toxics Cleanup Program

cc via email: Nicholas Acklam, Ecology
Ivy Anderson, Assistant Attorney General
Kristin Beck, Ecology
Erika Beresovoy, Ecology
Bri Brinkman, Ecology
Ecology Site File

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April 20, 2026

Jeremy Schmidt, PE, Site Manager, Toxics Cleanup Program
Department of Ecology
4601 N. Monroe Street
Spokane, WA 99205

RE: Submittal of Final Short-Term Interim Action Work Plan

Dear Jeremy:

This letter accompanies the approved Short-Term Interim Action Work Plan ("STIAWP"), issued under the Emergency Interim Action Scope of Work, being submitted jointly by the Spokane International Airport ("Airport"), the City of Spokane (the "City"), and Spokane County (the "County") (collectively, "the Parties"). Respectively, the Airport is operating under the Washington State Department of Ecology's (Ecology) Enforcement Order DE 22584 and the City and County are jointly operating under Ecology's Agreed Order DE 24355.

Enclosed is the Parties' response to Ecology's comments on the Draft STIAWP followed by the Final STIAWP that meets the requirements of the Emergency Interim Action Scope of Work and was approved in its entirety by Ecology on April 13, 2026.

Sincerely,

Lisa Corcoran
Chief Development Officer

**cc via email:** Spokane International Airport
Kyle Twohig, Senior Director of Public Works, Spokane County
Marlene Feist, Public Works Director, City of Spokane
Ivy Anderson, Assistant Attorney General, Department of Ecology

GSI ENVIRONMENTAL

**Table 1**
**Response to Ecology Comments of 27 March 2026**
**Regarding the Draft Short-term Interim Action Work Plan**

Spokane International Airport
Spokane, WA

| ECOLOGY COMMENT NO. | DOCUMENT SECTION NO. | ECOLOGY COMMENT | RESPONSE |
|---|---|---|---|
| ***Cover Letter*** | | | |
| 1 | | SIA again asserts in their cover letter that SIA is unclear whether they can use Airport revenue to implement work required by the EO. Ecology would remind SIA that the FAA's March 29, 2024 letter states "there is no bar on an airport using its own revenue to discharge its legal liabilities or to settle cases even where liability has yet to be adjudged."<br><br>Additionally, Ecology would note that the perceived limitation of SIA with respect to their federal law obligations certainly would not apply to the City of Spokane or Spokane County in implementing the work required by the AO. If SIA is refusing to conduct or fund the necessary interim action work, this needs to be clearly stated to Ecology so that work can commence with the City and County as lead as per the terms in their Agreed Order. | PLP RESPONSE: The FAA's March 29, 2024, letter explains the Airport's obligations and limitations regarding use of airport revenue under the grant assurances and federal law. In addition to the provision relied upon by Ecology, the letter contains contrary messaging reinforcing the fiduciary duties of the Airport sponsors. As joint sponsors of the Airport, the City of Spokane and Spokane County are subject to the same obligations and limitations. The PLPs have requested Ecology provide more information about the IA in order to evaluate the use of airport revenue in connection with the IA, which we hope will occur in the near future. |
| ***Work Plan*** | | | |
| 2 | General Comment | Ecology is disappointed the PLPs chose not to incorporate the advice Ecology provided in writing on March 5, 2026, which was based on over a year of experience interacting with, and supplying water and treatment to, West Plains residents. As we indicated, Ecology and the Washington Department of Health (DOH) have learned a great deal regarding public preferences and expectations for clean water which are relevant to the interim action, including the following:<br><br>• Many community members will not be physically capable of filling (or willing to fill) water bottles at the Garden Springs filling station and then transport full bottles to their homes. We received multiple complaints about having to carry water into their house when Culligan left it on the porch. The weight of carrying water, cost of gas and distance (up to 10 miles round trip for some), a lack of adjacent public transportation, bottle cleaning and sanitizing, and time needed to fill bottles daily or every other day will be significant obstacles for many residents. The Model Toxics Control Act (MTCA) requires that | The Emergency Interim Action Scope of Work and STIAWP is designed to be protective of human health, implementable on rapid timescales, and broadly accessible, while also remaining proportional to the objectives of a short-term emergency interim action. The Emergency Interim Action Scope of Work required the provision of bottled drinking water and/or point of use filter treatment.<br><br>The STIAWP provides a protective, conservative, and rapidly deployable approach that is consistent with the purpose and scope of the Emergency Interim Action. The intent of this action is to rapidly reduce potential exposure pathways without the barrier of providing a PFAS sample result, as an interim step until long-term remedies can be implemented. For these reasons, the PLPs will retain the current framework for alternative drinking water provisions as described in the Work Plan. |

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| | | all cleanup actions must protect human health and the environment, including vulnerable populations and overburdened communities; Ecology believes allowing only those who are able to access the Garden Springs filling station creates a disparate impact to vulnerable populations. Therefore, Ecology is requiring the PLPs to amend the STIAWP and provide delivered bottled water service to all businesses and residents who find using the Garden Springs filling station an impractical burden. The requirement to provide delivered bottled water service only applies to locations where water exceeds safe standards. The PLPs must provide delivered bottled water within seven days to any locations that are found to have water that exceeds safe standards through the sampling effort required by this Work Plan.<br>• Ecology hand-delivered Zero-Water countertop filters to residences in the Garden Springs area who participated in the EPA/Ecology second June 2024 sampling event. These homes were in the "expanded sampling area," which was outside the contracted area for bottled water delivery and had lower concentrations present in their well. Only 47 units were accepted and delivered to 33 homes serving 76 people. A countertop unit (and 8 replacement filters) was provided for every two people in the household so adequate water supply could be provided for all household activities (drinking, brushing teeth, boiling water for food, etc.). For example, a house with four people was provided with two countertop units and 16 replacement filters. The Zero-Water countertop filters were purchased through DOH's Alternative Drinking Water Fund, and there are still unused replacement filters at our office due to low demand. The countertop dispensers are slow to filter water and have been unpopular. Each home that received the countertop filters are set to receive point-of-use "under-sink" filters by DOH.<br>• Both self-filling bottles at the Garden Springs filling station and countertop dispensers or pitcher filters would likely be viewed as diminished service compared to the current efforts to provide delivered bottled water or install under-sink filters. As these are the | Under MTCA (WAC 173-340), emergency interim actions are intended to quickly address potential threats using measures that can be implemented rapidly and efficiently. The STIAWP achieves this objective by:<br>• Providing immediate and universal access to water without the requirement for prior PFAS sampling results,<br>• Avoiding delays associated with under-sink treatment system installation logistics,<br>• Providing a uniform level of service across the interim action area, regardless of test results,<br>• Providing equity and accessibility to everyone by providing three options where immediate drinking water needs are met with filter pitchers and high-volume drinking water needs are met with access to the fill station. |

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| | | only options provided in the STIAWP, Ecology expects the public to express extreme dissatisfaction. We encourage the PLPs to revise the Work Plan to provide replacement cartridges and operation and maintenance of currently installed systems for homes where DOH already installed under-sink filters and include installing under-sink filters for residents with drinking water that exceeds safe standards. The presence of existing, or installation of additional, under-sink filters would supplant the need to provide delivered bottled water. | |
| 3 | Section 1.1 | Revise the Work Plan to use the term "Site" as required under MTCA (any site or area where a hazardous substance, other than a consumer product in consumer use, has been deposited, stored, disposed of, or placed, or otherwise come to be located). When referring to the main operational area within the SIA Property Boundary, use the term "Main Operational Area" or similar. | The term "Site" is used to generally refer to the SIA PFAS site. It should be noted that the areas where AFFF was stored and used as part of the FAA-mandated training and testing are within the primary operational area of the airport. |
| 4 | Section 2.2 and Appendix A | Ecology welcomes and encourages collaboration on all PLP-led outreach efforts, including, but not limited to, press releases, postcards, fact sheets, public meetings, open houses, websites, social media posts, and videos. Section 8.6.2 of the AO states, "For all press releases, fact sheets, meetings, and other outreach efforts by AO PLPs that do not receive prior Ecology approval, AO PLPs shall clearly indicate to its audience that the press release, fact sheet, meeting, or other outreach effort was not sponsored or endorsed by Ecology." Please note this disclaimer was required to be included in the PLPs' March 20 press release regarding the submittal of the STIAWP and must be included on future independent outreach efforts by the PLPs regarding work covered by the AO or EO. | The disclaimer will be added to public materials that do not have prior approval from Ecology. |
| 5 | Section 2.2.1 | Bottled water service does not produce more waste than countertop or pitcher filters. Once the bottle is empty, it is sanitized and refilled by the water delivery service, a task the draft Work Plan requires affected residents to do themselves. Please remove this statement. | This statement did not specify only plastic waste. While bottled water services with reusable jugs have a greater plastic throughput over time than filter pitchers (the bottles need replacement over time and there are additional materials in the caps, seals, and associated transport packing), the environmental footprint due to transportation for the regular truck delivery and pickup is an additional waste. With both factors considered, the pitchers are regarded as a more environmentally sustainable option. |

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| 6 | Section 2.3 | Please revise the text to indicate one countertop pitcher will be provided for every two people in the household so adequate water supply could be provided for all household activities (drinking, brushing teeth, boiling water for food, etc.). This requirement is based on work completed by Ecology and DOH to calculate what would be necessary to supply an adequate amount of clean drinking and cooking water on a daily basis (minimum 1 gallon per person per day). | The plan states that a household may have a pitcher and/or a countertop dispenser. The pitchers provided will have a 12-cup capacity which according to the manufacturer is the appropriate size for a family of 4. As both the pitcher and the countertop dispenser are available, their combined capacity will accommodate the typical household. |
| 7 | Section 2.4 | Please indicate that in accordance with Section 8.6 of the EO and 8.5 of the AO, Ecology must be notified seven days in advance of private well sample collection. | Ecology will be notified 7 days prior to the commencement of the private well sampling program. The text has been revised accordingly. |
| 8 | Section 2.4 | Please describe and include a figure of the “zonal area” well sampling process, including a description of how the zones will be staged and how sampling will occur within each zone. | Figure 3-1 in Appendix B provides the initial spatial grouping for private well sampling. The sampling areas may need to be adjusted based on the density and locations of sampling requests from residences and businesses. |
| 9 | Section 2.4 and as applicable in the appendices | The text indicates sampling results will be transmitted to property owners within 60 days of receipt of validated laboratory data. Revise the text to indicate sampling results will be transmitted to property owners within 14 days of PLPs’ receipt of the complete analytical report from the laboratory. Impacted residents have a right to know the results as soon as possible to reduce their ongoing exposure to PFAS, which may include exposure pathways other than through drinking water. | We agree that providing data in an expedited manner is important. However, the data should first be reviewed to ensure it meets the data quality criteria outlined in the SAP/QAPP. This includes measures for QA/QC samples and associated field duplicates which may or may not be received as part of the same data package from the laboratory. In addition, the laboratory reports and results require review. This review is important as it allows for timely requests to the laboratory for re-analysis, if needed, for a specific sample or PFAS analyte. Our goal is to ensure that the residents receive accurate information. We have revised the time to 30 days after receipt of the final laboratory. |
| 10 | Section 2.4 and as applicable in the appendices | The text only references some of the federal MCLs. Revise the text to include the Hazard Index component of the federal MCLs and include a table of, or reference to, Washington State MCLs for PFAS. | The Emergency Interim Action Scope of Work requires comparison of private well sample results to applicable drinking water standards under MTCA. The Hazard Index (HI) was developed as a novel public water system compliance tool by the EPA under the federal Safe Drinking Water Act. The use of the HI, per the federal drinking water rule (EPA 2024), does not represent a comprehensive or science-based mixture approach for PFAS (Anderson et al. 2022). Moreover, in May 2025, EPA announced its intent to rescind the HI in addition to other changes to the federal MCLs for PFAS. This decision has been upheld in judicial filings made by the EPA in on-going litigation (American Water Works Association v. USEPA). While additive risk approaches may be used where scientifically appropriate, the limited scope of the EPA PFAS HI and its |

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| | | | exclusion of key compounds make it inconsistent with conducting receptor-specific evaluation of drinking water exposures at private wells. |
| 11 | Section 2.5 and as applicable in the appendices | In accordance with Section 8.5 of the AO, 8.6of the EO, and Sections 8.7 of the AO and EO, all sampling data must be submitted to Ecology and uploaded to EIM. Ecology understands this will require a disclaimer, such as the following, on the Right-of-Entry Form: "By consenting to this sampling, your results will be shared with the Washington Department of Ecology. Data provided to Ecology becomes public record and may be subject to public records requests and disclosure. The Washington Public Records Act, Chapter 42.56 RCW, requires Ecology to promptly make identifiable public records available for inspection and provide records upon request." | The text in Sections 2.4 and 2.5 has been revised from the original draft where the property owner could elect to keep their data private and now aligns with Ecology's requirement for sharing the data as a condition of sampling. The disclaimer provided by Ecology has been added to the STIAWP and the Right-of-Entry form in Appendix A. |
| 12 | Section 3.2 and as applicable in the appendices | In accordance with Sections 7 of the AO and EO, documents required by the AO and EO (including the schedules within those documents) become integral and enforceable components of the respective orders. The schedule within the approved STIAWP may not be modified without an approved Extension of Schedule (AO) or a Minor Amendment (EO). Remove the second two sentences of the first paragraph of Section 3.2 and similar language in the appendices. | We understand that schedule changes require Ecology approval under the EO and AO. The text has been revised to clarify this point. |
| 13 | Section 3.2 and as applicable in the appendices | Additional schedule specificity is required. Revise the schedule to include the following milestones and timeframes:<br>a. Send Survey Letter: within 45 days of STIAWP approval<br>b. Begin providing clean water: within 60 days of STIAWP approval<br>c. Public meeting or open house: within 60 days of STIAWP approval<br>d. Begin sampling private wells: within 90 days of STIAWP approval<br>e. Complete sampling private wells: within 210 days of STIAWP approval | The schedule has been revised as follows but includes consideration of practical constraints but also the ability of the PLPs to move quickly on providing drinking water:<br>a. Begin disseminating survey letters: within 45 days of STIAWP approval<br>b. Start providing drinking water: within 30 ~~45~~ days of STIAWP approval<br>c. Hold a public meeting or open house: within 60 days of STIAWP approval<br>d. Start the private well sampling: within 90 days of the STIAWP approval<br>e. Schedule private well sampling for all who chose to participate in the program: within 210 days of the survey letters being issued |

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| 14 | General Comment | DOH is currently contracting for the installation and maintenance of under-sink filters within the Interim Action Area. By June 30, 2026, DOH will have had contractors install 193 under-sink filters, most of which are within the Interim Action Area. DOH has indicated they will no longer maintain the systems within the Interim Action Area, as the PLPs have been identified as contributing to contamination within this area. Ecology believes it would be in the best interest of the impacted public for the PLPs to assume responsibility for the maintenance of these systems. Please revise the Work Plan to include this task. | The provision of replacement filters for DOH installed under-sink units has been added to the STIAWP. Long term maintenance and operation will be evaluated as components of the LTIAWP. |
| 15 | Attachment A, Sample Outreach Materials | Consider using tools to increase the readability and use of plain language and reduce the number of words; Ecology can assist with this and provide the sampling mailers we completed with EPA as examples.<br>a. Sample letter: The letter needs to inform residents that to qualify for additional assistance, such as POETs, a test result showing levels above safe standards from a certified laboratory will need to be provided by either past sampling efforts or from the sampling required in this Work Plan. Put the actions you are asking recipients to take first and the background information after.<br>b. PFAS investigation fact sheet: Please use Ecology's short link to our SIA PFAS webpage (https://go.ecology.wa.gov/SIA-PFAS). Create a short link for the ATSDR study; people are receiving this in print and shouldn't be expected to type that out.<br>c. POU fact sheet: Clarify whether people have the choice between the countertop dispenser or the pitcher (if you continue with the proposal to provide these rather than the more desirable under-sink units).<br>d. Water well survey: Add a line for an alternate phone number. After the sentence, "If you select "No," no further action is required on this form," add "You will not be eligible for a whole-house treatment system without well sampling results" (or something similar).<br>e. Portable filter consent form: Same as comment 15c. Also clarify if people can get a filter AND access to the fill station. As it reads now, it sounds like each residence only gets one or the other and like fill station | a. The visual layout and graphic design of all public materials will be finalized following acceptance of the STIAWP. The materials provided herein are intended to present content only. The examples included are designed to convey the required information and were developed within the timeframe available for preparation of the STIAWP.<br>b. The sample letter has been revised to include a statement that residents will be contacted regarding next steps as part of the long-term interim action.<br>c. The link to Ecology's webpage has been updated. A shortened link to the ATSDR study has been added.<br>d. Residents and businesses can elect to have one or both the pitcher and the countertop dispenser. This has been clarified in the letter and fact sheet.<br>e. A contact number has been added to the end of the well survey form. Additional revisions have been made to streamline the form that include the requested revisions and clarify that the form only needs to be completed by individuals requesting sampling.<br>f. The availability of both the pitcher and countertop dispenser has been clarified. Access to the fill station is in addition to the point-of-use options.<br>g. The CAS numbers have been removed and the sentence regarding future monitoring revised. |

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| | | access is not guaranteed (“You may also … “ should be “You will also …”). The acronym “POUT” is used without being defined. Add a statement explaining that accepting any of these options doesn’t prevent people from getting POETs later.<br>f. Sampling results letter: CAS Numbers are not needed. Remove “if offered” from the following sentence under “PFAS Were Not Detected”: “You may choose to participate in future monitoring ~~if offered~~.” | |

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SPOKANE INTERNATIONAL AIRPORT
Spokane, Washington
Facility Site ID: 6332493; Cleanup Site ID: 16774

# SHORT-TERM INTERIM ACTION WORK PLAN

*Prepared for:*

**CITY OF SPOKANE**
808 W. Spokane Falls Blvd.
Spokane, Washington
99201

**SPOKANE INTERNATIONAL AIRPORT**
9000 W. Airport Drive, Suite 204
Spokane, Washington 99224

**SPOKANE COUNTY**
1116 W. Broadway
Spokane, Washington
99260

*Prepared by:*

GSI ENVIRONMENTAL
1115 West Bay Drive NW, Suite 202
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Job No.: 6892
Issued: 03 April 2026

# SHORT-TERM INTERIM ACTION WORK PLAN

## SPOKANE INTERNATIONAL AIRPORT

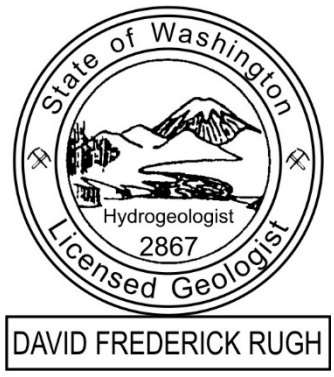
Spokane, WA
Facility Site ID: 6332493; Cleanup Site ID: 16774
**GSI Job No. 6892**

This Short-Term Interim Action Work Plan was prepared by the staff of GSI Environmental Inc., under the supervision of the Engineer(s), Geologist(s), and/or Licensed Hydrogeologist(s) whose signatures appear hereon, in collaboration with the Spokane International Airport, the City of Spokane, and Spokane County.

The findings, recommendations, specifications, or professional opinions were prepared in accordance with generally accepted professional engineering, geologic, and/or hydrogeologic practice. No warranty is expressed or implied.

**FINAL V1**
Issued: 03 April 2026

**Approved by:**




David Rugh, LG, LHG, PG
Principal Hydrogeologist, GSI Environmental Inc.

04/13/2026
Date

Amelia Tallman, RG
Principal Scientist, GSI Environmental Inc.

04/13/2026
Date

Kenia Whitehead, PhD
Principal Scientist, GSI Environmental Inc.

04/13/2026
Date

# SHORT-TERM INTERIM ACTION WORK PLAN

**Spokane International Airport**
Spokane, WA

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# SHORT-TERM INTERIM ACTION WORK PLAN

**Spokane International Airport**
Spokane, WA

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# SHORT-TERM INTERIM ACTION WORK PLAN

**Spokane International Airport**
Spokane, WA

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AFFF | aqueous film-forming foam |
| AO | Agreed Order |
| CFR | Code of Federal Regulations |
| Ecology | Washington State Department of Ecology |
| EIA | Emergency Interim Action |
| EIM | Environmental Information Management System |
| EO | Enforcement Order |
| EPA | U.S. Environmental Protection Agency |
| FAA | Federal Aviation Administration |
| GSI Environmental | GSI Environmental Inc. |
| HASP | Health and Safety Plan |
| HFPO-DA | hexafluoropropylene oxide-dimer acid |
| IAPR | Interim Action Performance Report |
| LTIAWP | Long-Term Interim Action Work Plan |
| MCL | maximum contaminant level |
| µg/kg | micrograms per kilogram |
| mg/kg | milligrams per kilogram |
| ng/L | nanograms per liter |
| NSF | National Sanitation Foundation |
| PFAS | per- and polyfluoroalkyl substances |
| PFHxS | perfluorohexanesulfonic acid |
| PFNA | perfluorononanoic acid |
| PFOA | perfluorooctanoic acid |
| PFOS | perfluorooctane sulfonic acid |
| PLPs | Potentially Liable Persons |
| POUT | Point-of-Use Treatment |
| QA | quality assurance |
| QC | quality control |
| QAPP | Quality Assurance Project Plan |
| RI/FS | Remedial Investigation and Feasibility Study |
| SAP | Sampling and Analysis Plan |
| SIA | Spokane International Airport |
| SOW | Scope of Work |
| STIAWP | Short-Term Interim Action Work Plan |
| WAC | Washington Administrative Code |

# SHORT-TERM INTERIM ACTION WORK PLAN

**Spokane International Airport**
Spokane, WA

## 1.0 INTRODUCTION

GSI Environmental Inc. (GSI) prepared this Short-term Interim Action Work Plan (STIAWP) on behalf of Spokane International Airport (SIA), the City of Spokane (City), and Spokane County (County) (collectively, the potentially liable persons [PLPs]). The PLPs, in coordination with, and under the direction of, the Washington State Department of Ecology, have established this plan to provide access to drinking water and testing of private water supply wells within the areal extent determined by Washington State Department of Ecology (Ecology) under the Emergency Interim Action (EIA) Scope of Work issued on 10 February 2026 for the Spokane International Airport PFAS site (the Site).

This Short-term Interim Action Work Plan (STIAWP) fulfills the requirements of Task 1 under the EIA Scope of Work and Schedule. This work is conducted pursuant to Task 4 of Ecology's Enforcement Order No. DE 22584 (EO) for SIA, issued on 29 March 2024, and amended on 21 August 2025, and Agreed Order No. DE 24355 (AO) for the City and the County, issued on 20 January 2026. The work included in the STIAWP pertains to the area defined in the EIA Statement of Work and applies to the performance period of the EO and AO.

The activities described in the STIAWP are intended to reduce potential exposure to PFAS in drinking water while additional investigation of groundwater conditions continues throughout the Remedial Investigation/Feasibility Study (RI/FS) process. These interim measures are designed to be protective of human health and the environment and to support ongoing remedial investigation activities regarding PFAS stemming from the Federally required use of aqueous film-forming foam (AFFF) without foreclosing long-term interim action measures or long-term cleanup alternatives that may be evaluated in the RI and FS.

This STIAWP outlines the following activities:

1. **Public outreach** to provide landowners with information about PFAS in groundwater in the area. This outreach will include an information-gathering step to determine whether landowners (a) have a private well used for drinking water, (b) elect to receive a point-of-use filtration device to reduce per- and polyfluoroalkyl substances (PFAS) concentrations in their drinking water, and (c) consent to allow sampling of water from their private well.

2. **The provision of point-of-use treatment (POUT) devices** at residences or businesses that use private water supply wells for drinking water, without the need for prior PFAS sampling results.

3. **Provide access to drinking water** through access to the City's bulk fill station at 4821 W. Garden Springs Road where residents can fill bottles or containers for in-home water consumption.

4. **Sampling and testing of well water** for PFAS at residences and businesses within the EIA area that have private water supply wells used for drinking water and provide consent for sampling; with results provided to the home, landowner, and/or lessee.

These activities will be conducted within the area defined in the EIA and shown in Figure 1-1.

In support of the above listed activities, this work plan also describes the logistics required to implement the short-term interim actions, including samples of informational materials and surveys for distribution to residences and businesses, the required right of entry form, and a communication action plan (Appendix A). A Sampling and Analysis Plan and Quality Assurance Project Plan (SAP/QAPP) including the Health and Safety Plan (Appendix B), a proposed schedule, and defined personnel roles and responsibilities is also included for the private well sampling program (Appendix B).

## 1.1 Site Background and Regional Setting

The formal address for the Primary Airport Area is 9000 West Airport Drive, Spokane, Washington (Figure 1-1). SIA is located within Spokane County and is jointly owned by the County and the City, with operations falling under SIA board authority. The second largest commercial airport in the State of Washington, SIA operates as a small hub airport providing commercial service for the surrounding community. As an airport providing scheduled air carrier passenger operations, SIA is required by the Federal Aviation Administration to (a) be certified under 14 Code of Federal Regulations (CFR) Part 139, Certification of Airports (Part 139) and (b) maintain compliance with safety and emergency response requirements, including the federal requirements for aircraft rescue, firefighting, testing and usage of AFFF.[1]

Prior to being a municipal airport, the land upon which SIA is situated was under the ownership and management of a branch of the DoD since 1939, and included the Air Force, Army, and Air National Guard (GSI Environmental Inc., 2024). The Army National Guard also leased a portion of SIA, currently referred to as Aerospace Park, until 2006. Due to the types of operations and historical use of the SIA land by the DoD, some areas were classified as a Formerly Used Defense Site (FUDS) under the Defense Environmental Restoration Program (DERP). DoD and joint DoD – SIA fire training exercises occurred, likely at certain times with AFFF, as required by both FAA and DoD policies (GSI Environmental Inc., 2024).

On 10 February 2026, Ecology formally notified SIA, the City, and the County that EIAs are required at the Spokane International Airport PFAS site. Based on their evaluation of the available groundwater data, Ecology determined that PFAS contamination originating from the primary operational area at SIA has migrated and impacted off-property through the extent of the EIA area causing drinking water at levels exceeding safe drinking water standards (USEPA, 2024). To address potential impacts to commercial and residential drinking water, emergency interim actions are required pursuant to Task 4 [Ecology Required Emergency Interim Action(s), if required] of both the EO and AO.

Regionally, SIA sits within the West Plains, a physiographic region in the northeast corner of the Columbia Basin. The West Plains is bounded in the north by the Spokane River, the south by upland buttes, the east by Marshall Creek and Latah Creek, and the west by the upland buttes and Spring Creek of eastern Lincoln County (McCollum & Pritchard, 2012). Ecology's Water Resource Inventory Area (WRIA) identifies three areas in the West Plains. WRIA 56 which includes a majority of the Site, WRIA 34 east of the Site, and WRIA 54 capturing the northernmost portion of the Site. There are multiple PFAS sources identified within the region including Fairchild Air Force Base (EA Engineering, 2021, 2025).

[1] https://www.faa.gov/airports/airport_safety/part139_cert

## 2.0 PROGRAM DESCRIPTION

The section below outlines the three main components of the short-term EIA for public outreach, the provision of drinking water, and the sampling of private wells.

### 2.1 Program Goals and Objectives

The objective of this program is to reduce potential exposure to PFAS through ingestion of drinking water from private groundwater wells within the EIA area by providing immediate access to clean drinking water and POUT devices. Access to POUT devices and drinking water will be offered to all residences and businesses receiving drinking water from private wells within the areal extent required by the EIA, regardless of whether prior testing has been conducted. Providing multiple drinking water options at the outset is an immediate protective measure for private well owners in the short term while additional information for long-terms options is collected and analyzed.

In addition, the program seeks to collect drinking water PFAS data over a broad geographic area within a focused timeframe, providing a representative snapshot of current PFAS conditions in well water. The representative PFAS snapshot is especially critical in areas where there is little known information regarding PFAS concentrations. These PFAS data will enhance the understanding of PFAS distribution and extent in groundwater and support evaluation of potential risks to groundwater users—key objectives of the Remedial Investigation and Feasibility Study. The results of this work will also support planning for long-term interim actions, which may include the installation of point-of-entry treatment systems at water supply wells, as described in Task 3, or connection to municipal water service.

Throughout the implementation of this short-term work plan, public outreach activities will help private well owners understand PFAS concentrations in their well water and the potential risks, supporting informed decisions about water use.

To efficiently conduct the activities of this STIAWP with consistent quality, the sampling of hundreds of wells will proceed in a stepwise, zonal manner beginning in the area closest to the Site and progressing outward (Appendix B, Figure 3-1). This approach supports the efficient execution of the STIAWP and the effective use of resources.

### 2.2 Public Outreach

A multifaceted public outreach program will be implemented as part of the STIAWP. Appendix A presents the Communication Action Plan with the objectives to:

- Communicate the availability of clean drinking water-- through the distribution of countertop POUT devices and the provision of drinking water at the City's fill station on Garden Springs Road.

- Encourage property owners with private wells to allow for testing for PFAS in groundwater from their well(s).

The primary audience are residents and businesses located in the EIA area as defined by Ecology, local advocacy groups that support communication with residents and businesses, the local media, and the public.

Outreach will include letters providing information and also requesting specific information from residents and businesses, a webpage that supports implementation of the STIAWP, and public

outreach meetings. Samples of the outreach materials are provided in Attachment A of Appendix A.

Spokane County, working with Spokane Regional Health District, is funding two Navigator staff to provide an additional point-of-contact for property owners interested in having their source water tested for PFAS and for appropriate water filter installation. The Navigators' activities will be conducted in coordination with other activities listed in this STIAWP.

### 2.2.1 Survey Letter

A survey letter (Appendix A, Attachment A) will be sent by first class mail to all landowners within the EIA area as identified through a parcel search. The letter will describe the short-term interim action plan and provide information on PFAS and the options being presented to residents and businesses in the area. Links to additional PFAS resources and Site-related reports will also be included.

Additionally, the survey letter will request information from landowners regarding the presence of water supply wells on their property, the status of those wells (active or inactive), and their current use (e.g., drinking water). For properties with a private well that is used for drinking water, the letter will offer a countertop POUT device to reduce PFAS concentrations, if present, in drinking water to below the federal drinking water standards (USEPA, 2024).The letter will also contain informational flyers describing how to access the City of Spokane's Garden Springs Fill Station as a source of bulk drinking water for their homes, gardens, and livestock; as well as details about the filtration device being offered (ZeroWater Dispenser or Pitcher, or equivalent). These options provide the additional benefit of environmental sustainability, as they do not produce the waste associated with bottled water. Finally, the letter requests permission for a consultant working on behalf of the PLPs to collect a sample from their private well(s) and have the sample tested for PFAS, at no cost to the landowner.

Landowners may respond either by returning the enclosed brief questionnaire in a prepaid envelope or by completing the same questionnaire online (see Section 2.2.3). The questionnaires and associated information will also be made available at public meetings and various locations such as the Garden Springs Fill Station and City Hall. The PLPs will use the survey responses to compile a list of properties with private drinking water wells; identify landowners who decline the water filtration device offering or drinking water sampling; identify those interested in one or both options; and track properties for which no response is received, or notification letters are returned. For landowners who indicate interest, project staff will follow up by phone (or by email if phone contact is not successful) to coordinate access to the bulk fill stations, countertop POUT device delivery, and to schedule drinking water sampling. For landowners who do not respond or cannot be contacted, a door-to-door survey will be conducted within each focus area to attempt to make contact (see Section 2.2.4, Door-to-Door Survey).

### 2.2.2 Webpage and Social Media

A project webpage will be developed to support public outreach and information sharing throughout implementation of this interim action; further details are available in Appendix A. The webpage will present the same information provided in the survey letter along with links to additional resources. It will also provide updates on the status of the sampling program, including the current focus area and contact information for questions or follow-up. In addition to the webpage, the PLPs will use their varied and trusted communications tools to facilitate public outreach (Appendix A)

### 2.2.3 Public Open House

A public open house will be held prior to the start of the private well-sampling efforts. The open house will allow participants to pick up a filter pitcher or an appropriate container to use at the fill station, learn how to gain access to and use the fill station, provide information on their private wells and generally learn about PFAS, its occurrence in groundwater supplied by private wells and the interim action approach. Residents will have an opportunity to ask individual questions and complete the survey during the open house. The open house will be designed to allow people to learn at their own pace and seek out additional information as needed.

### 2.2.4 Door-to-Door Survey

For landowners who do not respond to the survey, whose notification letters are not received, do not attend the public open house, or who initially respond but cannot be reached during follow-up communications, Navigators will support by making attempts at in-person contact through door-to-door visits. An initial visit will be followed by a second visit if the first attempt is unsuccessful. Navigators will document visits using the “Attempted Visit” form. During each visit, a survey letter will be left at the property, either secured to an entry gate or placed at the front door where accessible. If in-person contact is not achieved after two visits and no response is received to the survey letter, the landowner will be considered uncontactable. Landowners who do respond will be addressed in accordance with their stated preferences on the “Attempted Visit” form.

## 2.3 Provision of Drinking Water

To reduce potential human exposure to PFAS in drinking water, POUT devices will be provided to residents and businesses within the areal extent of the EIA (Figure 1-1). The POUT devices will consist of National Sanitation Foundation (NSF) certified filtration devices (e.g., pitcher-based or counter-top dispensers) designed for use at a kitchen faucet or other point of consumption; and are intended to provide an immediate, practical, and sustainable reduction in PFAS concentrations at the point of drinking water consumption.

POUT devices were selected as the preferred approach for this STIA based on their demonstrated ability to reduce PFAS concentrations in drinking water and their suitability for rapid deployment at this large scale. To ensure safety, only NSF-certified POUT systems (or equivalent performance certification) will be distributed under this program. NSF certification provides an independent verification that the filtration devices:

- Reduce concentrations of PFAS compounds;
- Meet established performance standards under the testing conditions; and
- Do not introduce additional contaminants into the treated water.

The implementation of POUT devices will include the selection and procurement of NSF-certified filtration units demonstrated to reduce PFAS (e.g., ZeroWater or equivalent) followed by their rapid and widespread distribution at residences and businesses within the EIA area. Clear instructions regarding system use, maintenance, and filter replacement schedules will also be provided. Filter replacement schedules will be based on manufacturer recommendations to ensure continued effectiveness, consistent with EPA guidance emphasizing that filter performance depends upon proper maintenance and timely replacement.[2]

[2] See EPA guidance on home filters: https://www.epa.gov/water-research/identifying-drinking-water-filters-certified-reduce-pfas

The survey letter provides a flyer with information on the POUT devices, replacement filter procedures, and filter disposal instructions (Appendix A, Attachment A). Adjustments may be made based on supply chain conditions and availability. Replacement filters will also be provided for homes within the EIA area that have received under sink filtration units via the Washington State Department of Health program during the short-term interim action.

The City, as the local water purveyor, will provide access to its Garden Springs Bulk Fill Station, located at 4821 W. Garden Springs Road, where residents can fill bottles for in-home water consumption. Landowners can contact the City of Spokane by dialing 3-1-1 to set up an account and gain access. Landowners will be provided with a PIN number to access the fill station within 48 hours of account set up. Two food grade (5) gallon transfer containers will be provided at no cost upon request.

This short-term plan serves to reduce overall exposure to PFAS in drinking water across the EIA area by providing multiple options for immediate and implementable risk-reduction measures while longer-term response actions are evaluated.

## 2.4 Private Well Sampling

Well water sampling will be conducted by GSI and/or subcontractors working on behalf of the PLPs. Ecology will be notified 7 days prior to the commencement of the private well sampling program. Sampling will generally be scheduled on a first-come, first-served basis within each zonal area to support an efficient sampling program. The objective of sampling is to obtain a representative sample of groundwater-supplied drinking water prior to typical in-home treatment (e.g., water softeners) and proposed point of use PFAS treatment. Sampling results will also generate supporting data for long-term response actions. Specific sampling areas will be identified to efficiently localize and coordinate sampling activities starting in the area proximal to SIA and progressing outward (Appendix B, Figure 3-1). At the time of sampling, residents will be asked to sign a Right of Entry (ROE) form authorizing contractors to enter the home to perform the sampling while the resident is present (Appendix A, Attachment A). No additional permits are required to conduct the activities.

Upon arrival at a residence or business, the sampling team will contact the resident or landowner and discuss their well system. The sampling team will note any existing water treatment systems, and the selected sampling location will be documented on the Sampling Form (Attachment B of Appendix B). Samples will be collected upstream of treatment systems whenever possible, preferably from an outdoor faucet located upstream to the well pressure tank. If a pre-treatment sampling location is not accessible, drinking water will be sampled at an indoor tap. In cases where a PFAS filtration system is already installed at the kitchen sink, sampling will be conducted at an alternative tap without a treatment unit, such as a bathroom faucet.

Prior to sample collection, the water will be purged for a minimum of two minutes in accordance with Environmental Protection Agency (EPA) guidance for drinking water sampling (USEPA, 2016). The SAP/QAPP details the sampling procedures, analytical procedures, and quality assurance/quality control (QA/QC) criteria to be followed during private well sampling events for this program (Appendix B).

Sampling results will be transmitted to property owners via USPS Certified Mail® within 30 days of receipt of final laboratory data allowing time for data validation and ensuring the results meet the data quality objective outlined in the SAP/QAPP (Appendix B). The results will include a table summarizing PFAS concentration data for constituents with applicable federal maximum

contaminant levels (Exhibit 2.4; USEPA, 2024), highlighting any relevant exceedances.[3] Per requirements from Ecology, all sampling results will be shared with Ecology and becomes incorporated in the public record and may be subject to public records requests (see Section 2.5). An example of the sample results letter is provided in Attachment A of Appendix A.

**Exhibit 2.4 Federal MCLs for PFAS in Groundwater**

| Group | PFAS | CAS Number | EPA MCL (ng/L or ppt) |
|---|---|---|---|
| Perfluoroalkyl carboxylic acids | PFOA | 335-67-1 | 4 |
| | PFNA | 375-95-1 | 10 |
| | HFPO-DA | 13252-13-6 | 10 |
| Perfluoroalkyl sulfonic acids | PFHxS | 355-46-4 | 10 |
| | PFOS | 1763-23-1 | 4 |

CAS = chemical abstracts service

The scope of work (SOW) within the STIA refers to the preparation of a Compliance Monitoring Plan; however, the short-term interim action proposed herein is limited to the distribution of POUT devices and access to the public water supply to reduce potential exposure at the tap and the additional provision of water at the filling station. This measure is intended as a short-term exposure mitigation action and does not include an action typically requiring compliance monitoring such as engineered treatment system(s). In lieu of a formal Compliance Monitoring Plan, this Work Plan includes procedures for dissemination of the POUT devices, including distribution tracking, user guidance, usage of POUT devices that are NSF certified to reduce PFAS concentrations, and a program to replace the filter cartridges to maintain filter performance.

## 2.5 Deliverables to Ecology

The PLPs or their contractors will submit all sampling data generated during the EIAs to Ecology and upload it to the Environmental Information Management System (EIM) in accordance with WAC 173-340-840(5) and Ecology's Toxics Cleanup Program Policy 840, Data Submittal Requirements. Ecology has required the following language on the Right-of-Entry form:

> "By consenting to this sampling, your results will be shared with the Washington Department of Ecology. Data provided to Ecology becomes public record and may be subject to public records requests and disclosure. The Washington Public Records Act, Chapter 42.56 RCW, requires Ecology to promptly make identifiable public records available for inspection and provide records upon request."

[3] Cleanup Levels and Risk Calculation (CLARC) tables under MTCA incorporate federal MCL-based values for certain PFAS compounds as applicable to potable groundwater. For public drinking water systems, State Action Levels (SALs) are used to guide response actions. The SALs were aligned with the federal MCLs in January 2026.

Personally identifiable information such as name, phone number, and email address will not be disclosed.

As outlined in Task 6 of the Scope of Work (SOW), the PLPs will submit monthly interim action progress reports that present the following:

- Site-related activities completed during the reporting period
- Deviations from required tasks or the scope of work for the current or upcoming reporting periods
- Raw data received during the month
- Planned deliverables and activities for the next reporting period

An annual interim action performance report will be submitted as outlined in Task 5 of the SOW. The annual report will include the following:

- Activities completed during the past year and planned for the coming year
- Landowner status, including whether contact has been made, whether a water supply well used for drinking water is present, and whether the landowner has signed up for access to the City's Garden Springs Bulk Fill Station, accepted a filtration device, or agreed to allow their well water to be sampled and tested for PFAS
- Tables of PFAS sampling results (results identified by a sample ID will not include contact information or address of the property owner, unless permission has been obtained from the property owner)
- Figures illustrating sampling data
- Raw data collected during the reporting period

## 3.0 PROGRAM MANAGEMENT AND SCHEDULING

This section provides an overview of program management and scheduling, including a description of the program team, required training for personnel conducting drinking water sampling, and the proposed schedule for completing program requirements.

### 3.1 Key Individuals and Their Responsibilities

Exhibit 3.1 summarizes key program personnel, along with their respective roles for this program.

**Exhibit 3.1: Program Team Roles and Responsibilities**

| Key Personnel | Title | Contact Information | Project Role |
|---|---|---|---|
| Lisa Corcoran, C.M.; SIA | Client – Chief Development Officer | Phone: 504-455-6406<br>Email: lcorcoran@spokaneairports.net | SIA point of contact. Provides internal review of the STIAWP, Quarterly Progress Reports, and Annual Performance Reports. |
| Marlene Feist<br>City of Spokane | Director, Public Works | Phone: 509.625.6505<br>Email: mfeist@spokanecity.org | City of Spokane point of contact. Provides internal review of the STIAWP, Quarterly Progress Reports, and Annual Performance Reports. |

| Key Personnel | Title | Contact Information | Project Role |
|---|---|---|---|
| Ben Brattebo<br>Spokane County | Water Programs Administrator | Phone: 509-477-3600<br>Email: bbrattebo@spokanecounty.gov | Spokane County point of contact. Provides internal review of the STIAWP, Quarterly Progress Reports, and Annual Performance Reports. |
| Kenia Whitehead, Ph.D.;<br>GSI Environmental | Project Lead; Principal Investigator | Phone: 564-999-5192<br>Email: kwhitehead@gsi-net.com | Technical review of the STIAWP, Quarterly Progress Reports, and Annual Performance Reports. Provides general technical oversight and project management. |
| Jeremy Schmidt, P.E.; Ecology | Site Manager | Phone: 509-724-1164<br>Email: jesc461@ecy.wa.go | Site manager for Ecology. Reviews and approves the STIAWP, Quarterly Progress Reports, and Annual Performance Reports. |

## 3.2 Proposed Program Schedule

The schedule for key elements of the STIAWP are as follows:

- Disseminate survey letters: within 45 days of STIAWP approval
- Commence the provision of drinking water: within 30 days of STIAWP approval
- Hold a public meeting or open house: within 60 days of STIAWP approval
- Start the private well sampling program: within 90 days of the STIAWP approval
- Schedule private well sampling for all who chose to participate in the program: within 210 days of the survey letters being issued

Requests to Ecology for changes to the schedule may be made depending on practical constraints related to implementing a program of this scale within the required expedited timeframe. These constraints include contractor and subcontractor availability, applicable procurement processes, analytical laboratory capacity, POUT device supplier inventory, and private well owner coordination.

The proposed program schedule in Exhibit 3.2 adheres to the task schedule defined in the EIA Scope of Work and Schedule issued by Ecology on 10 February 2026 for the short- and long-term interim actions.

**Exhibit 3.2: Program Schedule**

| Task | Expected Completion Date |
|---|---|
| 1a. Submit draft STIAWP | 38 days after PLPs receive Ecology's written notice that an Emergency Interim Action is required |
| 1b. Submit final STIAWP | 7 days after PLPs receive Ecology's comments on Draft STIAWP |
| 2. Begin work in STIAWP | 7 days after PLPs receive Ecology's approval of Final STIAWP |
| 2. Complete work from STIAWP | 1 year |
| 3. Submit draft LTIAWP | 90 days after PLPs receive Ecology's written notice that an Emergency Interim Action is required |

| Task | Expected Completion Date |
|---|---|
| 3. Submit final LTIAWP | 30 days after PLPs receive Ecology's comments on Draft LTIAWP |
| 4. Begin work from LTIAWP | 30 days after PLPs receive Ecology's approval of Final STIAWP |
| 4. Complete work from LTIAWP | As required by schedule in LTIAWP |
| 5. Submit draft annual IAPR | By March 15 of the subsequent year |
| 5. Submit final IAPR | 30 days after PLPs receive Ecology's comments on Draft IAPR |
| 6. Interim action progress reports | Monthly, on the 10th day of each following month |

## 4.0 REFERENCES

EA Engineering. (2021, September 22). *DRAFT - Fairchild Air Force Base Phase I PFAS Remedial Investigation Preliminary Groundwater Sampling Results*.

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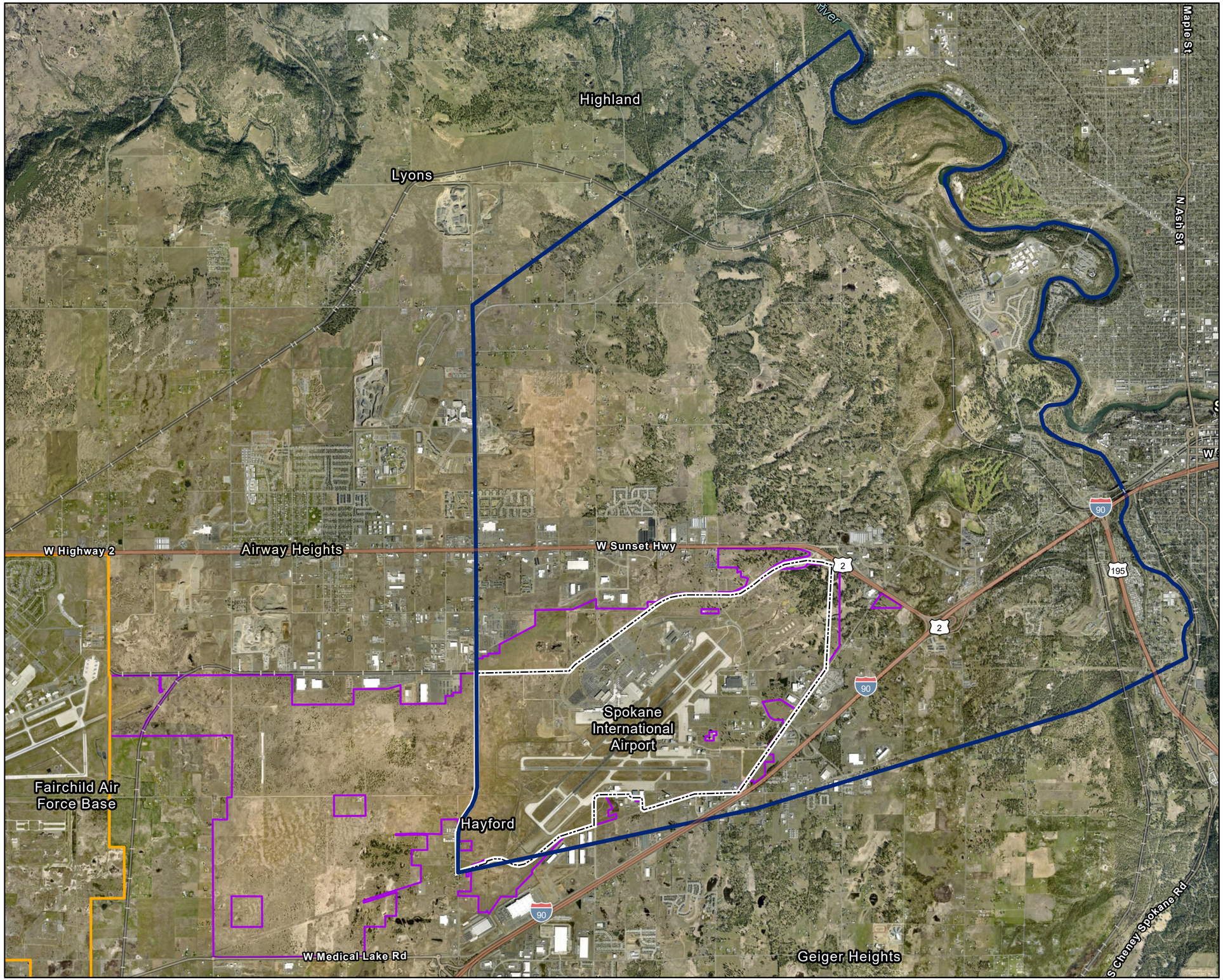
# SITE INVESTIGATION REPORT

**Site or Project Name**
City, State

## FIGURES

Figure 1-1 Site Location Map




## LEGEND

- Primary Airport Area
- Fairchild Air Force Base Property
- SIA Property Boundary
- Interim Action Area

**Notes**

1) SIA - Spokane International Airport
2) Base map imagery provided by Esri ArcGIS Online, 2026.

Miles
0 0.5 1

Projected Coordinate System
Datum: NAD 83
State Plane Washington North
Units: Feet

GSI ENVIRONMENTAL

## Interim Action Area

Short-Term Interim Action Work Plan
Spokane International Airport
Spokane, Washington

| | | | |
|---|---|---|---|
| GSI job No. | 6892 | Drawn By: | EKS |
| Issued: | 03-Apr-2026 | Chk'd By: | KW |
| Map ID: | ECY_EIA | Appv'd By: | **KW** |

**FIGURE 1-1**

# SITE INVESTIGATION REPORT

**Site or Project Name**
City, State

## APPENDICES

Appendix A Communication Action Plan and Public Outreach Materials
Appendix B Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP)

# SITE INVESTIGATION REPORT

**Site or Project Name**
City, State

## APPENDIX A

Communication Action Plan and Public Outreach Materials

SPOKANE INTERNATIONAL AIRPORT
Spokane, Washington
Facility Site ID: 6332493; Cleanup Site ID: 16774

# SHORT-TERM INTERIM ACTION WORK PLAN - APPENDIX A COMMUNICATION ACTION PLAN AND SAMPLE PUBLIC OUTREACH MATERIALS

*Prepared for:*

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Job No.: 6892
Issued: 03 April 2026

# SHORT-TERM INTERIM ACTION WORK PLAN

**Spokane International Airport**
Spokane, WA

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# SHORT-TERM INTERIM ACTION WORK PLAN

**Spokane International Airport**
Spokane, WA

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## ATTACHMENTS

Attachment A Sample Public Outreach Materials

# SHORT-TERM INTERIM ACTION WORK PLAN

**Spokane International Airport**
Spokane, WA

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| Ecology | Washington State Department of Ecology |
| EIA | Emergency Interim Action |
| CAP | Communication Action Plan |
| City | City of Spokane |
| County | Spokane County |
| PFAS | per- and polyfluoroalkyl substances |
| PLPs | Potentially Liable Persons |
| POUT | Point-of-Use Treatment |
| SIA | Spokane International Airport |
| STIAWP | Short-Term Interim Action Work Plan |
| USPS | United States Postal Service |

# SHORT-TERM INTERIM ACTION WORK PLAN

**Spokane International Airport**
Spokane, WA

## Appendix A Communication Action Plan

## 1.0 ABSTRACT

This Communication Action Plan (CAP) was prepared to support public communication related to efforts by the Spokane International Airport (SIA), the City of Spokane (the City), and Spokane County (the County) (collectively, the potentially liable persons [PLPs]) related to Task 1 of the Short-Term Emergency Interim Action Work Plan. Task 1 is outlined in the Emergency Interim Action (EIA) Scope of Work and Schedule issued by the Washington State Department of Ecology (Ecology) on 10 February 2026 for the Spokane International Airport PFAS site (the Site). The CAP outlines the communication protocols between the PLPs and the residents and businesses within the City and the County with private water supply wells that may have per- and polyfluorinated alkyl substances (PFAS) present above the applicable standards in the areal extent required for the EIA that will be followed during implementation of the Short-Term Interim Action Work Plan (STIAWP). See the STIAWP for information regarding the project's additional tasks, objectives, and site background.

## 2.0 PROGRAM DESCRIPTION

The STIAWP outlines the following activities to be performed within the EIA area (Exhibit 2.0):

1. **Public outreach** to provide landowners with information about PFAS in groundwater in the area. This outreach will include an information-gathering step to determine whether landowners (a) have a private well used for drinking water, (b) elect to receive a point-of-use filtration device to reduce per- and polyfluoroalkyl substances (PFAS) concentrations in their drinking water, and (c) consent to allow sampling of water from their private well.

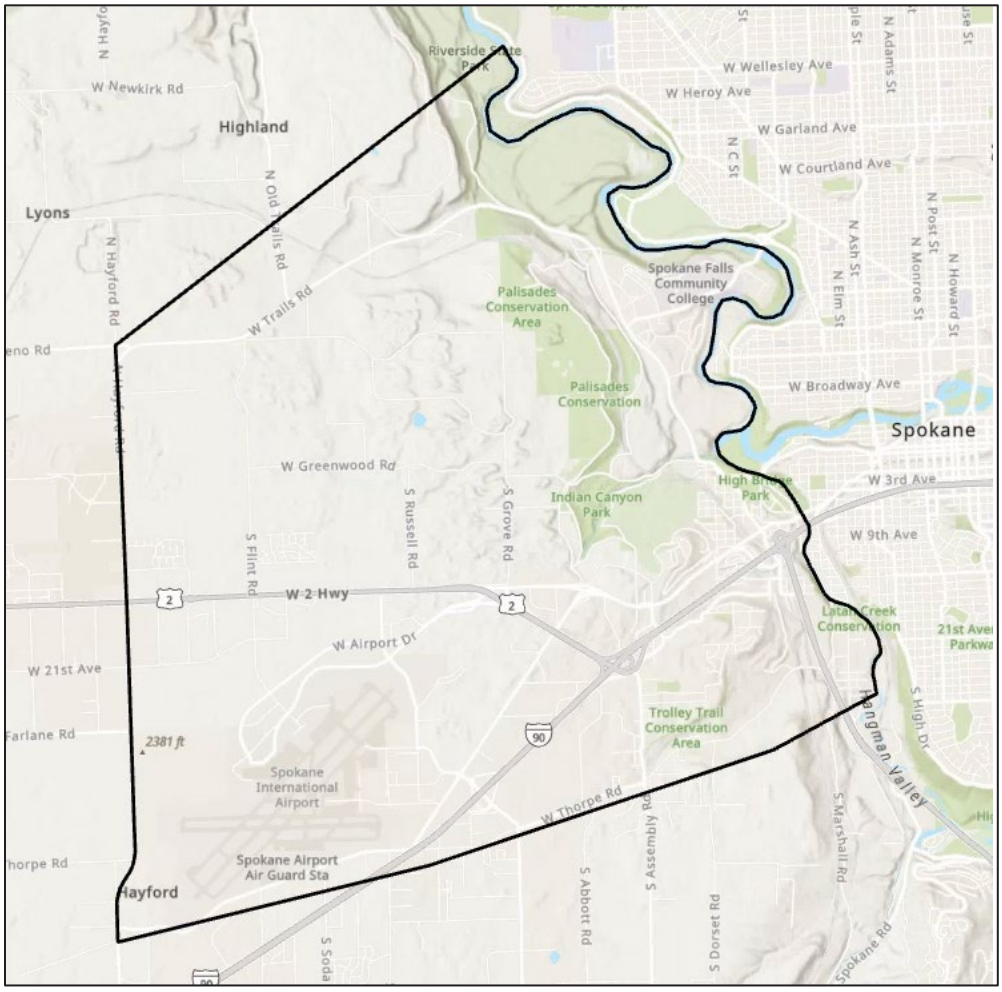
2. **The provision of point-of-use treatment (POUT) devices** at residences or businesses that use private water supply wells for drinking water, without the need for prior PFAS sampling results.

3. **Provide access to drinking water** through access to the City's bulk fill station at 4821 W. Garden Springs Road where residents can fill bottles or containers for in-home water consumption.

4. **Sampling and testing of well water** for PFAS at residences and businesses within the EIA area that have private water supply wells used for drinking water and provide consent for sampling; with results provided to the home, landowner, and/or lessee.

**This CAP addresses Activity 1:** providing information and communications to property owners that have private wells within the areal extent required by the EIA as outlined in the STIAWP for the Site. In support of this task, this CAP also describes the logistics required to implement the interim action, including example informational materials, surveys, and required access agreements for distribution to residences and businesses (Attachment A), and a proposed schedule.

**Exhibit 2.0. Areal Extent of the Emergency Interim Action**




Notes: Areal extent defined by Ecology (Ecology, 2026).

## 3.0 DESCRIPTION OF COMMUNICATION PLAN

This CAP outlines the objectives and protocols for providing communications for the activities defined in the STIAWP.

### 3.1 Communication Objectives

The primary goal of the CAP is to provide clear and consistent communications on behalf of the PLPs to inform the public and gain participation in the STIAWP activities. The specific objectives of providing communications for the EIA area are described as follows:

1. Communicate program information outlined in the STIAWP about the availability of clean drinking water.

2. Encourage property owners with private wells to allow for testing for PFAS.

### 3.2 Target Audiences

The target audiences for communications are identified as follows:

- City and County residents and businesses located in the EIA area
- Local advocacy groups that communicate with potentially impacted residents and businesses located in the EIA area
- Local media
- General public
- Ecology and additional agencies as needed.

## 3.3 Communication Tasks

Communication will be focused on providing clear, concise, and consistent information to residents and businesses in the EIA area defined by Ecology. The work outlined in this CAP will follow the program schedule proposed in the STIAWP (GSI Environmental Inc., 2026) and Exhibit 3.1 that lists the sequential communication actions to be performed along with their anticipated completion timelines. In the proposed program schedule, the required EIA activities are completed in phases. After Ecology approves the STIAWP, the first phase of work will involve offering access to the City of Spokane's Garden Springs Fill Station, POUT devices, and residential and commercial well sampling to private property owners following approval of the STIAWP by Ecology.

**Exhibit 3.1. Communication Actions**

| Communication Action[1] |
|---|
| Prepare template survey letters (Section 4.1.1) along with initial briefing paper and information messages. |
| Develop a webpage (Section 4.1.2) with information that hosts program information in a single location with links to additional resources. The City, County, and SIA regular web sites will send people to this website. |
| Develop a map to allow property owners to check if their property is within the EIA. |
| Provide briefing in public session(s) to both the City Council and County Commission—to keep elected officials and additional audiences (Section 3.2) informed. |
| Prepare and distribute a news release to explain what's happening and what options are available for residents and businesses in the EIA. Designate spokespeople available for interviews with news outlets. |
| Prepare a short video with program information. |
| Share video, web links, news release, and/or related information via PLPs' social media assets (Section 4.2; e.g., City, County and SIA Facebook, X and similar accounts (Section 4.1.3) and CityCable 5. |
| Provide information to City and County customer service personnel who may answer calls from the public. |
| Leverage all other available communication channels (e.g., City's Community Update email newsletter (Section 4.2), West Plains Water Coalition newsletter) |

| Communication Action[1] |
|---|
| Hold in-person event(s) (Section 4.1.4) to distribute portable POU filtration devices and water containers for use at bulk water fill station(s). Events will be used to collect survey information about property owners' wells for sampling (Appendix B of the STIAWP). |
| Develop a postcard for property owners in the EIA. |
| Update information on PLPs assets (Section 4.2) as needed. |

Notes:
1. Actions and timelines listed are for Objective #1. Similar communication actions for Objective #2 will follow private well sampling preparation activities outlined in Appendix B.

## 3.4 Practical Constraints

Implementation of the actions outlined in this CAP is subject to practical constraints that may affect scheduling, sequencing, and the completion dates listed in Exhibit 3.1. Public coordination—including distribution of educational materials, holding in-person events, obtaining written access consent, and scheduling sampling appointments—may introduce delays. Contractor and subcontractor availability and public procurement requirements may further limit the pace of field activities.

Communication events and delivery of materials may be delayed by weather-related conditions such as snow, significant snowmelt or rainfall, severe storms, or fires in the vicinity. Communication actions may be influenced by scheduling considerations associated with the availability of the PLPs and property owners within defined time frames. These constraints will be managed through advanced coordination between the PLPs, through documentation of completed action items and consistent adherence to the established communication protocols herein.

# 4.0 COMMUNICATIONS

This section provides a summary of example materials for distribution to residences and businesses and an overview of the available resources to provide effective communications.

## 4.1 Public Outreach Material

Key public outreach materials are described in Section 2.2 of the STIAWP. Sample materials are included in Attachment A for the survey letter, right of entry form to allow sampling, an attempted visit form, and the letter to report private well sampling PFAS results. Public outreach will also include construction of a webpage, the use of social media, and public open houses. For landowners who do not respond to the survey, whose notification letters are not received, or who respond but cannot be reached during follow-up; navigators will attempt in-person contact through door-to-door visits (see Section 2.3 of the STIAWP).

## 4.2 PLPs Toolkits and Assets

The PLPs will utilize the following toolkits and assets to prepare and distribute communications as applicable:

- GIS mapping tools

- Briefing papers for public officials and key SIA personnel
- Key message documents
- Frequently Asked Questions (FAQs)
- USPS® Direct Mail (postcards and/or letters such as survey letters), First-Class Mail (postcards and/or letters), and Certified Mail (sample results)
- Associated websites:
  - SIA: https://spokaneairports.net
  - SIA PFAS Investigation: https://gegsustainastg.wpenginepowered.com/ pfas-investigation
  - City: https://my.spokanecity.org
  - County: https://www.spokanecounty.gov
  - A webpage containing information issued by the PLPs specific to the STIAWP implementation that serves as a source of information, points to additional resources, and has a calendar for public outreach events.
- Social media accounts:
  - SIA accounts on Facebook, X, and Instagram
  - City accounts on Facebook, X, Instagram, Nextdoor, YouTube, and Vimeo
  - County accounts on Facebook, X, Instagram, YouTube, and Vimeo
- News releases and blog posts
- Video segments to be aired on CityCable5
- City of Spokane Community Update: email newsletter
  - Distributed weekly to about 80,000 email addresses

## 4.3 Roles and Responsibilities

Exhibit 4.3 defines the roles and responsibilities for the implementation of the CAP.

**Exhibit 4.3. Roles and Responsibilities**

| Key Personnel | Title | Contact Information | CAP Role |
|---|---|---|---|
| Lisa Corcoran, C.M.<br>SIA | Client – Chief Development Officer | Phone: 504-455-6406<br>Email: lcorcoran@spokaneairports.net | SIA Point of Contact |
| Marlene Feist<br>City of Spokane | Director, Public Works | Phone: 509.625.6505<br>Email: mfeist@spokanecity.org | City of Spokane Point of Contact |

| Key Personnel | Title | Contact Information | CAP Role |
|---|---|---|---|
| Ben Brattebo<br>Spokane County | Water Programs Administrator | Phone: 509-477-3600<br>Email: bbrattebo@spokanecounty.org | Spokane County Point of Contact |
| Kenia Whitehead, PhD<br>GSI Environmental Inc. | Project Lead; Principal Scientist | Phone: 564-999-5192<br>Email: kwhitehead@gsi-net.com | Technical Reviewer |

## 5.0 REFERENCES

Ecology. (2026). *Emergency Interim Action Scope of Work and Schedule*. Washington State Department of Ecology.

GSI Environmental Inc. (2026). *Short-Term Interim Action Work Plan* [Work Plan]. Spokane International Airport.

# SHORT-TERM INTERIM ACTION WORK PLAN

**Spokane International Airport**
Spokane, WA

## ATTACHMENT A

**Sample Public Outreach Materials**

Sample Letter and Survey

Sample Right-of-Entry (ROE) Form

Sample Attempt to Visit Form

Sample Results Letter

GSI ENVIRONMENTAL

**SAMPLE LETTER AND SURVEY**

XX Month 20XX

[Name of Private Well Owner]
[Address of Private Well Owner]
[Address of Private Well Owner]

Dear Well Owner,

Spokane International Airport (SIA), the City of Spokane (City), and Spokane County (County) are writing to inform you about ongoing groundwater investigations in your area related to per- and polyfluoroalkyl substances (PFAS). PFAS are a group of man-made chemicals that can persist in the environment and may increase the risk of certain health effects following long-term exposure. Recent sampling has identified PFAS concentrations above federal drinking water standards in some private water wells in your area. The federal drinking water standards for PFAS (known as Maximum Contaminant Levels or MCLs) are set to limit potential health concerns over a lifetime of exposure. Although drinking water with PFAS above the MCL does not indicate an immediate health concern, actions may be warranted to reduce exposure. Included with this letter, a fact sheet titled "PFAS Investigation and Community Commitment" presents information describing PFAS, their presence in groundwater in the area, and the investigation underway.

In coordination with, and under the direction of, the Washington State Department of Ecology (Ecology), we are offering options for you to receive drinking water. The options are:

- Point-of-use treatment (POUT) devices are being offered to you at no cost.
- In addition, the drinking water fill station located at 4821 W. Garden Springs Road is available and two food grade (5) gallon bottles will be supplied at no cost to you. You will need to set up an account with the City of Spokane which can be done online at [webpage] or at the fill station.

These options are meant to provide you with access to drinking water as a short-term measure while we work on finding solutions to provide drinking water over the long-term. To help us develop the most effective long-term solution, we are also offering to sample and test your well water for PFAS at no cost to you.

To support this effort, we ask that you complete the following actions:

1. Confirm whether your property has a private well used for drinking water.
2. Let us know if you would like to receive the POUT devices.
3. Indicate whether you are willing to allow your water to be sampled and tested for PFAS, at no cost to you, with the results provided to you.

The filters in the POUT devices are certified to reduce PFAS concentrations in water used for cooking and consumption to levels below the MCLs. Replacement filters will be provided, as needed. This option allows you to treat your drinking water without any plumbing modifications. Additional details on these devices are provided in the fact sheets following this letter.

With your permission, we will also collect water samples from your kitchen tap or another accessible faucet or sampling point prior to any treatment systems such as a water softener. The sampling process includes a brief flushing of the plumbing (i.e., letting the water run for a few minutes) followed by collection of water samples. Analytical results will be provided directly to you at no cost to you.

Ecology requires us to submit all data gathered as part of this private well sampling program to them. Therefore, by consenting to this sampling, your results will be shared with Ecology. Data provided to Ecology becomes public record and may be subject to public records requests and disclosure.

If your property has a private water supply well, please respond using one of these options:

- Visit the secure online portal: [INSERT WEBPAGE URL] The QR code will also take you to the portal.
- Complete and return the enclosed response forms using the prepaid envelope.

INSERT QR CODE TO WEB PORTAL

After we receive your response and if you indicate your consent, a member of our team will follow up by phone to discuss next steps. We will coordinate any associated drinking water sampling at a time convenient for you.

Please feel free to contact us at [insert contact phone number] or [insert contact email address] if you would like to discuss this further. We appreciate your cooperation and the opportunity to work with you.

Sincerely,

**[INSERT NAME]**

# PFAS INVESTIGATION AND COMMUNITY COMMITMENT

Spokane International Airport (SIA), the City of Spokane, and Spokane County take pride in the role that SIA plays as the main transportation hub for the Inland Northwest and as a responsible, active member of the local community and economy. We are working diligently to investigate per- and polyfluoroalkyl substances (PFAS) that may be on airport property as a result of activities for training firefighters to save lives during emergencies. We take our responsibility to address PFAS seriously and are committed to preventing undue risk to our environment or the health of our local community.

## What are PFAS?

PFAS are a broad family of man-made chemicals that contain carbon and fluorine. Since around the 1940s, PFAS can be found in many common consumer and industrial products, which has led to their widespread detection across the globe. At airports, PFAS have been released into the environment because they are used in aqueous film-forming foam (AFFF) for firefighting and emergency response. Since the 1960s, the Federal Aviation Administration (FAA) required passenger airports, such as SIA, to use AFFF that meets federally mandated standards.

## What do we know about sources of PFAS in groundwater?

SIA used PFAS-containing AFFF for emergency response. Before SIA was a municipal airport, the land was owned and managed by the City and County of Spokane or a branch of the Department of War (DOW), beginning in 1939. The Washington State Army National Guard also leased a portion of SIA, currently Aerospace Park, until 2006. DOW and joint DOW–SIA fire training exercises occurred, likely at certain times with AFFF, as required by both FAA and DOW.

## What are we doing?

We are investigating the locations, concentrations, and potential transport pathways of PFAS found in shallow groundwater at some locations on SIA. In your neighborhood, we are offering a POU filter device for residents in the Emergency Interim Action area and access to the City of Spokane's bulk fill station as a source of drinking water for homes. We are also sampling private wells in the Emergency Interim Action area to help us understand the presence and extent of PFAS in the area and also address long-term options for providing drinking water.

## Resources

SIA Environmental Overview: https://spokaneairports.net/ENVIRONMENTAL-OVERVIEW

Washington State Department of Ecology website with SIA's PFAS investigation information and links to documents: https://go.ecology.wa.gov/SIA-PFAS

Information related to the Fairchild Air Force Base PFAS cleanup program: https://www.fairchild.af.mil/Information/Restoration/

U.S. Agency of Toxic Substances and Disease Registry (ATSDR) PFAS community exposure study for Spokane County: https://www.atsdr.cdc.gov/pfas/exposure-assessments/spokane-county-washington-community-level-results.html

ATSDR website: Per- and Polyfluoroalkyl Substances (PFAS) and Your Health. https://www.atsdr.cdc.gov/pfas/talk-to-your-healthcare-provider/index.html

U.S. Environmental Protection Agency's PFAS information website. https://www.epa.gov/pfas

# POINT-OF-USE WATER FILTER DEVICES FOR PFAS REDUCTION

## What is a PFAS-Reducing Water Filter Device?

The point-of-use treatment (POUT) filter is a simple, countertop dispenser or pitcher that holds tap water and passes it through a specialized filter cartridge that reduces per- and polyfluoroalkyl substances (PFAS). These filters also improve taste and reduce other contaminants that may be present. We are offering one ZeroWater countertop dispenser or pitcher along with replacement filters. The ZeroWater filter is NSF-certified to reduce PFOA and PFOS as well as lead and chromium, if present.

*ZeroWater Countertop Dispenser*

*ZeroWater Pitcher*

## How do you know the POUT filter works to remove PFAS?

NSF thoroughly tests filters before they are labeled “certified.”

## How does it work?

Fill the dispenser’s or pitcher’s top reservoir with cold tap water. The water slowly flows through the filter which often contains a combination of activated carbon and other materials that trap PFAS before the water collects in the lower dispenser or pitcher.

Only use cold tap water with your countertop dispenser or filter pitcher. Hot water can damage filtration media and reduce PFAS removal ability. Cold, filtered water is suitable for general consumption such as drinking, cooking, and making beverages.

## What are the benefits of using a PFAS-Reducing POUT Filter?

- Reduces levels of certain PFAS such as PFOA and PFOS when using a filter tested or certified for PFAS removal.
- Improves taste and odor of drinking water.
- Portable and easy to use without plumbing changes.

## How do I maintain the dispenser or pitcher and replace the filter?

ZeroWater filter dispensers and pitchers use a replaceable filter that should be changed based on water quality and usage rather than on a fixed schedule. Depending on source water quality, a typical filter treats approximately 20 to 40 gallons of water. Each filter device includes a total dissolved solids (TDS) meter. The filter cartridge should be replaced when the meter reading reaches 006 or when taste noticeably changes. To maximize PFAS reduction, replace cartridges before they expire.

*Content adapted from the Washington State Department of Health informational sheet titled “Free Point-of-Use Filter Program for West Plains Residents.”*

# WATER WELL SURVEY

GSI Environmental, Inc. (GSI) has been contracted by Spokane International Airport (SIA), the City of Spokane, and Spokane County to conduct water supply well sampling as directed by the Washington State Department of Ecology. This effort is intended to identify private residential drinking water that may be impacted by per- and polyfluoroalkyl substances (PFAS). This survey will determine whether a water well is present on your property and, if so, whether you are willing to allow that well to be sampled.

**Property Address and Contact Information**

Name: _____

Landowner / Renter (Circle one). If Renter, Landowners Name:

_____

Physical Address (Unit, Street, City, State, Zip):

_____

Mailing Address (if different from physical address):

_____

Best Phone Number: _____

E-mail: _____

**Water Well Information**

Is there a water well present on your property? (Circle one) Yes / No

If you select “No,” no further action is required on this form. If you select “Yes,” please continue to the next page.

# PORTABLE FILTER CONSENT FORM

A point-of-use treatment (POUT) device is being offered for use at your residence for free. There are two styles of devices, a pitcher with a filter or a countertop dispenser with a filter. These filters are designed to reduce concentrations of per- and polyfluoroalkyl substances (PFAS) in water to below the applicable federal Maximum Contaminant Levels (MCLs). We will additionally provide replacement filters, as needed. This option allows you to treat drinking water without any plumbing modifications.

You can also access the City of Spokane's Garden Springs Bulk Fill Station, located at 4821 W. Garden Springs Road, for drinking water. We will provide you with two food grade (5) gallon bottles to use for collecting water at no cost to you. Please see XXXXX for additional information.

If you would like to have a filter pitcher and/or a countertop dispenser provided for you, please fill out the information below. In addition, please fill out the water well information form on the next page. Your answers on the well water form will not affect your eligibility for this filter device offer, fill station access, or option to have your water tested for PFAS. Once your form providing information about your well(s) is received, a member of our team will contact you to discuss access details and next steps.

Please indicate whether you accept or decline the offered POUT filter device. Accepting the POUT filter device does not negate future options for long-term treatment.

**Please indicate your preference below:**

I would like to receive a certified portable filter device for drinking water:

☐ Accept Pitcher with Filter

☐ Accept Countertop Dispenser with Filter

OR: I decline the portable filter device offer.

☐ Decline the Filter Devices

Printed Name:_____

Signature: _____ Date: _____

# SAMPLE FORM AND QUESTIONS

[Provides text and questionnaire content, layout and formatting for an improved visual presentation will be applied]

## PERMISSION TO SAMPLE DRINKING WATER IF WATER WELL IS PRESENT

Will you allow the one-time collection of a drinking water sample at your property? The sampling will be conducted at no cost to you, and you will be provided with the results. Please circle one:

Yes / No

If you selected "Yes," a member of our team will contact you to discuss the details and coordinate a convenient time for sampling. Please fill out the information below.

If you select "No", no further action is required on this form. You will also be ineligible for future options, if needed, for long-term treatment.

## WATER WELL INFORMATION AND SAMPLING AUTHORIZATION

How many water wells are located on your property? _____

If you have more than one well, we will reach out for additional information.

Please complete the following information (if available) for the primary well.

**Well Information and Usage**

Well Address (if different from home address): _____

Well Tag ID (if known): _____

*[What is a well tag? A well tag is a small (~1⅞" x 3¼"), stainless steel plate stamped with a unique six character alphanumeric ID (e.g. AAB123). Well tags are typically permanently attached to the outer casing of a well]*

Active (circle one): Yes / No

Location of Well (circle one): Outdoors / Well House / Outbuilding / Indoors

Primary Use (circle one): Drinking Water / Household Use Not for Drinking Water / Pets / Gardens / Livestock / Irrigation / Commercial / Unused / Other: _____

Additional Uses: Drinking Water / Household Use Not for Drinking Water / Pets / Gardens / Livestock / Irrigation / Commercial / Unused / Other: _____

Source(s) of Drinking Water Available on Your Property: Private Well / Public Water Supply / Other: _____

Source(s) of Drinking Water Your Home Typically Uses: Private Well / Public Water Supply / Purchased Bottled Water / Other: _____

Number of Homes Your Well Serves: 1-2 / 3-4 / 5-6 / more than 6

Total Number of People Your Well Serves: _____

Approximate Well Usage Rate (gallons per year, if known): _____

Well Has Previously Gone Dry: Yes / No

If yes, occurs after prolonged use: Yes / No

If yes, frequently occurs: Yes / No

If yes, time of year this normally occurs: Winter / Spring / Summer / Fall

Recent Well Maintenance or Repairs (circle one): Yes / No

If yes, repairs or maintenance performed: _____

**Current Well Water Treatment**

Water Storage or Pressure Tank Present (circle one): Yes – Storage Tank / Yes – Pressure Tank / No

If yes, location(s) of tank(s): At Well / Garage / Basement / Under Kitchen Sink / Other: _____

If yes, frost free hose bib to collect a water sample before the tank(s): Yes / No

If yes, time of last cleaning: 0 – 6 months ago / 6 -12 months ago / 1-2 years ago / more than 2 years ago / Unknown

Water Treatment Present (circle one): Yes / No

If yes, type(s) present: Carbon Filtration / Water Softener / UV Disinfection / Chlorination / Reverse Osmosis / Iron & Manganese Filtration / Particulate Filter / Other: _____

If yes, location(s) of treatment system(s): At Well / Garage / Basement / Under Kitchen Sink / Other: _

If yes, tap to collect a water sample before the treatment system(s): Yes / No

If yes, does water go through treatment system(s) before or after the water tank(s) (if present): Before Tank / After Tank / NA – No Tank Present

Well Recently Shocked or Chlorinated (circle one): Yes / No

If yes, date of last chlorination: _____

Recent Well Inspection/Assessment Performed: Yes / No

If yes, date of last well inspection/assessment: _____

If yes, would you be willing to share a copy of your report with our team: Yes / No

Well Water Previously Sampled: Yes / No

If yes, would you be willing to share a copy of your data with our team: Yes / No

In Your Opinion, what is the aesthetic quality (taste) of the water:

Excellent / Good / Fair / Poor / Other: _____

Recent aesthetic quality (taste) change: Yes / No

If yes, type of change: Odor / Taste / Color or Cloudiness / Sediment / Other: __

If yes, time when change occurred (Date or Months/Years ago): _____

**Well Construction Information (if known. fields may be left blank if information is unavailable):**

Source of Well Construction Information: Self (Owner) / Neighbor / Log / Report / Other: _____

If log or report, would you be willing to share a copy with our team: Yes / No

Well Completion Date/Year: _____

Drilling Contractor: _____

Drilling Method (circle one): Air Rotary / Auger / Cable Tool / Dug / Mud Rotary / Sonic / Other: _____

Casing Material: Steel / Stainless Steel / PVC / Concrete / Other: _____

Sanitary Well Cap Installed (circle one): Yes / No

Well Casing Outer Diameter (in inches): _____

Wellhead Height (in feet above ground surface): _____

Total Well Depth (in feet): _____

Well Casing Depth (in feet): _____

Screen Type(s): Perforated or Slotted / Louvered / V-Shaped Continuous / Open Borehole / Other: _____

Screened or Open Depth(s) (in feet below ground surface): _____

Type of Pump (circle one): Submersible / Jet / Hand Pump / Other: _____

If submersible, Pump Depth (in feet below ground surface): _____

Geologic/Boring Log Prepared: Yes / No

If yes, would you be willing to share a copy with our team: Yes / No

If you require additional assistance, please email: XXXXX@XXXX or leave a message at: XXX-XXX-XXXX

## Sample Right-of-Entry (ROE) Form

### Right-of-Entry (ROE) and Permission to Collect Drinking Water Sample Request

Dear [Name of Private Well Owner]:

**REQUEST**
GSI Environmental, Inc. (GSI) requests permission from Property Owner [INSERT FULL NAME] for GSI—its consultants and subcontractors—to enter Property [INSERT STREET ADDRESS] to collect a water sample at the primary drinking water tap (i.e., kitchen faucet) that is supplied by the private well on [INSERT SAMPLE DATE].

**GSI COMMITMENTS**
In return for the Property Owner granting GSI (or its subcontractors) access to the Property to perform drinking water sampling, GSI agrees to the following:

a) The Property Owner has the right to be present during all field activities performed by GSI on the Property.

b) GSI will, to the extent practicable, return the Property to the general condition it was in before any field activities.

c) The Property Owner will not be charged for the collection or laboratory analysis of any sample collected by GSI.

d) GSI will provide the validated samples results to the Property Owner.

e) The following language is required to be contained on this form by the Department of Ecology: “By consenting to this sampling, your results will be shared with the Washington Department of Ecology. Data provided to Ecology becomes public record and may be subject to public records requests and disclosure. The Washington Public Records Act, Chapter 42.56 RCW, requires Ecology to promptly make identifiable public records available for inspection and provide records upon request.”

**INDEMNIFICATION & INSURANCE**
GSI will cover (indemnify) the Property Owner for any damages or claims caused by GSI’s negligent activities on the property. However, GSI is not responsible for:

1. Any claims for which they have no legal liability under Washington State or Federal law.

2. Any issues or damages related to conditions that already existed on the property before this agreement, or that were caused by the Property Owner.

**GENERAL CONDITIONS**
This ROE is the complete agreement between the Property Owner and GSI for site access and replaces any previous written or verbal agreements.

The Property Owner may terminate this ROE at any time with advance written notice. Any changes to this agreement must be in writing, unless GSI determines otherwise. If any change is made verbally, GSI will document the modification in writing as soon as possible.

This ROE applies to and is binding on both the Property Owner and GSI—including GSI’s consultants and subcontractors.

If you consent or decline this ROE and sampling permission request, please sign below.

**CONSENT TERM**
If you consent to this ROE and sampling permission request, it shall take effect as of the date both parties have signed and dated this Consent Term. Unless terminated sooner by mutual written agreement of the Property Owner and GSI, this request shall expire upon GSI and the Property Owner agreeing that drinking water sampling for this program is completed.

| **Property Owner** | **GSI Environmental Inc** |
|---|---|
| | (prefilled by PM/PD) |
| Signature | Signature |
| | (prefilled by PM/PD) |
| Name (Print) | Name (Print) |
| | (prefilled by PM/PD) |
| Property Address | Title |
| | (prefilled) |
| Date | Date |

**DECLINE TERM**
If you decline this ROE and sampling permission request, GSI shall stop further requests for this program following retrieval of this signed and dated Decline Term. If you decide to change your position on this request at a later time, you may provide your consent through the online portal.

**Property Owner**

| | |
|---|---|
| Signature | Date |
| Name (Print) | Property Address |

# Sample Attempt to Visit Form

## Attempted Visit or Oral Decline to Right-of-Entry and Collection of Private Well Sample

**Attempted Visit for Right-of-Entry and Request to Collect a Private Well Sample**
GSI Environmental Inc. (GSI), its consultants or subcontractors, attempted to request access to the following property and/or to collect a water sample from the associated private well as part of the Short-term Interim Action Work detailed in Task 2 (Implementation of the work identified in the STIAWP) of the Emergency Interim Action issued by the Washington Department of Ecology on February 10, 2026 for the Spokane International Airport PFAS site, but did **not** obtain a response from the Property Owner:

Property Owner Name

Property Address

**Attempt 1:**

Date of Attempted Visit at Property Address

Field Staff Name and Company

Field Staff Signature Date

**Attempt 2:**

Date of Attempted Visit at Property Address

Field Staff Name and Company

Field Staff Signature Date

**Oral Decline to Right-of-Entry and Request to Collect a Private Well Sample**
GSI Environmental Inc. (GSI), its consultants or subcontractors, obtained oral **denial** from the Property Owner to access their property and/or to collect a water sample from the associated private well as part of the Short-term Interim Action Work detailed in Task 2 (Implementation of the work identified in the STIAWP) of the Emergency Interim Action issued by the Washington Department of Ecology on February 10, 2026 for the Spokane International Airport PFAS site:

Property Owner Name

Property Address

Contact Name (if different from Property Owner)

Relationship to Property Owner

Property Owner Contact Information
(Mailing Address)

Property Owner Contact Information
(Phone, E-mail)

Date of Oral Communication

Field Staff Name and Company

Field Staff Signature Date

With either of the above sections completed, GSI and it's consultants or subcontractors shall stop any further requests to the above listed Property Owner for the Short-term Interim Action private well sampling program. GSI cannot and will not collect a sample from the above listed Property unless the Property Owner provides consent at a later date through the project webpage by [INSERT END DATE TO OPT-IN].

GSI Job No.: 6892
Issued: 03 April 2026

GSI ENVIRONMENTAL

**SAMPLE RESULTS LETTER**

XX Month 20XX

[Name of Private Well Owner]
[Address of Private Well Owner]
[Address of Private Well Owner]

**RE: Drinking Water Sample Results at [PRIVATE OWNER ADDRESS]**

Dear [Name of Private Well Owner]:

GSI Environmental Inc (GSI) has been retained by Spokane International Airport (SIA) to perform activities on behalf of SIA, City of Spokane and Spokane that are required by the Emergency Interim Action (EIA) issued by the Washington Department of Ecology (Ecology) on February 10, 2026, for the Spokane International Airport PFAS site. This work is subject and pursuant to the requirements of Enforcement Order No. DE 22584 (EO) issued on March 29, 2024, to SIA (amended on August 21, 2025) and an Agreed Order No. DE 24355 (AO) issued on January 20, 2026, by Ecology to the City of Spokane and Spokane County.

Please find enclosed the results from the water sample collected from your private well by GSI's sampling team on [SAMPLE DATE]. This information can help you understand the concentrations and potential risks of per- and polyfluoroalkyl substances (PFAS) in the water from your well, and support informed decisions about your eligibility for a short-term treatment program as we work to deliver a long-term option.

The sample collected from your private well was analyzed for PFAS substances using Environmental Protection Agency (EPA) Method 1633 by Eurofins Environmental Testing laboratory. The sample results were reviewed and compared to EPA Maximum Contamination Levels (MCL) for safe long-term consumption of drinking water.

If you previously declined the offer for a point of use filter system for your home and would now like to receive one, please visit the following website to sign up:
[INSERT URL]

We greatly appreciate your cooperation and proactive participation in this private well sampling effort! If you have any questions about your results, please send an email to [INSERT EMAIL] stating your name, address, and question and respond within [INSERT TIME PERIOD].

Sincerely,

Name, Credentials
Title

## RESULTS FOR [INSERT ADDRESS]

**Sample Date:** [SAMPLE DATE]

**Sample Location:** [Sampling Point]

**Result Summary:** [INSERT SUMMARY STATEMENT — e.g., "PFAS were not detected." OR "PFOA was detected at 6.2 ppt, which is above the federal MCL of 4 ppt."] [Include data quality statement – data was reviewed and found to be valid. If an issue was found with the analysis this letter will be revised to indicate that there was an issue with the sample/analysis and request to collect another private well sample.]

The table below provides the results with additional information explaining these results.

**SAMPLE RESULTS AND COMPARISON TO FEDERAL DRINKING WATER STANDARDS**

| Group | PFAS | EPA MCL (ng/L or ppt) | Result (ng/L or ppt) | Comparison to the MCL |
|---|---|---|---|---|
| Perfluoroalkyl carboxylic acids | PFOA | 4 | | |
| | PFNA | 10 | | |
| | HFPO-DA | 10 | | |
| Perfluoroalkyl sulfonic acids | PFHxS | 10 | | |
| | PFOS | 4 | | |

ND indicates that there the PFAS compound was not detected above the laboratory detection limit.
CAS number is the unique, numerical identifier for chemical substances.
The concentrations are shown in nanograms per liter (ng/L) which is equivalent to parts per trillion (ppt).

## HOW TO READ YOUR RESULTS

Your private well water was sampled as part of the ongoing PFAS groundwater investigation being conducted in coordination with the Washington State Department of Ecology. The purpose of this sampling is to:

- Determine whether PFAS are present in drinking water wells in your area
- Compare results to federal drinking water standards (MCLs)
- Provide you with clear information about what your results mean

**What Standards Are Used to Evaluate My Results?**

In 2024, the U.S. Environmental Protection Agency finalized federal drinking water standards, called Maximum Contaminant Levels (MCLs), for several PFAS compounds.

These standards are set to protect people who drink the water every day over a lifetime.

Your laboratory report lists PFAS with federal standards and the measured concentration in parts per trillion (ppt). There are three possible situations:

**1. PFAS Were Not Detected**

If your results show "ND" (non-detect), PFAS were not found above the laboratory detection limits. This means:

- PFAS were not detected at measurable levels in your drinking water at the time of sampling.
- No action is needed at this time.
- You may still choose to participate in future monitoring events.

**2. PFAS Were Detected, But Below the MCL**

If PFAS were detected but are below federal MCLs this means:

- PFAS are present at low levels.
- The concentrations are below EPA's health-based drinking water standards.
- No immediate action is required.

You may still choose to use a filter system if you prefer to further reduce PFAS levels.

**3. PFAS Were Detected Above the MCL**

If one or more PFAS exceed the federal MCL this means:

- The concentration is above the long-term drinking water standard.
- This does not represent an immediate health emergency.
- The standard is based on lifetime exposure (70 years).

## UNDERSTANDING YOUR WATER SAMPLE RESULTS

### Should I Stop Drinking My Water?

For most households:

- PFAS above the MCL do not require immediate cessation of water use.
- The standards are designed to reduce potential health risk over decades of daily consumption.
- If you are pregnant, nursing, or have specific health concerns, you may wish to consult your healthcare provider.

If you prefer, you may use bottled water or filtered water for drinking and cooking until treatment is installed.

### How Can PFAS Be Reduced in Drinking Water?

Two types of treatment are offered:

- Point-of-use treatment (POUT):
  - POUT devices that are certified to reduce PFOA, PFOS, and other regulated PFAS to levels below MCLs are available at no cost to you. If you have not yet received a filtration unit, please visit the following website to sign up: [INSERT URL AND QR CODE]
- Bulk water from the drinking water fill station located at 4821 W. Garden Springs Road.
  - You only will need to set up an account with the City of Spokane which can be done online at [webpage] or at the fill station and two containers are available at no cost to you.

## ADDITIONAL INFORMATION

### What Are PFAS?

PFAS (per- and polyfluoroalkyl substances) are a group of man-made chemicals used since the 1940s in products that resist heat, water, and oil. Their use was historically required in firefighting foam at airports and military facilities.

Some PFAS can persist in groundwater for many years. Long-term exposure to certain PFAS at elevated levels may increase the risk of certain health effects.

For more information about health effects, you may visit:

U.S. Environmental Protection Agency (EPA): https://www.epa.gov/pfas

Agency for Toxic Substances and Disease Registry (ATSDR): https://www.atsdr.cdc.gov/pfas

Spokane Regional Health District (SRHD):
https://srhd.org/health-topics/environmental-health/pfas-per-and-polyfluoroalkyl-substances

# SITE INVESTIGATION REPORT

**Site or Project Name**
City, State

## APPENDIX B

Sampling Analysis Plan/Quality Assurance Project Plan

SPOKANE INTERNATIONAL AIRPORT
Spokane, Washington
Facility Site ID: 6332493; Cleanup Site ID: 16774

# SHORT-TERM INTERIM ACTION WORK PLAN - APPENDIX B SAMPLING ANALYSIS PLAN / QUALITY ASSURANCE PROJECT PLAN

*Prepared for:*

**CITY OF SPOKANE**
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*Prepared by:*

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Job No.: 6892
Issued: 03 April 2026

# SAMPLING ANALYSIS PLAN / QUALITY ASSURANCE PROJECT PLAN

## SPOKANE INTERNATIONAL AIRPORT
## Spokane, WA
## Facility Site ID: 6332493; Cleanup Site ID: 16774
## GSI Job No. 6892

This Short-term Interim Action - Sampling and Analysis Plan/Quality Assurance Project Plan was prepared by the staff of GSI Environmental Inc. under the supervision of the Engineer(s), Geologist(s), and Licensed Hydrogeologist(s) whose signatures appear hereon.

Data for this program will be available on the Washington State Department of Ecology's Environmental Information Management (EIM) website at www.ecy.wa.gov/eim/index.htm. Search for Cleanup Site ID: 16774.

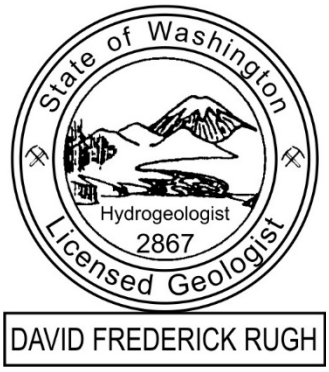
This Sampling and Analysis Plan/Quality Assurance Project Plan is valid through 13 April 2031, five years from the date of approval.

**Approved:** 13 April 2026
**Issued:** 03 April 2026

**Approved by:**

David Rugh, LG, LHG, PG
Principal Hydrogeologist, GSI Environmental

04/13/2026
Date




Amelia Tallman, RG
Principal Scientist, GSI Environmental

04/13/2026
Date

Kenia Whitehead, PhD
Principal Scientist, GSI Environmental

04/13/2026
Date

# SHORT-TERM INTERIM ACTION WORK PLAN
## Spokane International Airport
Spokane, WA

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# SHORT-TERM INTERIM ACTION WORK PLAN
## Spokane International Airport
Spokane, WA

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Attachment B Field Forms
Attachment C Site-Specific Health and Safety Plan

# SHORT-TERM INTERIM ACTION WORK PLAN
## Spokane International Airport
Spokane, WA

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| CASRN | Chemical Abstract Service |
| City | City of Spokane |
| COC | Chain of Custody |
| County | Spokane County |
| °C | Degrees Celsius |
| DQO | Data Quality Objectives |
| DO | Dissolved Oxygen |
| DOD | United States Department of Defense |
| Ecology | Washington Department of Ecology |
| EDD | Electronic Data Deliverable |
| EIA | Emergency Interim Action |
| EIM | Electronic Information Management |
| EIS | Extracted Internal Standard |
| EPA | United States Environmental Protection Agency |
| GSI | GSI Environmental Inc. |
| HDPE | High-Density Polyethylene |
| HFPO-DA | hexafluoropropylene oxide-dimer acid |
| LCS | Laboratory Control Sample |
| MDL | Method Detection Limit |
| MQO | Measurement Quality Objective |
| ND | Non-detect |
| ng/L | nanograms per liter |
| NIS | Non-extractable Internal Standard |
| NTU | Nephelometric Turbidity Units |
| ORP | Oxidation Reduction Potential |
| PFAS | per- and polyfluorinated alkyl substances |
| PFHxS | perfluorohexanesulfonic acid |
| PFNA | perfluorononanoic acid |
| PFOA | perfluorooctanoic acid |
| PFOS | perfluorooctanesulfonic acid |
| POUT | Point-of-Use Treatment |
| PPE | Personal Protective Equipment |
| QA | Quality Assurance |
| QAPP | Quality Assurance Project Plan |
| QA/QC | Quality Assurance / Quality Control |
| QC | Quality Control |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |

# SHORT-TERM INTERIM ACTION WORK PLAN
## Spokane International Airport
Spokane, WA

| | |
|---|---|
| SAP | Sampling and Analysis Plan |
| SIA | Spokane International Airport |
| SM | Standard Method |
| SOP | Standard Operating Procedure |
| STIAWP | Short-Term Interim Action Work Plan |

# SHORT-TERM INTERIM ACTION WORK PLAN
**Spokane International Airport**
Spokane, WA

## Appendix B: Quality Assurance Project Plan/ Sampling Analysis Plan

## 1.0 ABSTRACT

GSI Environmental Inc. (GSI) prepared this Sampling and Analysis Plan and Quality Assurance Project Plan (SAP/QAPP) on behalf of Spokane International Airport (SIA), the City of Spokane (the City), and Spokane County (the County) (collectively, the potentially liable persons [PLPs]) to support the requirements of Task 1, Short-Term Emergency Interim Action Work Plan, under the Emergency Interim Action Scope of Work and Schedule issued by the Washington State Department of Ecology (Ecology) on 10 February 2026, for the Spokane International Airport PFAS site (the Site). This SAP/QAPP focuses on the sampling of private and commercial wells and establishes and documents the sampling methods, analytical procedures, and quality assurance and quality control (QA/QC) criteria that will be followed during implementation of the Short-Term Interim Action Work Plan (STIAWP).

## 2.0 BACKGROUND

This section provides an overview of background information regarding sampling for per- and polyfluorinated alkyl substances (PFAS) in residential and commercial wells within the aerial boundary defined by the Emergency Interim Action (EIA) notification. Information regarding overall project tasks related to the Short-term Interim Action provision of drinking water and site background is presented in the STIAWP.

### 2.1 Introduction

GSI prepared this SAP/QAPP on behalf of the PLPs in association with the Site. The SAP/QAPP provides the procedural and QA/QC framework for STIAWP sampling and analysis activities.

PFAS analysis will be performed in accordance with U.S. Environmental Protection Agency (EPA) Method 1633 (USEPA, 2024) by a laboratory accredited by Ecology for PFAS analysis including EPA Method 1633.

### 2.2 Program Description

This STIAWP outlines the following activities:

1. **Public outreach** to provide landowners with information about PFAS in groundwater in the area. This outreach will include an information-gathering step to determine whether landowners (a) have a private well used for drinking water, (b) elect to receive a point-of-use filtration device to reduce per- and polyfluoroalkyl substances (PFAS) concentrations in their drinking water, and (c) consent to allow sampling of water from their private well.

2. **The provision of point-of-use treatment (POUT) devices** at residences or businesses that use private water supply wells for drinking water, without the need for prior PFAS sampling results.

3. **Provide access to drinking water** through access to the City's bulk fill station at 4821 W. Garden Springs Road where residents can fill bottles or containers for in-home water consumption.

4. **Sampling and testing of well water** for PFAS at residences and businesses within the EIA area that have private water supply wells used for drinking water and provide consent for sampling; with results provided to the home, landowner, and/or lessee.

**This SAP/QAPP addresses Activity 4:** sampling residential and commercial wells for PFAS within the EIA area for those who opt into the program.

## 2.3 Interim Action Area

The areal extent of the EIA for this program was defined by Ecology is shown in Exhibit 2.2 and described as follows:

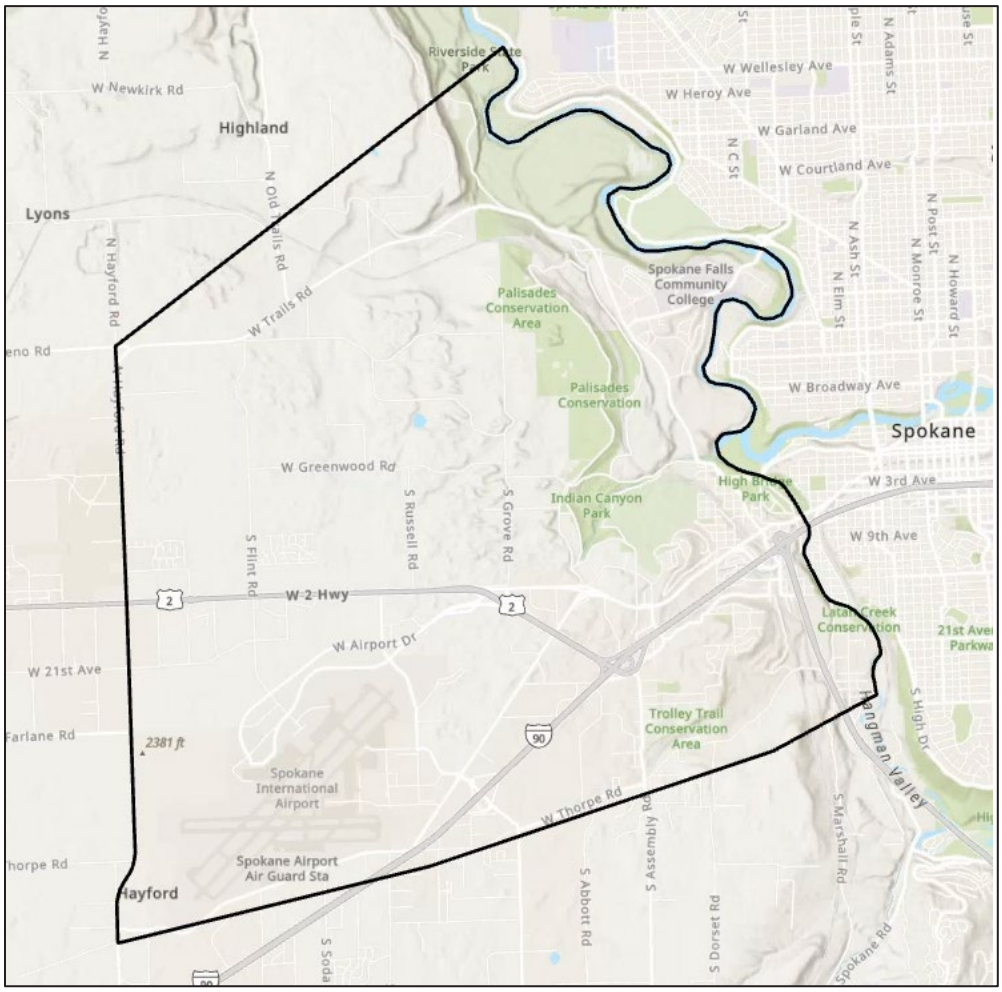
- **Northern boundary:** Follows the Spokane River corridor, beginning near the Riverside Avenue area west of downtown Spokane and tracking the river's broad meander past Spokane Falls Community College and the Palisades area.

- **Eastern boundary:** Runs along the western edge of central Spokane's developed area, roughly paralleling north–south city streets near the High Bridge and the Latah Creek corridor, forming a clear divide between the urban core and the canyon and upland areas to the west.

- **Southern boundary:** Extends westward from the Latah Creek area, crosses south of Interstate 90, and then follows the southern edge of the Spokane International Airport and the Air National Guard facilities.

- **Western boundary:** Trends northward along rural and semi-rural terrain west of the airport, aligning with the eastern extent of the Remedial Investigation area for the Fairchild Air Force Base, which follows section-line style boundaries near agricultural and open land before reconnecting with the Spokane River corridor north of the Palisades.

**Exhibit 2.2. Areal Extent of the Emergency Interim Action**




Notes: Areal extent defined by Ecology (Ecology, 2026).

## 3.0 SAMPLING DESCRIPTION

Because there are many hundreds of private water supply wells in the EIA area, sampling will proceed in the area closest to the Site with the activities outlined in Section 2.2 to be implemented in a zonal step-out manner (Figure 3-1). This approach supports the efficient execution of the STIAWP and the effective use of resources by focusing on sampling within specific areas. Per requirements from Ecology, data gathered during this sampling program must be shared with Ecology and becomes incorporated in the public record and may be subject to public record requests.

### 3.1 Sampling Goals and Objectives

This SAP/QAPP presents the methodology for sampling residential and commercial wells as outlined in the STIAWP. The objective of sampling in the EIA area is to obtain representative samples of groundwater-supplied water, collected upstream of any treatment units (e.g., water softeners) and reservoirs (e.g., pressure tanks) whenever possible, for analysis of PFAS concentrations in residential and commercial wells within the EIA area.

## 3.2 Sampling Tasks

The following tasks are required for the private well sampling outlined in the STIAWP:

- Notify Ecology 7 days prior to commencing the private well sampling program.
- Obtain written access and sampling consent from landowners within the EIA area.
- Schedule sampling appointments with landowners within the EIA area.
- Obtain written Right of Entry (ROE) and permission to collect well water samples.
- Collect well water samples supplied from private wells within the EIA area.
    - › Submit the collected water samples to an accredited laboratory for analysis of PFAS compounds via EPA Method 1633.
- Review electronic data deliverables (EDDs) from laboratories for completeness.
- Conduct a Level 2 validation on the PFAS data.
- Provide raw laboratory data in monthly progress reports to Ecology as available.
- Submit validated laboratory data to Ecology in annual progress report(s).

## 3.3 Practical Constraints

Implementation of this SAP/QAPP is subject to practical constraints that may affect scheduling, sequencing, and execution. Public coordination activities, including distribution of educational materials, obtaining written access consent, and scheduling sampling appointments, may introduce delays. Contractor and subcontractor availability may further limit the pace of field activities, particularly during periods of high seasonal demand. Analytical laboratory capacity may also affect the timing of sample collection and processing.

Field activities may be delayed by weather-related conditions such as snow, significant snowmelt or rainfall, severe storms, or fires in the vicinity. Additional constraints arise from site-specific plumbing configurations, access limitations, and existing water treatment systems at individual residences or businesses. In some cases, a suitable pre-treatment sampling location may not be available, requiring sample collection from an interior tap. Depending on the presence, configuration, or operational status of point-of-entry or point-of-use treatment systems (e.g., chlorination systems), field staff may need to make adjustments, such as adding a reducing agent at the time of sample collection.

Sample collection timing may be influenced by scheduling considerations related to property access within defined time frames. These constraints will be managed through advanced coordination with Ecology, landowners, field documentation, and adherence to consistent sampling and data validation procedures.

# 4.0 SAMPLING ORGANIZATION

This section provides an overview of the specific training required for personnel to conduct private well sampling. Program subcontractors and laboratories will be selected based on adherence to the qualifications outlined in this SAP/QAPP and program availability.

## 4.1 Specialized Training and Certificaftions

To conduct sampling, program personnel must have up-to-date 40-hour Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Response (OSHA 40-Hour HAZWOPER) certifications. All project personnel will follow the Site-Specific Health and Safety Plan (Attachment C). Prior to sample collection, program personnel will be trained in sampling procedures (Section 6) and PFAS-specific field procedures (SOP SEMPFAS; USEPA, 2016; Attachment A).

## 4.2 Proposed Sampling Phasing and Schedule

The work outlined in this SAP/QAPP will follow the program schedule proposed in the STIAWP (GSI Environmental Inc., 2026).

In the proposed program schedule, the required EIA activities are completed in phases. After Ecology approves the STIAWP, the first phase of work will involve offering access to the City of Spokane's Garden Springs Fill Station, portable filtration devices (e.g., countertop dispensers or filter pitchers), and well water sampling to private property owners following approval of the STIAWP by Ecology in the first area. Sampling of private wells will commence within 90 days of the STIAWP approval (assuming affirmative response letters have been received) and all sampling will be scheduled within 210 days after the survey letters were issued.

# 5.0 QUALITY OBJECTIVES

This section details the data quality objectives (DQOs) and measurement quality objectives (MQOs) for analytical data.

## 5.1 Data Quality Objectives

The DQOs are to (a) collect one sample from each private water well as part of the STIA, and (b) have the samples analyzed for PFAS by a certified laboratory. Laboratory analyses and field procedures will employ standard methods (SMs) that meet the MQOs described in Section 5.2.

## 5.2 Measurement Quality Objectives

MQOs are performance or acceptability criteria established for key quality assurance indicators: precision, bias, sensitivity, comparability, representativeness, and completeness. These MQOs are described in separate subsections as each data type has inherent variability. MQOs provide the basis for evaluating data quality and usability, ensuring the quality and consistency of all measurement methods and datasets. For data collected in this program, MQOs are based on standard analytical method requirements, laboratory standard operating procedures (e.g., SOP from Eurofins Testing; Attachment A), and the Ecology PFAS Guidance (WA ECY, 2023).

### 5.2.1 Targets for Precision, Bias, and Sensitivity

The MQOs for program results, expressed in terms of acceptable precision, bias, and sensitivity, are described in this section and Exhibit 5.2.1. Table 1 includes the full list of field parameters and laboratory analytes to be measured. Method detection limits (MDLs) and reporting limits (RLs) for each analyte are detailed in Table 2. Laboratory Control Standards for individual PFAS are listed in Table 3.

**Exhibit 5.2.1. Measurement Quality Objectives for Laboratory Analysis of Private Well Samples**

| Parameter | Duplicate (RPD[1]) | Lab Control Standard (% Recovery) | Method Blanks | Field Blanks and Equipment Blanks | Applicable Area |
|---|---|---|---|---|---|
| PFAS | ≤ 30% (field) | Varies by analyte; see Table 3 | No target analytes > RL or 1/10 the amount measured in any sample (whichever is greater) | No target analytes > RL or 1/10 the amount measured in any sample (whichever is greater) | EIA |

Notes:
1. RPD = Relative Percent Difference

#### 5.2.1.1 Precision

Precision is a measure of variability among replicate measurements due to random error. It is usually assessed using duplicate field measurements or laboratory analysis of duplicate samples. For this program, precision will be estimated by collecting and analyzing field duplicates at a rate of one per 20 field samples. The MQO for PFAS analytical precision is defined for this program as a maximum of 30% relative percent difference (RPD). Precision will be evaluated by calculating the RPD between the primary result and its associated field duplicate results using the following equation:

$$RPD = \frac{2|D_1 - D_2|}{D_1 + D_2} x\ 100\%$$

Where: $D_1$ = original sample concentration
$D_2$ = replicate sample concentration
RPD = relative percent difference

#### 5.2.1.2 Bias

Bias is the difference between the sample mean and the true value. Bias is usually addressed by (a) calibrating field and laboratory instruments, and (b) analyzing laboratory control samples (LCSs, referred to as Ongoing Precision and Recovery samples in EPA Method 1633), matrix spikes, and/or standard reference materials (i.e., extracted and non-extracted internal standards). Acceptable limits for extracted internal standards (EIS) and non-extracted internal standards (NIS) are listed in Table 4. For this program, PFAS bias will be measured through proper calibration of laboratory instruments and analysis of LCSs. LCS recovery acceptance criteria are indicated in Table 3. Per EPA Method 1633, matrix spike and matrix spike duplicate sample analysis is not required for methods that employ isotope dilution quantification because any deleterious effects

of the matrix should be evident in the recoveries of the EIS compounds spiked into every sample (USEPA, 2024). Bias will be expressed mathematically as accuracy, calculated as percent recovery using the following equation:

$$\%\mathrm{R} = \frac{C_m}{C_s} x\ 100\%$$

Where: $C_m$ = Measured concentration
$C_{ms}$ = Actual Concentration
%R = Percent Recovery

#### 5.2.1.3 Sensitivity

Sensitivity is a measure of the capability of a field instrument or laboratory method to detect a substance or change in parameter. Laboratory-provided MDLs and RLs for water samples are presented in Table 2. MDLs and RLs may vary based on matrix interference, high concentrations of target or non-target analytes, dilutions, or other factors.

### 5.2.2 Targets for Completeness, Representativeness, and Comparability

#### 5.2.2.1 Completeness

Completeness is the amount of data obtained from the measurement system. The objective in addressing completeness is to assess whether enough data have been collected and enough data are valid to meet DQOs. Valid data include qualified/estimated data and unqualified data but not rejected data. Completeness is evaluated by comparing the number of valid sample results to the number of samples collected, including required QA/QC samples. This program's completeness goal is for 90% of samples to meet acceptability criteria.

#### 5.2.2.2 Representativeness

Representativeness is the degree to which the data accurately describe the conditions being evaluated based on the selected sampling locations, frequency and duration, and methods. Representativeness is determined by appropriate program design, with consideration of elements such as proper well locations, drilling and installation procedures, operations process locations, and sampling locations. Assessment of representativeness shall be achieved through use of the standard field, sampling, and analytical procedures.

To prevent cross-contamination of samples by field materials or procedures, program personnel will implement stringent QA/QC procedures according to SOP SEMPFAS: Sampling of Environmental Media for Per and Polyfluoroalkyl Substances (Attachment A) and relevant sampling guidelines, such as the EPA Quick Guide to Drinking Water Sample Collection (USEPA, 2016). Program personnel will collect samples from existing sampling points that are determined to be acceptable and usable.

#### 5.2.2.3 Comparability

Comparability is a qualitative indicator of the confidence with which one dataset can be compared to another dataset. Comparability is inherently linked to other MQOs, as datasets can only be confidently compared when their precision and accuracy are known. The objective is to produce

data with the greatest possible degree of comparability. Comparability is determined by considering the number of matrices sampled and the range of field conditions encountered. Comparability is achieved by using SMs for sampling and analysis, reporting data in standard units, normalizing results to standard conditions, and using standard and comprehensive reporting formats. To support the assessment of comparability, program personnel will complete field documentation using standardized data collection forms. Historical comparability shall be achieved through consistent use of methods and documentation procedures throughout the program. Assessment of comparability is primarily subjective, and results should be interpreted by experienced environmental professionals with a clear knowledge of the DQOs and program decisions.

Sampling and laboratory standard operating procedures (SOPs) are provided in Attachment A and listed in Sections 6.2 and 7.2.

## 5.3 Acceptance Criteria for Quality of Existing Data

Acceptance criteria for existing PFAS data will be based upon Ecology-certified lab accreditation. Data will only be accepted from a laboratory accredited for each PFAS analyte included in USEPA Method 1633 at the time of sample analysis. Depending on laboratory accreditation status, acceptance may be determined on an individual analyte basis rather than a method basis. When sampling methods involve an analyte group, such as USEPA Method 1633, Ecology may withhold accreditation for specific analytes if results are repeatedly unsatisfactory for those analytes (WA ECY, 2010). Each individual compound requires successful performance evaluation sample results for accreditation. A laboratory must pass the performance evaluation samples to add the analytes to its accreditation list.

# 6.0 FIELD PROCEDURES

The following subsections describe the field procedures for sample collection from residential and commercial wells.

## 6.1 Access Agreements and Permits

At the time of sampling, residents will be asked to sign a ROE form authorizing contractors to enter the home to perform the sampling while the resident is present (Appendix A of the STIAWP). No additional permits are required to conduct the required field activities.

## 6.2 Measurement and Sampling Procedures

The following GSI standard operating procedures (Attachment A) will be referenced for private well sampling:

- SOP SEMPFAS: Sampling of Environmental Media for Per and Polyfluoroalkyl Substances
- SOP 1: Field Records and Field Sampling Forms
- SOP 2: Equipment Decontamination
- SOP 3: Sample Documentation & COC Procedures
- SOP 4: Sample Packaging & Shipping

- SOP 5: Quality Control Sampling

The following EPA guides will be referenced for sampling:

- Quick Guide to Drinking Water Sample Collection (Second Edition, Update; USEPA, 2016)

### *6.2.1 PFAS Cross Contamination Considerations*

PFAS sampling requires specific procedures due to the prevalence of PFAS in consumer goods and the possibility of contamination during field activities. All field staff will complete PFAS-specific sampling training prior to performing the field work outlined in this SAP/QAPP. SOPs for sampling well water for PFAS are detailed in SOP SEMPFAS (Attachment A) and summarized in this subsection:

- General Equipment and Field Supplies:
    - Sampling equipment and supplies can potentially contain PFAS. PFAS may still be present in the materials even if not listed in the safety data sheet as PFAS might have been used during the manufacturing process. Materials that have been known to contain PFAS should be avoided in sampling. Materials that do not normally contain PFAS can be used, including high-density polyethylene (HDPE), polypropylene, silicone, and acetate. While glass containers may be PFAS-free, it is not recommended for use as PFAS can adsorb to glass, especially if the sample is stored over long period of time.
    - Decontamination should be completed with lab-certified PFAS-free water. Alconox, Citranox, and Liquinox can be used for decontamination. Any other detergent must be verified to not contain fluorosurfactants prior to use.
    - Field supplies should not be waterproof (e.g., pens, paper, folders).
    - Post-it notes or other similar sticky notes should not be brought on site during sampling.
- Personal Protective Equipment (PPE), Clothing, and Hygiene Products:
    - Water resistant, waterproof, or stain-treated clothing should be avoided as should Gore-Tex boots and rain gear. Cotton, wax-coated PPE, polyurethane, polyvinyl chloride, and rubber/neoprene materials are acceptable.
    - Latex gloves should not be used; powderless nitrile or neoprene gloves are acceptable.
    - The use of cosmetics, moisturizers, hand cream, and other hygiene products should be avoided prior to sampling events.
    - Sunblock and insect repellant may contain PFAS; only products listed as PFAS-free should be used. Any product application in the staging area should be followed by handwashing and replacement of gloves.
    - Food and drink packaging may contain PFAS. On-site consumption of food and drink should be minimized and not occur within the sampling or staging area.

Following consumption, hands should be washed thoroughly before returning to the staging area.

- Private Well Sampling Point and Equipment:
  - A sampling point will consist of a tap located upstream of any treatment system or, where such a point is not accessible, a cold-water kitchen or bathroom faucet. Reasonable efforts will be made to use a tap that is free of attachments (e.g., screens, aerators, hoses, purification devices, or single-handle mixing faucets). If the only available sampling location includes any of these features, their presence will be documented in the sampling notes.
  - Site-specific sampling checklists should be used during sampling. Avoid glass containers, Teflon materials, and unapproved PPE.

### *6.2.2 Private Well Sampling Procedures*

Samples will be collected from taps supplied by private property wells located within the areal extent of the EIA. Upon arrival at a residence or business, the sampling team will contact the resident or landowner and discuss their well system. One of two sampling procedures will be followed depending on the accessible sampling point and presence of any treatment systems at each property:

5. Primary Sampling Point: A tap located upstream of any treatment system, preferably before a pressure tank or from an exterior frost-free spigot. The cold-water line will be flushed, field parameters may be recorded, and a water sample will be collected.

6. Secondary Sampling Point: A kitchen or bathroom faucet. If a primary sampling point is not available, the cold-water line will be flushed and a water sample will be collected without measuring any field parameters.

File staff will note any existing water treatment systems, and the selected sampling point will be documented on the Sampling Form (Attachment B). The sampling procedure includes flushing the cold-water line for at least two minutes, consistent with the EPA Region 9 recommended flushing time (USEPA, 2016). At Primary Sampling Points, (upstream to any treatment system), a YSI Professional Plus Multi-Parameter Water Quality Meter (YSI Pro Plus) or similar equipment may be used to measure field parameters such as temperature, pH, Oxidation-Reduction Potential (ORP), Specific Conductance (SC), Dissolved Oxygen (DO), and turbidity.

The samples will be submitted to an analytical laboratory accredited by Ecology for PFAS analysis using EPA Method 1633, which has been promulgated by the EPA for all aqueous matrices, including groundwater and drinking water. Certain PFAS compounds in the EPA Method 1633 analyte list can degrade if drinking water or tap water has been chlorinated as part of treatment. If chlorination is identified, field staff will add a weak reducing agent (e.g., sodium sulfite or sodium thiosulfate) at the time of sample collection to prevent degradation. This step will be clearly noted on the chain-of-custody (COC) and communicated to the laboratory so that samples can be analyzed by Method 1633 without interference or the risk of reporting PFAS degradation products.

## 6.3 Sample Containers, Preservation, and Holding Times

Exhibit 6.3 presents sample containers, preservation requirements, and holding times.

**Exhibit 6.3. Sample Containers, Preservation, and Holding Times**

| Analyte | Sample Container | Sample Container Volume | Preservation | Holding Time[1] |
|---|---|---|---|---|
| PFAS via EPA 1633 | Laboratory-provided HDPE with linerless HDPE caps | 3x125 mL | 6 °C during transportation, 0–6 °C or < -20 °C until sample preparation | 0–6 °C up to 28 days from collection, ≤ -20 °C up to 90 days |

Note:
1. Extraction holding time is calculated from date of collection. Analytical holding time is determined from date of extraction.

## 6.4 Equipment Decontamination

It is essential that field staff implement adequate decontamination procedures to prevent cross-contamination. Dedicated and disposable equipment will be used for sample collection where possible. When collecting a water sample, all non-disposable sampling equipment should be cleaned and decontaminated prior to mobilization and between uses. Laboratory-supplied, certified PFAS-free water should be used for the final rinse of sampling equipment. Commercially available deionized water may be used for decontamination if verified to be PFAS-free. Triple rinsing with PFAS-free water is recommended. Decontamination procedures will adhere to the protocols in SOP SEMPFAS and SOP 2 (Attachment A).

## 6.5 Flush Water

Flush water will be discharged to the ground surface when the Primary Sampling Point is located outdoors. When samples are collected indoors, the flush water will be directed to the kitchen or bathroom sink drain.

## 6.6 Sample ID

Sample labels should enable a person unfamiliar with the Site to identify the sample but not provide personal information for the resident/owner of the well. The sample ID for natural samples will consist of the designated zonal identification, domestic well identification, and date in MMDDYYYY format. An example of the labeling system for a drinking water sample is as follows:

- The third natural drinking water sample collected from the first sampling area on 6 April 2026 would be labeled A1-DW-03-04062026.

For quality control samples, a field duplicate sample ID will include the designated area identification, domestic well identification, first letter of the last name, and date in MMDDYYYY format. Field duplicate sample IDs and their locations will be recorded to identify duplicates during data validation. Other quality control samples will be labeled using acronyms for the quality control sample type (i.e., ‘FB’ for field blank and ‘TB’ for trip blank), followed by the date in MMDDYYYY format (SOP 3 in Attachment A). Examples of the labeling system for quality control samples is as follows:

- A field duplicate sample collected from the third area on 25 December 2026 would be labeled A3-DW-12252026.
- A field blank sample collected on 12 June 2026 would be labeled FB-06122026.

- A trip blank sample initially stored on 10 May 2027 would be labeled TB-05102027.

## 6.7 Chain of Custody

Field staff will generate COC forms for all samples collected in the field for laboratory analysis as detailed in SOP 3 (Attachment A). Sample custody records must be maintained from the time of sample collection until the time of sample delivery to the analytical laboratory. These records should accompany the sample through analysis and final disposition. The information on the COC forms, including the sample ID, must correspond to the information recorded by the sampler on the field forms, logbook, and sample container label.

When relinquishing custody of a sample, the sampler will sign and date the COC forms and note the time that custody was relinquished. The person receiving custody of the sample will sign and date the form and note the time that the sample was accepted into custody.

## 6.8 Field Log Requirements

To provide a continual record of daily field activities, field staff will document field records and sampling information on paper or digital sampling forms, with supplemental notes recorded in a field logbook as needed (SOP 1 in Attachment A). At minimum, field records and sampling information documentation procedures will include the following:

- Program and client name
- Purpose of the field effort
- Details of actual work effort—particularly any deviations from the field work plan or standard operating procedures
- Description of field conditions (weather), observations, and any unusual circumstances
- Names of the field crew leader, team members, and private property owners
- Addresses of the private properties visited or attempted to be visited
- Documentation of whether the private property owner signed the right-of-entry and sample permission request form (Attachment B)
- Location of sample point in relation to any present treatment systems
- Date, time, and sample ID of collected samples and any quality control samples
- Field measurements (e.g., field parameters), if applicable
- Date and time of initiation and cessation of work

Attachment B provides examples of associated field forms.

## 7.0 LABORATORY PROCEDURES

All laboratory procedures will be carried out by laboratories accredited by Ecology for analysis of PFAS samples via EPA Method 1633. The measurement procedures outlined below do not have any special applicable method requirements.

### 7.1 Laboratory Procedures Table

Exhibit 7.1 provides example RLs and MDLs for select PFAS EPA Method 1633 analytes provided by Eurofins Environmental Testing Northern California. Table 2 presents the full list of RLs and MDLs for analytes under PFAS EPA Method 1633.

**Exhibit 7.1. Laboratory Method Detection and Reporting Limits for Select PFAS Analytes Laboratory Procedures Table**

| PFAS Compound | CASRN | EPA Method 1633 | |
|---|---|---|---|
| | | Reporting Limit | Method Detection Limit |
| | | (ng/L) or ppt | |
| PFOA | 335-67-1 | 2.00 | 0.500 |
| PFNA | 375-95-1 | 2.00 | 0.500 |
| HFPO-DA | 13252-13-6 | 8.00 | 2.00 |
| PFHxS | 355-46-4 | 2.00 | 0.500 |
| PFOS | 1763-23-1 | 2.00 | 0.500 |

### 7.2 Sample Preparation Method

Samples will be prepared and analyzed for PFAS in accordance with EPA Method 1633 (USEPA, 2024) and the laboratory's associated SOP, similar to the Eurofins SOP included in Attachment A (Eurofins Sacramento, 2025).

To analyze PFAS via EPA Method 1633, water samples are extracted using a solid phase extraction cartridge. PFAS are eluted from the cartridge with an ammonium hydroxide/methanol solution.

## 8.0 QUALITY CONTROL PROCEDURES

The QC procedures for this program include collection of field quality control samples, analysis of laboratory quality control samples, use of analytical surrogate compounds, and measures to avoid cross contamination of PFAS (SOP SEMPFAS in Attachment A). Level II data validation will be conducted for all PFAS samples.

## 8.1 Field and Laboratory Quality Control

Exhibit 8.1 shows the types and frequencies of field and laboratory QC samples. The QC samples have MQOs to quantify DQOs and qualify their usability (Section 5.2). Samples consisting of laboratory-provided, certified PFAS-free deionized water will be identified as field blanks and analyzed for PFAS. Field blanks are used to assess possible cross-contamination of samples due to ambient conditions during sampling collection. If reused sampling equipment contacts well water upstream of the designated sampling point, field staff should collect equipment blanks at sampling locations by running laboratory-provided PFAS-free deionized water over the reused, decontaminated field equipment. Equipment blanks will be analyzed for PFAS to assess possible cross-contamination of samples resulting from reuse of sampling equipment. Laboratory bias will be evaluated through the analysis of laboratory method blanks and laboratory control samples.

**Exhibit 8.1. Field and Laboratory Quality Control Sample Details**

| Analyte | Field Blanks | Field Duplicates | Equipment Blank | Laboratory Method Blanks | Laboratory Control Samples |
|---|---|---|---|---|---|
| PFAS | 1 per 20 samples | 1 per 20 samples | 1 per 20 applicable samples | 1 per 20 samples | 1 per 20 samples |

## 8.2 Corrective Action Procedures

Corrective action procedures for laboratory analysis will be detailed in the laboratory's SOP (similar to Eurofins SOP in Attachment A).

# 9.0 DATA MANAGEMENT PRACTICES

Data management practices are described in the following subsections.

## 9.1 Data Recording and Reporting Requirements

Analytical data will be transmitted electronically as EDDs in the format specified by GSI, minimizing the potential for transcription errors as data is loaded into the project database. In addition to EDDs, analytical reports will be transmitted in PDF format to the Data Manager, Program Manager, and Program Lead.

## 9.2 Laboratory Data Package Requirements

The analytical laboratory will provide results in standard laboratory reports that include project narratives, detection summaries, sample results, and relevant quality control data. Any deviations from analytical SOPs will be documented in the project narrative.

## 9.3 Electronic Transfer Requirements

Along with laboratory reports, laboratories will provide data electronically as EDDs in the requested format.

## 9.4 Data Upload Procedures

Per the requirement by Ecology for reporting all data gathered as part of the EIA, the data manager will compile the private well data collected in the appropriate format to be uploaded to Ecology's Environmental Information Management (EIM) system.

# 10.0 DATA VERIFICATION

Data verification will be performed using the procedures described in the following subsections.

## 10.1 Field Data Verification, Requirements, and Responsibilities

At the end of each day, the field manager will review recorded field data to verify that data are recorded completely and legibly on daily field activity logs, field instrument calibration logs, static water level surveys, and low-flow sampling forms. If static water levels and low-flow sampling are recorded digitally, the program manager will verify with the field manager daily that data has been recorded accurately.

## 10.2 Laboratory Data Verification

On a daily basis, the QA manager or program manager will review COC forms to verify that the correct number of QC samples were collected and that the forms are complete and accurate. The QA manager will review login acknowledgements from the laboratory upon receipt to confirm sample receipts match COC forms and that samples have been correctly logged.

## 10.3 Validation Requirements

GSI will perform Level 2 data validation for PFAS analytical data. Samples will be analyzed in a laboratory that is accredited by Ecology (WA ELAP) and certified by the Department of Defense (DOD) under the Environmental Laboratory Approval Program (ELAP). The selected DoD ELAP certified laboratory will adhere to the procedures and processes required under Quality Systems Manual for Environmental Laboratories (DOD & DOE, 2023).

# 11.0 DATA QUALITY ASSESSMENT

## 11.1 Process for Determining Program Objectives

The data validation process evaluates the usability of the data collected. Data validators will evaluate the data, apply validation qualifiers to data that are estimated or rejected based on MQOs, and provide data usability summary reports to the application of any applied validation qualifiers.

## 11.2 Data Handling

For non-detects (NDs), data will be reported to the MDLs and flagged “U.” NDs will be reported in result letters to the landowner summary tables as “ND”. Detections between the MDL and RL will be flagged “J” as estimated.

For sample locations with field duplicates, GSI will perform hierarchical data averaging. In the case of NDs, data validators will use half of the MDL if at least one sample location result included in the average is detected. To preserve data validation qualifiers, the following rules for propagating data validation qualifiers will be followed:

- If both detected and undetected data are to be averaged, then undetected data lower than the highest detected value will be taken at one-half the detection limit and averaged with the detected data. The result will be identified as detected. NDs that are higher than the highest detected value will be omitted from the average.

- If all data to be averaged are undetected, the result will be an average of the detection limits and will be identified as undetected.
- If J-qualified data are averaged with non-J-qualified data, the result will be J-qualified.
- If R-qualified data are averaged with non-R-qualified data, the result will be R-qualified.

## 11.3 Documentation of Assessment

Data validators will document the data usability assessment in a data usability summary report to be issued annually. Validation qualifiers will be electronically transmitted in EDDs to the Data Manager, Program Manager, and Program Lead.

## 12.0 REFERENCES

DOD, & DOE. (2023). *Quality Systems Manual for Environmental Laboratories* (6.0). Environmental Data Quality Workgroup. https://www.denix.osd.mil/edqw/denix-files/sites/43/2024/01/QSM-Version-6.0-FINAL-Dec-13-2023.pdf

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# Short-term Interim Action Work Plan
# Sampling and Analysis / Quality Assurance Project Plan
## Spokane International Airport
Spokane, WA

## TABLES

Table 1. Private Well Sampling - Analytes and Field Parameters

Table 2. Laboratory Method Detection and Reporting Limits for PFAS

Table 3. Measurement Quality Objectives for PFAS Laboratory Control Standards

Table 4. Acceptance Limits for EIS and NIS Compounds in Primary and QC Samples

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## Table 1. Private Well Sampling - Analytes and Field Parameters

Short-term Interim Action SAP/QAPP
Spokane International Airport
Spokane, WA

| Analyte/Field Parameter | Acronym | CASRN |
|---|---|---|
| Perfluorobutanoic acid | PFBA | 375-22-4 |
| Perfluoropentanoic acid | PFPeA | 2706-90-3 |
| Perfluorohexanoic acid | PFHxA | 307-24-4 |
| Perfluoroheptanoic acid | PFHpA | 375-85-9 |
| Perfluorooctanoic acid | PFOA | 335-67-1 |
| Perfluorononanoic acid | PFNA | 375-95-1 |
| Perfluorodecanoic acid | PFDA | 335-76-2 |
| Perfluoroundecanoic acid | PFUnA | 2058-94-8 |
| Perfluorododecanoic acid | PFDoA | 307-55-1 |
| Perfluorotridecanoic acid | PFTrDA | 72629-94-8 |
| Perfluorotetradecanoic acid | PFTeA | 376-06-7 |
| Perfluorobutanesulfonic acid | PFBS | 375-73-5 |
| Perfluoropentanesulfonic acid | PFPeS | 2706-91-4 |
| Perfluorohexanesulfonic acid | PFHxS | 355-46-4 |
| Perfluoroheptanesulfonic acid | PFHpS | 375-92-8 |
| Perfluorooctanesulfonic acid | PFOS | 1763-23-1 |
| Perfluorononanesulfonic acid | PFNS | 68259-12-1 |
| Perfluorodecanesulfonic acid | PFDS | 335-77-3 |
| Perfluorododecanesulfonic acid | PFDoS | 79780-39-5 |
| 1H,1H, 2H, 2H-Perfluorohexane sulfonic acid | 4:2 FTS | 757124-72-4 |
| 1H,1H, 2H, 2H-Perfluorooctane sulfonic acid | 6:2 FTS | 27619-97-2 |
| 1H,1H, 2H, 2H-Perfluorodecane sulfonic acid | 8:2 FTS | 39108-34-4 |
| Perfluorooctanesulfonamide | FOSA | 754-91-6 |
| N-methyl perfluorooctanesulfonamide | NMeFOSA | 31506-32-8 |
| N-ethyl perfluorooctanesulfonamide | NEtFOSA | 4151-50-2 |
| N-methyl perfluorooctanesulfonamidoacetic acid | NMeFOSAA | 2355-31-9 |
| N-ethyl perfluorooctanesulfonamidoacetic acid | NEtFOSAA | 2991-50-6 |
| N-methyl perfluorooctanesulfonamidoethanol | NMeFOSE | 24448-09-7 |
| N-ethyl perfluorooctanesulfonamidoethanol | NEtFOSE | 1691-99-2 |
| Hexafluoropropylene oxide dimer acid | HFPO-DA (GenX) | 13252-13-6 |
| 4,8-Dioxa-3H-perfluorononanoic acid | ADONA | 919005-14-4 |
| Perfluoro-3-methoxypropanoic acid | PFMPA | 377-73-1 |
| Perfluoro-4-methoxybutanoic acid | PFMBA | 863090-89-5 |
| Nonafluoro-3,6-dioxaheptanoic acid | NFDHA | 151772-58-6 |
| 9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid | 9Cl-PF3ONS | 756426-58-1 |
| 11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid | 11Cl-PF3OUdS | 763051-92-9 |
| Perfluoro(2-ethoxyethane) sulfonic acid | PFEESA | 113507-82-7 |
| 3-Perfluoropropyl propanoic acid | 3:3 FTCA | 356-02-5 |
| 2H,2H,3H,3H-Perfluorooctanoic acid | 5:3 FTCA | 914637-49-3 |
| 3-Perfluoroheptyl propanoic acid | 7:3 FTCA | 812-70-4 |

## Table 1. Private Well Sampling - Analytes and Field Parameters

Short-term Interim Action SAP/QAPP
Spokane International Airport
Spokane, WA

| Analyte/Field Parameter | Acronym | CASRN |
|---|---|---|
| Temperature | None | Not applicable |
| pH | pH | Not applicable |
| Oxidation-Reduction Potential | ORP | Not applicable |
| Dissolved Oxygen | DO | Not applicable |
| Turbidity | None | Not applicable |
| Specific Conductance | SC | Not applicable |

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## Table 2. Laboratory Method Detection and Reporting Limits for PFAS

Short-term Interim Action SAP/QAPP

Spokane International Airport
Spokane, WA

| Analyte Acronym | CASRN | Reporting Limit | Method Detection Limit | Sample Prep Method | Analytical Method |
|---|---|---|---|---|---|
| PFBA | 375-22-4 | 8.00 ng/L | 2.00 ng/L | SPE | EPA 1633 |
| PFPeA | 2706-90-3 | 4.00 ng/L | 1.00 ng/L | SPE | EPA 1633 |
| PFHxA | 307-24-4 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| PFHpA | 375-85-9 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| PFOA | 335-67-1 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| PFNA | 375-95-1 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| PFDA | 335-76-2 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| PFUnA | 2058-94-8 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| PFDoA | 307-55-1 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| PFTrDA | 72629-94-8 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| PFTeA | 376-06-7 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| PFBS | 375-73-5 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| PFPeS | 2706-91-4 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| PFHxS | 355-46-4 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| PFHpS | 375-92-8 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| PFOS | 1763-23-1 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| PFNS | 68259-12-1 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| PFDS | 335-77-3 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| PFDoS | 79780-39-5 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| 4:2 FTS | 757124-72-4 | 8.00 ng/L | 2.00 ng/L | SPE | EPA 1633 |
| 6:2 FTS | 27619-97-2 | 8.00 ng/L | 2.00 ng/L | SPE | EPA 1633 |
| 8:2 FTS | 39108-34-4 | 8.00 ng/L | 2.00 ng/L | SPE | EPA 1633 |
| FOSA | 754-91-6 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| NMeFOSA | 31506-32-8 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| NEtFOSA | 4151-50-2 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| NMeFOSAA | 2355-31-9 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| NEtFOSAA | 2991-50-6 | 2.00 ng/L | 0.500 ng/L | SPE | EPA 1633 |
| NMeFOSE | 24448-09-7 | 20.0 ng/L | 5.00 ng/L | SPE | EPA 1633 |
| NEtFOSE | 1691-99-2 | 20.0 ng/L | 5.00 ng/L | SPE | EPA 1633 |
| HFPO-DA (GenX) | 13252-13-6 | 8.00 ng/L | 2.00 ng/L | SPE | EPA 1633 |
| (ADONA) | 919005-14-4 | 8.00 ng/L | 2.00 ng/L | SPE | EPA 1633 |
| PFMPA | 377-73-1 | 4.00 ng/L | 1.00 ng/L | SPE | EPA 1633 |
| PFMBA | 863090-89-5 | 4.00 ng/L | 1.00 ng/L | SPE | EPA 1633 |
| NFDHA | 151772-58-6 | 4.00 ng/L | 1.00 ng/L | SPE | EPA 1633 |
| 9Cl-PF3ONS | 756426-58-1 | 8.00 ng/L | 2.00 ng/L | SPE | EPA 1633 |
| 11Cl-PF3OUdS | 763051-92-9 | 8.00 ng/L | 2.00 ng/L | SPE | EPA 1633 |
| PFEESA | 113507-82-7 | 4.00 ng/L | 1.00 ng/L | SPE | EPA 1633 |
| 3:3 FTCA | 356-02-5 | 10.0 ng/L | 2.50 ng/L | SPE | EPA 1633 |
| 5:3 FTCA | 914637-49-3 | 50.0 ng/L | 12.5 ng/L | SPE | EPA 1633 |
| 7:3 FTCA | 812-70-4 | 50.0 ng/L | 12.5 ng/L | SPE | EPA 1633 |

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**Table 3. Measurement Quality Objectives for PFAS Laboratory Control Standards**

Short-term Interim Action SAP/QAPP
Spokane International Airport
Spokane, WA

| Acronym | CASRN | Parameter | LCS (% Recovery) | LCS (% Recovery High) |
|---|---|---|---|---|
| PFBA | 375-22-4 | Perfluorobutanoic acid | 70 | 140 |
| PFPeA | 2706-90-3 | Perfluoropentanoic acid | 65 | 135 |
| PFHxA | 307-24-4 | Perfluorohexanoic acid | 70 | 145 |
| PFHpA | 375-85-9 | Perfluoroheptanoic acid | 70 | 150 |
| PFOA | 335-67-1 | Perfluorooctanoic acid | 70 | 150 |
| PFNA | 375-95-1 | Perfluorononanoic acid | 70 | 150 |
| PFDA | 335-76-2 | Perfluorodecanoic acid | 70 | 140 |
| PFUnA | 2058-94-8 | Perfluoroundecanoic acid | 70 | 145 |
| PFDoA | 307-55-1 | Perfluorododecanoic acid | 70 | 140 |
| PFTrDA | 72629-94-8 | Perfluorotridecanoic acid | 65 | 140 |
| PFTeA | 376-06-7 | Perfluorotetradecanoic acid | 60 | 140 |
| PFBS | 375-73-5 | Perfluorobutanesulfonic acid | 60 | 145 |
| PFPeS | 2706-91-4 | Perfluoropentanesulfonic acid | 65 | 140 |
| PFHxS | 355-46-4 | Perfluorohexanesulfonic acid | 65 | 145 |
| PFHpS | 375-92-8 | Perfluoroheptanesulfonic acid | 70 | 150 |
| PFOS | 1763-23-1 | Perfluorooctanesulfonic acid | 55 | 150 |
| PFNS | 68259-12-1 | Perfluorononanesulfonic acid | 65 | 145 |
| PFDS | 335-77-3 | Perfluorodecanesulfonic acid | 60 | 145 |
| PFDoS | 79780-39-5 | Perfluorododecanesulfonic acid | 50 | 145 |
| 4:2 FTS | 757124-72-4 | 1H,1H, 2H, 2H-Perfluorohexane sulfonic acid | 70 | 145 |
| 6:2 FTS | 27619-97-2 | 1H,1H, 2H, 2H-Perfluorooctane sulfonic acid | 65 | 155 |
| 8:2 FTS | 39108-34-4 | 1H,1H, 2H, 2H-Perfluorodecane sulfonic acid | 60 | 150 |
| FOSA | 754-91-6 | Perfluorooctanesulfonamide | 70 | 145 |
| NMeFOSA | 31506-32-8 | N-methyl perfluorooctanesulfonamide | 60 | 150 |
| NEtFOSA | 4151-50-2 | N-ethyl perfluorooctanesulfonamide | 65 | 145 |
| NMeFOSAA | 2355-31-9 | N-methyl perfluorooctanesulfonamidoacetic acid | 50 | 140 |
| NEtFOSAA | 2991-50-6 | N-ethyl perfluorooctanesulfonamidoacetic acid | 70 | 145 |
| NMeFOSE | 24448-09-7 | N-methyl perfluorooctanesulfonamidoethanol | 70 | 145 |
| NEtFOSE | 1691-99-2 | N-ethyl perfluorooctanesulfonamidoethanol | 70 | 135 |
| HFPO-DA (GenX) | 13252-13-6 | Hexafluoropropylene oxide dimer acid | 70 | 140 |
| (ADONA) | 919005-14-4 | 4,8-Dioxa-3H-perfluorononanoic acid | 65 | 145 |
| PFMPA | 377-73-1 | Perfluoro-3-methoxypropanoic acid | 55 | 140 |
| PFMBA | 863090-89-5 | Perfluoro-4-methoxybutanoic acid | 60 | 150 |
| NFDHA | 151772-58-6 | Nonafluoro-3,6-dioxaheptanoic acid | 50 | 150 |
| 9Cl-PF3ONS | 756426-58-1 | 9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid | 70 | 155 |
| 11Cl-PF3OUdS | 763051-92-9 | 11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid | 55 | 160 |
| PFEESA | 113507-82-7 | Perfluoro(2-ethoxyethane) sulfonic acid | 70 | 140 |
| 3:3 FTCA | 356-02-5 | 3-Perfluoropropyl propanoic acid | 65 | 130 |
| 5:3 FTCA | 914637-49-3 | 2H,2H,3H,3H-Perfluorooctanoic acid | 70 | 135 |
| 7:3 FTCA | 812-70-4 | 3-Perfluoroheptyl propanoic acid | 50 | 145 |

Notes:

1. LCS - Laboratory Control Standard

## Table 4. Acceptance Limits for EIS[1] and NIS[2] Compounds in Primary and QC Samples

Short-term Interim Action SAP/QAPP
Spokane International Airport
Spokane, WA

| EIS Compound | Recovery (%) | NIS Compound | Recovery (%) |
|---|---|---|---|
| 13C4-PFBA | 5 - 130** | 13C3-PFBA | 50 - 200 |
| 13C5-PFPeA | 40 - 130 | | |
| 13C5-PFHxA | 40 - 130 | 13C2-PFHxA | 50 - 200 |
| 13C4-PFH A | 40 - 130 | | |
| 13C8-PFOA | 40 - 130 | 13C4-PFOA | 50 - 200 |
| 13C9-PFNA | 40 - 130 | 13C5-PFNA | 50 - 200 |
| 13C6-PFDA | 40- 130 | 13C2-PFDA | 50 - 200 |
| 13C7-PFUnA | 30- 130 | | |
| 13C2-PFDoA | 10 - 130 | | |
| 13C2-PFTeDA | 10 - 130 | | |
| 13C3-PFBS | 40 - 135 | | |
| 13C3-PFHxS | 40 - 130 | 18C2-PFHxS | 50 - 200 |
| 13C8-PFOS | 40 - 130 | 13C4-PFOS | 50 - 200 |
| 13C2-4:2FTS | 40 - 200 | | |
| 13C2-6:2FTS | 40 - 200 | | |
| 13C2-8:2FTS | 40 - 300 | | |
| 13C8-PFOSA | 40 - 130 | | |
| D3-NMeFOSA | 10 - 130 | | |
| D5-NEtFOSA | 10 - 130 | | |
| D3-NMeFOSAA | 40 - 170 | | |
| D5-NEtFOSAA | 25 - 135 | | |
| D7-NMeFOSE | 10 - 130 | | |
| D9-NEtFOSE | 10 - 130 | | |
| 13C3-HFPO-DA | 40- 130 | | |

Notes:

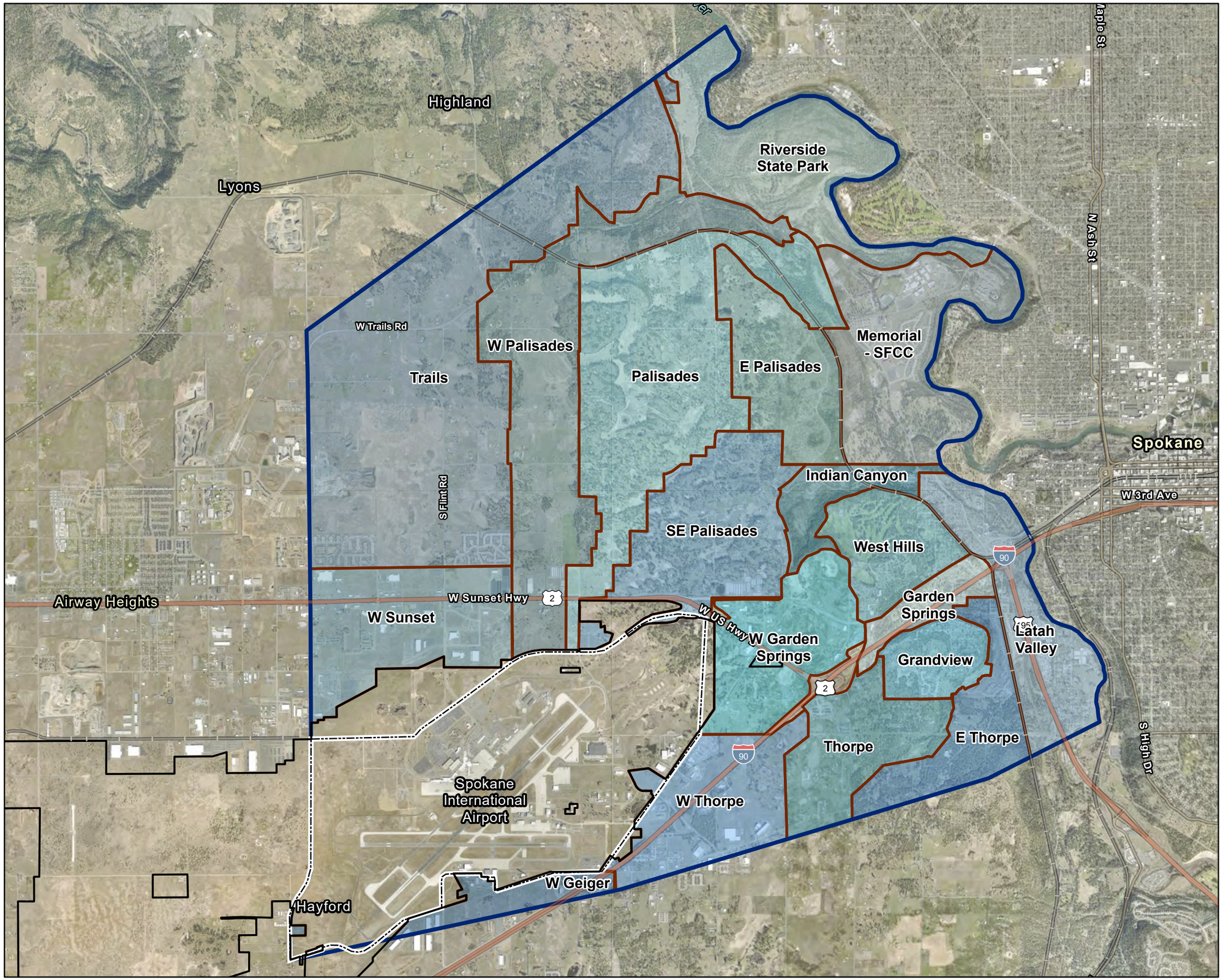
1. EIS- Extracted Internal Standards
2. NIS- Non-Extracted Internal Standards

* * Recovery of 13C4-PFBA can be problematic in some field samples. Although the lower limit for recovery for this EIS is set below 10%, laboratories should routinely track recovery of this EIS and take reasonable steps to ensure that recovery is at least 10% in the majority of samples

# Short-term Interim Action Work Plan
# Sampling and Analysis / Quality Assurance Project Plan
## Spokane International Airport
Spokane, WA

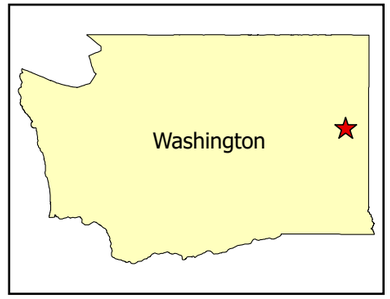
## FIGURES

Figure 1. Initial Private Well Sampling Zones




## LEGEND

- Primary Airport Area
- SIA Property Boundary
- Interim Action Area
- Private Well Sampling Zones




**Notes**

1) SIA - Spokane International Airport
2) Base map imagery provided by Esri ArcGIS Online, 2026.

Miles
0 0.5 1

Projected Coordinate System
Datum: NAD 83
State Plane Washington North
Units: Feet

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# Initial Private Well Sampling Zones

Short-Term Emergency Interim Action Work Plan
Appendix B: Sampling Analysis Plan/Quality Assurance Project Plan
Spokane International Airport
Spokane, Washington

| | | | |
|---|---|---|---|
| GSI job No. | 6892 | Drawn By: | EKS |
| Issued: | 3-Apr-2026 | Chk'd By: | KW |
| Map ID: | ECY_EIA_Z | Appv'd By: | KW |

**FIGURE 3-1**

# Short-Term Emergency Interim Action Work Plan: SAP/QAPP

**Spokane International Airport**
Spokane, WA

## ATTACHMENT A

### Attachment A. Standard Operating Procedures (SOPS)

1. Field Records & Field Sampling
2. Equipment Decontamination
3. Sampling Documentation & COC Procedures
4. Sample Packaging and Shipping
5. Field Measurement of Groundwater Level
7. Field Measurement of Electric Conductivity (EC) or Specific Conductance (SC)
8. Field Measurement of pH
9. Field Measurement of DO
10. Field Measurement of ORP

12A. Low Flow Groundwater Sampling

24. Quality Control Sampling
25. Management of Waste
36. Incident & Accident Investigations
38. Emergency Action Plan

SEMPFAS. Sampling of Environmental Media for Per and Polyfluoroalkyl Substances (PFAS)

SAC-LC-SOP73084. Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Water, Solid, Biosolids and Tissue [Method 1633]

SP-T-WET-SOP48719. Analysis of Anions by Ion Chromatography EPA Method 300

SP-T-WET-SOP65776. Determination of Alkalinity by Titration Standard Method 2320B

SP-T-MET-SOP69896. Determination of Total and Dissolved Trace Elements in Liquids, Solids and Wastes (Inductively Coupled Plasma) EPA 200.7, 6010C and 6010D.

SP-T-GCS-SOP55482: Analysis of Semivolatile Petroleum Hydrocarbons In Water and Soil: NWTPH-Dx (GC/FID) and AK102/103

SP-T-VOA-SOP48021: Determination of Gasoline Range Hydrocarbons by Gas Chromatography-Mass Spectroscopy (GC-MS) NWTPHGx, AK101

SP-T-MSS-SOP45366: Measurement of Polynuclear Aromatic Hydrocarbons (PAHs) By Gas Chromatography/Mass Spectrometry in Selective Ion Monitoring (SIM) Mode Method 8270E/8270E-SV

EFGS-T-MET-SOP41304: Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) [Methods 6020, 6020A, 6020B, 200.8]

# SOP-1

## 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.

### 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

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

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 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 Tubs (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.

### 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

### 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-TP1-12', 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 (TP1, 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.

| 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

### 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

### 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.

GSI ENVIRONMENTAL

# STANDARD OPERATING PROCEDURE
# Sampling of Environmental Media for Per and Polyfluoroalkyl Substances (PFAS)

## GENERAL

This Standard Operating Procedure (SOP) for Per- and Polyfluoroalkyl Substances (PFAS) sampling describes field equipment, site conduct, and sampling requirements. PFAS sampling requires specific procedures due to the prevalence of PFAS in consumer goods and the possibility of contamination during field activities. The typically low concentrations of PFAS found in the environment further increase the possibility of contamination and necessitate careful attention to the following procedures. All procedures performed in general field activities are applicable unless addressed in this SOP.

Additionally, a sampling sequence should be established to minimize cross contamination. Here, sampling should be conducted starting in the least contaminated area (e.g., upgradient of suspected source, furthest downgradient) and progressing to the areas that are thought to be the most contaminated (e.g., progressively sampled from furthest downgradient to the closest suspected PFAS source (Water Board, 2020). If feasible, single-use, disposable equipment is recommended for use in high concentration areas (ITRC, 2022).

## GENERAL EQUIPMENT AND FIELD SUPPLIES

Sampling equipment and supplies can contain potentially contain PFAS. Therefore, it is recommended that a conservative approach be adopted that exclude materials that are known to contain PFAS. The Safety Data Sheets (SDSs) of all materials used during sampling should be reviewed to ensure that they do not contain PFAS, particularly PFAS that are in project defined analyte list. PFAS may still be present in the materials even if not listed in the SDS as PFAS might have been used during the manufacturing process (ITRC, 2022).

Some materials that have been known to contain PFAS and should be avoided in sampling equipment and supplies (MDEQ, 2018; ITRC, 2022) include the following:

1. Polytetrafluoroethylene (PTFE)
2. Polychlorotrifluoroethylene (PCTFE)
3. Waterproof coatings containing PFAS
4. Fluorinated ethylene-propylene (FEP)
5. Ethylene tetrafluoroethylene (ETFE)
6. Low-density polyethylene (LDPE)
7. Polyvinylidene fluoride (PVDF)
8. Pipe thread compounds and tape.

Some materials that can be used and normally do not contain PFAS include the following:

1. High-density polyethylene (HDPE)
2. Polypropylene
3. Silicone
4. Acetate

It is recommended that glass should not be used even if is PFAS-free as PFAS can absorb onto glass, especially if sample is stored over long period of time in a glass container (MDEQ, 2018).

**STANDARD OPERATING PROCEDURE**
**Sampling of Environmental Media for Per and Polyfluoroalkyl Substances (PFAS)**

| Not Approved for Use | Approved Alternatives |
|---|---|
| **General Sampling Equipment** | |
| Standard decontamination water | Lab certified PFAS-free decontamination water (1), if possible. Commercially available deionized water or municipal drinking water may be used for decontamination only if the water is verified as PFAS-free (Water Board, 2020). |
| Decon 90 detergent, PFAS treated paper towel | Alconox, Citranox, and Liquinox can be used for decontamination (MDEQ, 2018; Water Board, 2020). If other detergent is used for decontamination, it must be verified that it does not contain any fluorosurfactants. A polyethylene or PVC brush can also be used to remove particulates from the sampling equipment (Water Board, 2020).Cotton cloth or untreated paper towel (MDEQ, 2018) |
| Glass or Teflon-lined sampling bottles and lids | Polyproplyene or high-density polyethylene (HDPE) sample bottles with an unlined polypropylene HDPE screw cap (2). HDPE resealable storage bags are recommended. LDPE resealable storage bags (e.g., Ziploc) may be used if it is ensured that the bag does not come into contact with sample media (MDEQ, 2018). |
| Fluoropolymer tubing, valves and other parts in pumps | HDPE, polypropylene, stainless steel, nylon, PVC, acetate, and silicone materials (Water Board, 2020; EDQW, 2017) |
| Teflon tubing, bailers, tape and plumbing paste | HDPE and silicon materials or disposable equipment |
| LDPE HydraSleeves | HDPE HydraSleeves (EDQW, 2017) |
| Aluminum foil | Thin HDPE sheeting |
| **Field Supplies** | |
| Markers (including regular/thick size Sharpies) and waterproof pens | Non-waterproof pens. Ballpoints and pencils. Fine and Ultra-Fine tip Sharpie markers may be used, only on empty lidded sample bottles while in the staging area. (EDQW, 2017; MDEQ, 2018; Water Board, 2020) |
| PFAS-treated paper, binders, and plastic clipboards | All field paperwork should be printed on standard paper (non-water proof and non-recycled) and placed in a non-water-resistant folder or aluminum, polypropylene or Masonite clipboard (EDQW, 2017, MDEQ, 2018). |
| Post-It Notes | No Post-It Notes should be brought to the site |
| Chemical (blue) ice packs | Only regular ice should be used for refrigeration on site (EDQW, 2017) |

(1) "PFAS free" is a project-defined concentration.
(2) Sample bottles are defined by the analytical method. For example, USEPA Method 1633 requires the use of HDPE containers. These should be provided by the laboratory and verified by the laboratory to be PFAS-free.

## PERSONAL PROTECTIVE EQUIPMENT, CLOTHING, AND HYGIENE PRODUCTS

Due to the prevalence of PFAS in consumer products specific clothing and personal protective equipment (PPE) selections must be made.

**STANDARD OPERATING PROCEDURE**
**Sampling of Environmental Media for Per and Polyfluoroalkyl Substances (PFAS)**

| PPE, Clothing, or Hygiene Product | PFAS Concerns | Approved Alternative |
|---|---|---|
| Steel-toed boots | Boots may not contain Gore-Tex. Many waterproof boots are lined with Gore-Tex and are prohibited. | Steel-toed boots made with polyurethane and polyvinyl chloride (PVC). If PFAS-free boots cannot be purchased, PFAS-free over-boots can be worn (MDEQ, 2018). |
| Clothing | Water resistant, waterproof, or stain-treated clothing should be avoided (EDQW, 2017). Clothing chemically treated for insect resistance and ultraviolet protection should also be avoided (Water Board, 2020). | Cotton is preferred. Waterproof clothing made with polyurethane, PVC, wax-coated fabrics, rubber, or neoprene is acceptable (Water Board, 2020).<br><br>Cotton overalls may be provided for use. |
| Rain gear | Most rain gear is coated with a Gore-Tex™ lining and contains fluoropolymers. | Rain gear made from polyurethane, PVC, rubber/neoprene and wax-coated materials may be worn (EDWQ, 2016; MDEQ, 2018). |
| Gloves | Latex gloves should not be used. | Powderless nitrile gloves or neoprene gloves can be used (MDEQ, 2018). |
| Protective Clothing | Fluoropolymer linings are used on Tyvek, Nomex, and Vitron materials (EDWQ, 2016) | Select alterative protective clothing that do not contain fluoropolymers. If use of Tyvek is necessary, MDEQ (2018) recommends that equipment blank should be collected prior to Tyvek use. |
| Sunblock and Insect Repellant | Many manufactured sunblocks and repellants contain PFAS. | Several PFAS-free insect repellants and sunblock are listed MDEQ (2018) and are detailed below. Products applied in staging area should be followed by hand washing and replacement of gloves. |
| Cosmetics, Moisturizers, hand creams, etc. | Many of these products contain surfactants and represent a potential source for PFAS. | The use of these products should be avoided prior to a sampling event, if possible. |
| Food and Drink | Food packaging often contains PFAS as a protectant from water and grease. | No food or drink shall be brought on-site, except for bottled water and hydration drinks (i.e., Gatorade). If consuming food on-site becomes necessary, wash hands thoroughly before returning to staging and sampling area (MDEQ, 2018). |

Surface treatment products for clothing that are known to contain PFAS and should be avoided (MDEQ, 2018).

- Advanced Dual Action Teflon® fabric protector.
- Repel Teflon® fabric protector
- High performance Repel Teflon® fabric protector
- Advanced Dual Action Teflon® fabric protector
- Tri-Effects Teflon® fabric protector
- Oleo-phobol CP®
- Release Teflon®
- Unidyne™
- Bionic Finish®
- RUCO-GUARD®
- RUCOSTAR®
- RUCO-COAT®
- RUCO-PROTECT®
- RUCOTEC®

- High Performance Release Teflon®
- Ultra Release Teflon®
- GreenShield®
- Lurotex Protector RL ECO ®
- Repellan KFC®
- Rucostar® EEE6
- RUCO®
- Resist Spills™
- Resists Spills and Releases Stains™
- Scotchgard™ Fabric Protector
- NK Guard S series
- Gore-Tex™

Several PFAS-free insect repellants and sunscreens are listed in MDEQ (2018) PFAS Sampling Guidance and included below.

- OFF Deep Woods
- Sawyer Permethrin
- Banana Boat Sport Performance Sunscreen Lotion Broad Spectrum SPF 30
- Meijer Sunscreen Lotion Broad Spectrum SPF 30
- Neutrogena Ultra-Sheer Dry-Touch Sunscreen Broad Spectrum SPF 30
- Banana Boat for Men Triple Defense Continuous Spray Sunscreen SPF 30
- Banana Boat Sport Performance Coolzone Broad Spectrum SPF 30
- Banana Boat Sport Performance Sunscreen Lotion Broad Spectrum SPF 30
- Banana Boat Sport Performance Sunscreen Stick SPF 50
- Coppertone Sunscreen Lotion Ultra Guard Broad Spectrum SPF 50
- Coppertone Sport High-Performance AccuSpray Sunscreen SPF 30
- Coppertone Sunscreen Stick Kids SPF 55
- L'Oréal Silky Sheer Face Lotion 50+
- Meijer Clear Zinc Sunscreen Lotion Broad Spectrum SPF 15, 30 and 50
- Meijer Wet Skin Kids Sunscreen Continuous Spray Broad Spectrum SPF 70
- Neutrogena Beach Defense Water + Sun Barrier Lotion SPF 70
- Neutrogena Beach Defense Water + Sun Barrier Spray Broad Spectrum SPF 30
- Neutrogena Pure & Free Baby Sunscreen Broad Spectrum SPF 60+

**STANDARD OPERATING PROCEDURE**
**Sampling of Environmental Media for Per and Polyfluoroalkyl Substances (PFAS)**

## DRILLING AND SAMPLING EQUIPMENT

Generally, equipment that is not in direct contact with the external environment or sample may contain PFAS-coated parts (i.e., internal to the equipment). Additionally, parts made of low-density polyethylene (LDPE) should be avoided if it comes in direct contact with the sample (Water Board, 2020).

| | |
|---|---|
| Drilling | • PFAS-free drilling fluids should be used, to the extent possible. While preparing the detailed site work plan, confirm the type of drilling fluids typically used by the drillers and confirm no fluoropolymers are included.<br>• PVC well material should not be re-used if previously used at sites where PFAS may be present. It is recommended that the re-use of PVC pipe be avoided.<br>• All purged water must be properly disposed of. |
| Groundwater Sampling | • Site-specific groundwater sampling checklists should be used during sampling<br>• Follow all equipment guidelines outlined above, specifically avoid glass containers, any Teflon materials, and un-approved PPE<br>• PTFE Masterflex should not be used with the peristaltic pump.<br>• The lines attached to bailers for sample collection should be Nylon or cotton (Water Board, 2020). |
| Soil Sampling | • Site-specific soil sampling checklists should be used during sampling<br>• Follow all equipment guidelines outlined above, specifically avoid aluminum foil, Teflon lid liners or sampling equipment, and un-approved PPE<br>• Glass containers may be used for dry samples, provided that the laboratory can extract adsorbed PFAS during sample preparation (Water Board, 2020).<br>• The plastic bags used to store soil should be certified PFAS free.<br>• If collecting core samples, liners should be made of acetate or other materials known to be PFAS-free (Water Board, 2020). |
| Sediment Sampling | • All augers and auger baskets should not contain any Teflon fittings.<br>• All equipment is to be decontaminated between each sample.<br>• Glass containers may be used for dry samples, provided that the laboratory can extract adsorbed PFAS during sample preparation (Water Board, 2020).<br>• The plastic bags used to store sediment should be certified PFAS free. |
| Surface Water Sampling | • Surface water dipper, if applicable, should not consist of LDPE. The dipper bowl should be polypropylene; glass should be avoided.<br>• The dipper and bowl should be decontaminated before every sample.<br>• Waders and boots, if required, should not contain Gore-Tex. Only footwear made with polyurethane or polyvinyl chloride should be used. |

**STANDARD OPERATING PROCEDURE**
**Sampling of Environmental Media for Per and Polyfluoroalkyl Substances (PFAS)**

## GENERAL SITE CONDUCT

Typical expectations for site conduct apply to PFAS sampling. However, additional precautions should be taken.

- As stated above, no food is allowed on site. Only bottled water and hydration drinks are allowed. These should be consumed downwind of the sampling area, if possible.
- Due to the prevalence of PFAS in consumer products, visitors who have not complied with the PPE, clothing, and hygiene guidelines above should be asked to remain at least 30 feet from sampling areas.
- Gloves and coveralls should be removed before breaking for food or drink. Gloves and coveralls should be put back on before returning to the sampling area.
- Hands should be thoroughly washed after taking breaks for food or lunch.

## DECONTAMINATION

It is essential that adequate decontamination procedures are implemented to prevent cross-contamination. Some best practices that should be followed are listed below (MDEQ, 2018; ITRC, 2022):

- It is recommended that disposable sampling equipment be used whenever possible.
- All non-disposable sampling equipment should be cleaned and decontaminated prior to mobilization to the site and between uses at the site.
- Alconox, Cintranox, and Liquinox are the recommended decontamination solutions that should be used for the sampling equipment (MDEQ, 2018). If other decontamination solutions are to be used, the SDSs should be thoroughly reviewed to ensure that they do not contain any fluorosurfactants.
- Laboratory supplied PFAS-free water should be used for the final rinse of sampling equipment. Commercially available deionized water may be used for decontamination if it has been determined to be PFAS free. Triple rinsing with PFAS-free water is recommended.
- Downhole equipment should be placed on PFAS-free plastic sheet after decontamination to prevent contact with contaminated soil. If equipment will not be used immediately, it is recommended that the equipment be wrapped in PFAS-free plastic sheet to prevent contamination from volatile PFAS.
- Larger equipment such as drilling equipment should be scrubbed with a polyethylene or PVC brush if it is caked with drill cuttings, soil or other material. The scrapings must be adequately containerized and disposed. Subsequently, the equipment should be pressure washed with potable water. Parts of the equipment that come in contact with samples should be washed with PFAS-free water to the extent possible. Triple rinsing with PFAS-free water is recommended.

## REFERENCES

California State Water Quality Control Board (Water Board), 2020. Per- and Polyfluoroalkyl Substances (PFAS) Sampling Guidelines for Non-Drinking Water. September 2020.

EDQW, 2017. Bottle Selection and other Sampling Considerations when Sampling for PFAS. Environmental Data Quality Workgroup

ITRC, 2022. PFAS Technical and Regulatory Guidance Document. Interstate Technology Regulatory Council. June 2022. https://pfas-1.itrcweb.org/

MDEQ, 2018. General PFAS Sampling Guidance. Michigan Department of Environmental Quality. Issued 16 October 2018.

Revision Log
Reference
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1) Scope and Application
2) Summary of Method
3) Definitions
4) Interferences
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## Revision Log

| **Revision:** 3.3 | **Effective date:** | This version |
|---|---|---|
| **Section** | **Justification** | **Changes** |
| Revision Log | Removal | Revision history prior to 08/15/2025 has been removed and can be viewed in previous versions of this SOP. |
| 11.5.10, 11.5.14 | Revision | Solvent changed to NH4OH/Methanol or KOH/Methanol |

| **Revision:** 3.2 | **Effective date:** | 26 August 2025 |
|---|---|---|
| **Section** | **Justification** | **Changes** |
| Revision Log | Removal | Revision history prior to 07/17/2025 has been removed and can be viewed in previous versions of this SOP. |
| 11.5.10, 11.5.14 | Revision | Solvent changed to NH4OH/MeOH |
| 11.7.1 | Revision | Section edited, all matrices have same final volume, NIS volume, and H2O volume. |
| 11.7.1.1 | Removal | Section removed specifying difference between soil and tissue, final volume is the same now. |
| 11.8.2, 11.8.3 | Revision | Section edited, all matrices have same final volume, NIS volume, and H2O volume. |
| Throughout | Editorial changes | Editorial changes |

| **Revision:** 3.1 | **Effective date:** | 15 August 2025 |
|---|---|---|
| **Section** | **Justification** | **Changes** |
| Revision Log | Removal | Revision history prior to 05/23/2025 has been removed and can be viewed in previous versions of this SOP. |

| Revision: 3.1 | Effective date: | 15 August 2025 |
|---|---|---|
| **Section** | **Justification** | **Changes** |
| 7.1 Note | Addition | Added clarification that the eluent containers are replaced in entirety or cleaned prior to reuse and properly documented. |
| Table 8 | Revision | Clarification was added as to the starting conditions of the holding time when dealing with tissue samples. |
| Table 8 | Addition | Added footnote 4 to acknowledge shipping and storage conditions when dealing with whole fish. |
| 8.1.1. | Addition | Added section 8.1.1. to cover hold time exceptions when 11Cl-PF3OUdS and/or 9Cl-PF3ONS are analytes of interest. |
| 11.2.7, 11.4.3, 11.5.5, 11.8.1 | Addition | Add 30 minute wait time to allow reagents to reach room temperature. |
| 11.9.11 to 11.9.11.9 | Addition | Added centrifuge/decant procedure for promochrom samples. |
| Throughout | Editorial changes | Editorial changes |



## Reference

1.1. Method 1633 – Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids and Tissue Samples by LC-MS/MS, January 2024.

1.2. Department of Defense and Department of Energy Quality Systems Manual for Environmental Laboratories, Version 6.0, December 2023.

1.3. Method 1633, Revision A - Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS, December 2024

## Cross Reference

| Document | Document Title |
|---|---|
| *SAC-T-OP-SOP70329* | Cleaning of Glassware (Organics) |
| *NDSC-US EHS-QP46060* | Environmental Health and Safety (EHS) Manual |
| *SAC-QA-SOP71665* | Standards and Reagents and Quality Control Check Procedures |
| *SAC-QA-P-QP71748* | Quality Control Program |
| *NDSC-QA-QP44940* | Calibration Curves and Selection of Calibration Points |
| *QA-SOP70881* | Nonconformance and Corrective Action System |
| *SAC-QA-P-QP71754* | Data Review Policy |
| *QA-SOP71736* | Detection and Quantitation Limits |
| *SAC-R-EHS-SOP70477* | Sacramento Addendum to Environmental Health and Safety (EHS) Manual |
| *SAC-QA-QAM-QM69954* | Quality Assurance Manual |
| *SAC-LC-WI81787* | Procedure to Employ When the SPE Clogs for 1633 DoD Work |
| *SAC-QA-SOP71742* | Calibration and Calibration Check of Balances |

## 1) Scope and Application

1.1. This procedure describes the analysis of water, soil, solids, biosolids, and tissue samples for the following compounds using liquid chromatography / tandem mass spectrometry (LC/MS/MS).

**Table 1.1**
**PFAS Supported**

| Compound Name | Abbreviations | CAS # |
|---|---|---|
| **Short Chain** | | |
| Perfluoropropionic acid * | PFPrA, PPF Acid | 422-64-0 |
| Bis(trifluoromethane)sulfonamide * | TFSI | 82113-65-3 |
| **Perfluoroalkylcarboxylic acids (PFCAs)** | | |
| Perfluoro-n-butanoic acid | PFBA | 375-22-4 |
| Perfluoro-n-pentanoic acid | PFPeA | 2706-90-3 |
| Perfluoro-n-hexanoic acid | PFHxA | 307-24-4 |
| Perfluoro-n-heptanoic acid | PFHpA | 375-85-9 |
| Perfluoro-n-octanoic acid | PFOA | 335-67-1 |
| Perfluoro-n-nonanoic acid | PFNA | 375-95-1 |

| Table 1.1<br>PFAS Supported | | |
|---|---|---|
| **Compound Name** | **Abbreviations** | **CAS #** |
| **Short Chain** | | |
| Perfluoropropionic acid * | PFPrA, PPF Acid | 422-64-0 |
| Bis(trifluoromethane)sulfonamide * | TFSI | 82113-65-3 |
| Perfluoro-n-decanoic acid | PFDA | 335-76-2 |
| Perfluoro-n-undecanoic acid | PFUnA | 2058-94-8 |
| Perfluoro-n-dodecanoic acid | PFDoA | 307-55-1 |
| Perfluoro-n-tridecanoic acid | PFTrDA | 72629-94-8 |
| Perfluoro-n-tetradecanoic acid | PFTeDA | 376-06-7 |
| Perfluoro-n-hexadecanoic acid * | PFHxDA | 67905-19-5 |
| Perfluoro-n-octadecanoic acid * | PFODA | 16517-11-6 |
| **Perfluorinated sulfonic acids (PFSAs)** | | |
| Perfluoro-1-butanesulfonic acid | PFBS | 375-73-5 |
| Perfluoro-1-pentanesulfonic acid | PFPeS | 2706-91-4 |
| Perfluoro-1-hexanesulfonic acid | PFHxS | 355-46-4 |
| Perfluoro-1-heptanesulfonic acid | PFHpS | 375-92-8 |
| Perfluoro-1-octanesulfonic acid | PFOS | 1763-23-1 |
| Perfluoro-nonanesulfonic acid | PFNS | 68259-12-1 |
| Perfluoro-1-decanesulfonic acid | PFDS | 335-77-3 |
| Perfluoro-1-dodecansulfonic acid | PFDoS | 79780-39-5 |
| **Perfluorinated sulfonamides (FOSAs)** | | |
| Perfluoro-1-octanesulfonamide | PFOSA, (FOSA) | 754-91-6 |
| N-ethylperfluoro-1-octanesulfonamide | NEtFOSA (Et-FOSA) | 4151-50-2 |
| N-methylperfluoro-1-octanesulfonamide | NMeFOSA (Me-FOSA) | 31506-32-8 |
| **Perfluorinated sulfonamide ethanols (FOSEs)** | | |
| 2-(N-ethylperfluoro-1-octanesulfonamido) ethanol | NEtFOSE (Et-FOSE) | 1691-99-2 |
| 2-(N-methylperfluoro-1-octanesulfonamido) ethanol | NMeFOSE (Me-FOSE) | 24448-09-7 |
| **Perfluorinated sulfonamidoacetic acids (FOSAAs)** | | |
| N-ethylperfluoro-1-octanesulfonamidoacetic acid | NEtFOSAA (EtFOSAA) | 2991-50-6 |
| N-methylperfluoro-1-octanesulfonamidoacetic acid | NMeFOSAA (MeFOSAA) | 2355-31-9 |
| **Fluorotelomer sulfonic acids (FTS)** | | |
| 1H,1H,2H,2H-perfluorohexane sulfonic acid *(4:2)* | 4:2 FTS | 757124-72-4 |
| 1H,1H,2H,2H-perfluorooctane sulfonic acid *(6:2)* | 6:2 FTS | 27619-97-2 |
| 1H,1H,2H,2H-perfluorodecane sulfonic acid *(8:2)* | 8:2 FTS | 39108-34-4 |
| **Fluorotelomer carboxylic acids (FTCAs)** | | |
| 3-Perfluoropropylpropanoic acid | 3:3 FTCA | 356-02-5 |
| 3-Perfluoropentylpropanoic acid | 5:3 FTCA | 914637-49-3 |
| 3-Perfluoroheptylpropanoic acid | 7:3 FTCA | 812-70-4 |
| Per-and Polyfluoroether carboxylic acids | | |
| Perfluoro(2-propoxypropanoic) acid or Hexafluoropropylene oxide dimer acid | HFPO-DA, GenX | 13252-13-6 |
| 4,8-dioxa-3H-perfluorononanoic acid | ADONA(1) (DONA) | 919005-14-4 |
| Perfluoro-3-methoxypropanoic acid (PFMPA) | PFMPA, (PFECA F) | 377-73-1 |
| Perfluoro-4-methoxybutanoic acid (PFMBA) | PFMBA,( PFECA A) | 863090-89-5 |
| Nonafluoro-3,6-dioxaheptanoic acid (NFDHA) | NFDHA (PFECA B) | 151772-58-6 |
| **Ether sulfonic acids** | | |
| 9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid | 9Cl-PF3ONS | 756426-58-1 |
| 11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid | 11Cl-PF3OUdS | 763051-92-9 |
| Perfluoro(2-ethoxyethane) sulfonic acid | PFEESA (PES) | 113507-82-7 |

***Note:*** *Abbreviations in parenthesis are the abbreviations used by the laboratory's LIMS where they differ from the abbreviation listed in Method 1633.*

**Analyte not officially listed in Method 1633, but added to meet market demands.*

(*1) In some literature, the acronym ADONA refers to the ammonium salt, CAS 958445-44-8, and DONA refers to the parent acid. In Method 1633, ADONA refers to the parent acid. DONA is the acronym present on the laboratory raw data.*

1.2. Additional analytes supported by this method under special request.

| Table 1.2<br>Additional Compounds | | |
|---|---|---|
| **Compound Name** | **Abbreviation** | **CAS #** |
| **Perfluorinated sulfonic acids (PFSAs)** | | |
| Perfluoro-4-ethylcyclohexanesulfonic acid | PFECHS | 133201-07-7 |
| Perfluoropropanesulfonic acid | PFPrS | 423-41-6 |
| Perfluoroundecanesulfonic acid | PFUdS | 749786-16-1 |
| Perfluorotridecanesulfonic acid | PFTrDS | 791563-89-8 |
| **Fluorotelomer carboxylic acids (FTCA)** | | |
| 2-Perfluorohexylethanoic acid | 6:2 FTCA | 53826-12-3 |
| 2-Perfluorooctylethanoic acid | 8:2 FTCA | 27854-31-5 |

| Table 1.2<br>Additional Compounds | | |
|---|---|---|
| **Compound Name** | **Abbreviation** | **CAS #** |
| 2-Perfluorodecylethanoic acid | 10:2 FTCA | 53826-13-4 |
| **Fluorotelomer unsaturated carboxylic acids (FTUCA)** | | |
| 2H-Perfluoro-2-octenoic acid | 6:2 FTUCA | 70887-88-6 |
| 2H-Perfluoro-2-decenoic acid | 8:2 FTUCA | 70887-84-2 |
| 2H-Perfluoro-2-dodecenoic acid | 10:2 FTUCA | 70887-94-4 |
| **Short Chain and Specialty Analytes** | | |
| Difluoro(perfluoromethoxy)acetic acid | PFMOAA | 674-13-5 |
| Perfluoro-4-isopropoxybutanoic acid | PFPE-1, (PFECA G) | 801212-59-9 |
| Perfluoro-3,5,7,9-butaoxadecanoic acid | PFO4DA | 39492-90-5 |
| Perfluoro-3,5,7-trioxaoctanoic acid | PFO3OA | 39492-89-2 |
| Perfluoro-3,5-dioxahexanoic acid | PFO2HxA | 39492-88-1 |
| Perfluoro-3,6-dioxa-4-methyl-7-octene-1-sulfonic acid | PS Acid | 29311-67-9 |
| Perfluoro-2-{[perfluoro-3-(perfluoroethoxy)-2-propanyl]oxy}ethanesulfonic acid | Hydro-PS Acid | 749836-20-2 |
| Perfluoro-3,5,7,9,11-pentaoxadodecanoic acid | PFO5DA, (PFO5DoA) | 39492-91-6 |
| Perfluoro-2-(perfluoromethoxy)propanoic acid | PMPA | 13140-29-9 |
| 2,3,3,3-Tetrafluoro-2-(pentafluoroethoxy)propanoic acid | PEPA | 267239-61-2 |
| 3-(Methoxy)tetrafluoropropionic acid | MTP | 93449-21-9 |
| 4-(2-carboxy-1,1,2,2-tetrafluoroethoxy)-2,2,3,3,4,5,5,5-octafluoro-pentanoic acid | R-EVE | 2416366-22-6 |
| 2,2,3,3-Tetrafluoro-3-{[1,1,1,2,3,3-hexafluoro-3-(1,2,2-trifluoroethenoxy)propan-2-yl]oxy}propanoic acid | EVE Acid | 69087-46-3 |
| 1,1,2,2,4,5,5,5-heptafluoro-3-oxapentanesulfonic acid | NVHOS | 801209-99-4 |
| 2,2,3,3-Tetrafluoro-3-{[1,1,1,2,3,3-hexafluoro-3-(1,2,2,2-tetrafluoroethoxy)propan-2-yl]oxy}propanoic acid | Hydro-EVE Acid | 773804-62-9 |
| Ethanesulfonic acid, 1,1,2,2-tetrafluoro-2-[1,2,2,3,3-pentafluoro-1-(trifluoromethyl)propoxy]- | R-PDSCA | 2416366-21-5 |
| 2,2,3,3,4,5,5,5-octafluoro-4-(1,1,2,2-tetrafluoro-2-sulfoethoxy) pentanoic acid | R-PSDA | 2416366-18-0 |
| Perfluoro-1-butanesulfonamide | FBSA | 30334-69-1 |
| Perfluoro-1-hexanesulfonamide | FHxSA | 41997-13-1 |
| 6:2 Fluorotelomer phosphate diester | 6:2 diPAP | 57677-95-9 |
| 6:2\8:2 Fluorotelomer phosphate diester | 6:2\8:2 diPAP | 943913-15-3 |
| 8:2 Fluorotelomer phosphate diester | 8:2 diPAP | 678-41-1 |
| 2-fluoro-2-[1,1,2,3,3,3-hexafluoro-2-(1,1,2,2-tetrafluoro-2-sulfoethoxy)propoxy] acetic acid | HPSDA, H-PSDA, Hydrolyzed PSDA | 2416366-19-1 |
| 1H,1H,2H,2H-perfluorododecane sulfonic acid (10:2) | 10:2 FTS | 120226-60-0 |
| 1-Octanesulfonic acid | 1-OSA | 3944-72-7 |
| Perfluoro-2,5-dimethyl-3,6-dioxanonanoic acid | HFPO-TrA | 13252-14-7 |
| Perfluoro-(2,5,8-trimethyl-3,6,9-trioxadodecanoic) acid | HFPO-TeA | 65294-16-8 |
| Pentadecafluoro-2,4,6,8,10,12-hexaoxatetradecan-14-oic acid | PFO6TeA | STL03418 |

1.3. The working range of the method is listed below. The linear range can be extended by diluting the extracts. Note that all compounds are reported in their acid form. Reporting limits and Method Detection Limits for individual compounds are stored in the laboratory's LIMS.

| T**able 1.2**<br>**Reporting Limits and Working Range** | | | |
|---|---|---|---|
| **Matrix** | **Nominal Sample Size** | **Reporting Limit** | **Working Range** |
| Water | 125 mL | 1.5 ng/L – 10 ng/L | 1.5 ng/L - 2000 ng/L |
| Leachate | 25 mL | 7.5 ng/L – 50 ng/L | 7.5 ng/L-10000 ng/L |
| Solid | 2 g | 0.2 ng/g – 1.0 ng/g | 0.2 ng/g - 125 ng/g |
| Biosolids | 0.5 g | 0.8 ng/g – 4.0 ng/g | 2 ng/g – 500 ng/g |
| Tissue | 2 g | 0.4 ng/g – 2.0 ng/g | 0.4 ng/g – 250 ng/g |

## 2) Summary of Method

2.1. Water samples are extracted using a solid phase extraction (SPE) cartridge. PFAS are eluted from the cartridge with an ammonium hydroxide (NH4OH)/methanol solution.

2.2. Solid/biosolids and tissue samples are extracted with a NH4OH/methanol solution using agitation for 1 hour. The extract is then cleaned using a solid phase extraction (SPE) cartridge. PFAS are eluted from the cartridge with an ammonium hydroxide (NH4OH)/methanol solution.

2.3. The final extracts are analyzed by LC/MS/MS. PFAS are separated from other components on a C18 column with a solvent gradient program using 5 mM ammonium acetate/water and methanol. The mass spectrometer detector is operated in the electrospray (ESI) negative ion mode for the analysis of PFAS.

2.4. An isotope dilution technique is employed with this method for the compounds of interest. The isotope dilution analytes (IDA) consist of carbon-13 labeled analogs or deuterated analogs of the compounds of interest, and they are fortified into the samples at the time of extraction. This technique allows for the correction for analytical bias encountered when analyzing more chemically complex environmental samples. The isotopically labeled compounds are chemically similar to the compounds of concern and are therefore affected by sample-related interferences to the same extent as the compounds of concern. Compounds that do not have an identically labeled analog are quantitated by the IDA method using a closely related labeled analog.

2.4. Quantitation by the internal standard method is employed for the IDA analytes/recoveries. Peak response is measured as the area of the peak.

## 3) Definitions

3.1. PFAS: Per- and Polyfluoroalkyl Substances

3.2. PFCAs: Perfluorocarboxylic acids

3.3. PFSAs: Perfluorinated sulfonic acids

3.4. FOSA: Perfluorinated sulfonamide

3.5. PFOA: Perfluorooctanoic acid

3.6. PFOS: Perfluorooctane sulfonic acid

3.7. PTFE: Polytetrafluoroethylene (e.g. Teflon®)

3.8. SPE: Solid phase extraction

3.9. PP: Polypropylene

3.10. PE: Polyethylene

3.11. HDPE: High density polyethylene

3.12. AFFF: Aqueous Film Forming Foam

3.13. TDCA: Taurodeoxycholic acid

3.14. TCDCA: Taurochenodeoxycholic acid

3.15. TUDCA: Tauroursodeoxycholic acid

3.16. IDA: Isotope dilution analyte (equivalent to EIS in reference method)

3.17. IS: Internal Standard (equivalent to NIS in reference method)

3.18. LCS: Laboratory control sample (equivalent to OPR in reference method)

3.19 PT: Performance Testing

3.20 SRM: Standard Reference Material

3.21. Further definitions of terms used in this SOP may be found in the glossary of the Laboratory Quality Assurance Manual (QAM), *SAC-QA-QAM-QM69954*.

## 4) Interferences

4.1. PFAS have been used in a wide variety of manufacturing processes, and laboratory supplies should be considered potentially contaminated until they have been tested and shown to be otherwise. The materials and supplies used during the method validation process have been tested and shown to be clean (i.e., no contribution greater than the method detection limit (MDL)). These items are listed below in Section 6.

4.2. To avoid contamination of samples, standards are prepared in a ventilation hood in an area separate from where samples are extracted.

4.3. PTFE products can be a source of PFOA contamination. The use of PTFE in the procedure should be avoided or at least thoroughly tested before use. Polypropylene (PP) or polyethylene (PE, HDPE) products may be used in place of PTFE products to minimize PFOA contamination.

4.3.1. Standards and samples are injected from polypropylene autosampler vials with polypropylene screw caps once. Multiple injections may be performed on Primers when conditioning the instrument for analysis.

4.3.2. Random evaporation losses have been observed with the polypropylene caps causing high IDA recovery after the vial was punctured and sample re-injected. For this reason, it is best to inject standards and samples once in the analytical sequence.

4.3.3. Teflon-lined screw caps have detected PFAS at low concentrations. Repeated injection from the same Teflon-lined screw cap have detected PFNA at increasing concentration as each repeated injection was performed, therefore, it is best to use polypropylene screw caps.

4.4. Volumetric glassware and syringes are difficult to clean after being used for solutions containing high levels of PFOA. These items should be labeled for use only with similarly concentrated solutions or verified clean prior to re-use. To the extent possible, disposable labware is used.

4.5. Both branched and linear PFAS isomers can potentially be found in the environment. Linear and branched isomers are known to exist for PFOS, PFOA, PFNA, PFHxS, FOSA, PFBS, Et-FOSA, Me-FOSA, Et-FOSE, Me-FOSE, Et-FOSAA, and Me-FOSAA based upon the scientific literature. If multiple isomers are present for one of these PFAS they might be adjacent peaks that completely resolve or not, but usually with a deflection point resolved during peak integration. The later of these peaks matches the retention time of its labeled linear analog. In general, earlier peaks are the branched isomers and are not the result of peak splitting.

As of this writing, only PFOS, PFOA, PFNA, PFHxS, FOSA, Et-FOSA, Me-FOSA, Et-FOSE, Me-FOSE, Et-FOSAA and Me-FOSAA are commercially available as technical mixtures. These reference standards of the technical mixtures for these specific PFAS are used to ensure that all appropriate peaks are included during peak integration.

4.6. In an attempt to reduce PFOS bias, it is required that m/z 499>80 transition be used as the quantitation transition.

4.7. Aluminum foil should not be used for this analysis due to the potential interferences from the PFAS used as release agents.

## 5) Safety

Employees must abide by the policies and procedures in the NBLSC Environmental Health and Safety Manual (*NDSC-US EHS-QP46060*), and the Sacramento Addendum to the Environmental Health and Safety Manual (*SAC-R-EHS-SOP70477*). All work must be stopped in the event of a known or potential compromise to the health or safety of an associate. The situation must be reported **immediately** to a supervisor, the EH&S Staff, or a senior manager.

5.1. Specific Safety Concerns

5.1.1. Preliminary toxicity studies indicate that PFAS could have significant toxic effects. In the interest of keeping exposure levels as low as reasonably achievable, PFAS and PFAS samples must be handled in the laboratory as hazardous and toxic chemicals.

5.1.2. The use of a filtering syringe with the SPE cartridge, if and when needed, presents an extreme risk of ergonomic injury due to the force needed to push the sample through the cartridge, and the set-up and body geometry of the individual using the syringe/SPE cartridge. Use step boxes to position yourself above the syringe and manifold so that your body weight can be carefully applied to pushing the syringe plunger down, rather than just using your arm and shoulder muscles. Ensure that this task is rotated amongst staff members so that no one has to do it repeatedly for weeks or months. Ensure that routine breaks are taken, and that muscles and joints involved with this task are routinely stretched to offset this hazard.

5.1.3. Exercise caution when using syringes with attached filter disc assemblies. Application of excessive force has, upon occasion, caused a filter disc to burst during the process.

5.1.4. Laboratory procedures such as manual use of Vortex mixers or similar equipment, hand shaking samples beyond several inversions, repetitive use of pipets, repetitive transferring of extracts and manipulation of filled separatory funnels and other glassware represent a significant potential for repetitive motion or other ergonomic injuries. Laboratory associates performing these procedures are in the best position to realize when they are at risk for these types of injuries. Whenever a situation is found in which an employee is performing the same repetitive motion, the employee shall immediately bring this to the attention of their supervisor, manager, or the EH&S staff. The task will be analyzed to determine a better means of accomplishing it. This specifically includes identification and use of mechanical options that reduce the amount of manual handling required to perform extraction procedures such as Vortex mixing and shaking.

5.1.5. Eye protection that satisfies ANSI Z87.1 (as per the NBLSC Safety Manual), laboratory coat, and nitrile gloves must be worn while handling samples, standards, solvents, and reagents. Disposable gloves that have been contaminated will be removed and discarded; other gloves will be cleaned immediately.

5.1.6. Perfluorocarboxylic acids are acids and are not compatible with strong bases.

5.1.7. The use of vacuum systems presents the risk of imploding glassware. All glassware used during vacuum operations must be thoroughly inspected prior to each use. Glass that is chipped, scratched, cracked, rubbed, or marred in any manner must not be used under vacuum. It must be removed from service and replaced.

5.1.8. Ensure that the vacuum exhaust hose used during the filtering is securely anchored inside a fume hood so that the vapors are not pumped into the working environment.

5.2. Primary Materials Used

The following is a list of the materials used in this method, which have a serious or significant hazard rating. **NOTE: This list does not include all materials used in the method. The table contains a summary of the primary hazards listed in**

**the SDS for each of the materials listed in the table.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the SDS for each material before using it for the first time or when there are major changes to the SDS.

| Material(1) | Hazards | Exposure Limit(2) | Signs and Symptoms of Exposure |
|---|---|---|---|
| Acetic Acid (3-2-1) | Corrosive<br>Poison<br>Flammable | 10 ppm-TWA<br>15 ppm-STEL | Contact with concentrated solution may cause serious damage to the skin and eyes. Inhalation of concentrated vapors may cause serious damage to the lining of the nose, throat, and lungs. Breathing difficulties may occur. |
| Acetonitrile (2-3-0) | Flammable<br>Poison | 20 ppm-TWA | Early symptoms may include nose and throat irritation, flushing of the face, and chest tightness. Prolonged exposure to high levels of vapors may cause formation of cyanide anions in the body. |
| Ammonium Hydroxide (3-1-0) | Corrosive<br>Poison | 50 ppm-TWA | Severe irritant. Effects from inhalation of dust or mist vary from mild irritation to serious damage to the upper respiratory tract. Symptoms may include sneezing, sore throat or runny nose. Contact with skin can cause irritation or severe burns and scarring with greater exposures. Causes irritation of eyes, and with greater exposures it can cause burns that may result in permanent damage, including blindness. Brief exposure to 5000 PPM can be fatal. |
| Formic Acid (3-2-1) | Flammable<br>Corrosive<br>Toxic<br>Irritant | 5 ppm TWA<br>10 ppm STEL | Extremely destructive on contact with skin, mucous membranes, eyes, upper respiratory tract. Inhalation may result in spasms, inflammation and edema. Symptoms include burning sensation, coughing, wheezing, shortness of breath, headache, nausea, vomiting, and depression. |
| Methanol (2-3-0) | Flammable<br>Poison<br>Irritant | 200 ppm PEL<br>250 ppm STEL | Harmful or fatal if swallowed, or absorbed through the skin. Causes eye, skin and respiratory tract irritation, and may cause central nervous system depression. A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Symptoms of overexposure may include headache, drowsiness and dizziness. Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure. Irritant to the eyes. |
| Potassium Hydroxide (3-0-1) | Corrosive<br>Poison | 2 $mg/m^3$ (Ceiling) | Symptoms of inhalation may include coughing, sneezing, and damage to the nasal or respiratory tract. High concentrations can cause lung damage. Contact with skin can cause irritation or severe burns and scarring with greater exposures. Causes irritation of eyes with tearing, redness, and swelling. |
| Sodium Hydroxide (3-0-1) | Corrosive<br>Poison | 2 Mg/M3-PEL | Severe irritant. Effects from inhalation of dust or mist vary from mild irritation to serious damage of the upper respiratory tract, depending on severity of exposure. Symptoms may include sneezing, sore throat or runny nose. Contact with skin can cause irritation or severe burns and scarring with greater exposures. Causes irritation of eyes, and with greater exposures it can cause burns that may result in permanent impairment of vision, even blindness. |

(1) Always add acid to water to prevent violent reactions.
(2) Exposure limit refers to the OSHA regulatory exposure limit.

## 6) Equipment and Supplies

Due to the ubiquitous nature of PFAS, all disposable equipment (including, but not limited to vials, pipet tips, and SPE manifold parts) that directly contacts a sample or extract is subject to QC checks on a by-lot basis prior to use. At a minimum, the QC checks include either a rinse with reagent water or an extraction with basic methanol to mimic the usage encountered during sample preparation. QC check data is kept on file for reference as needed. Processes for cleaning extraction manifolds and associated components are described in *SAC-T-OP-SOP70329*, "Glassware Cleaning". All equipment described below must be constructed of materials that will not react with or sorb PFAS constituents and before use must be demonstrated to be free of PFAS at levels that would be detectable (i.e., at or above the laboratory's MDLs) in blanks or samples.

6.1. 15 mL polypropylene test tubes with polypropylene screw caps.

6.2. 50 mL graduated plastic centrifuge tubes.

6.3. 125 mL HDPE bottles with HDPE screw caps, ESS Part # 0125-1902-QC, or equivalent.

6.3.1. The average weight of the HDPE bottles with HDPE screw caps are calibrated once per year. The calibration is performed by weighing 10 bottles with caps and dividing by 10 to get the average weight. The average weight is used in Section 11.3.5.1 Step 4.

6.4. Analytical balance capable of accurately weighing to the nearest 0.0001g, and checked for accuracy each day it is used in accordance with *SAC-T-OP-SOP70329*.

6.5. Extract concentrator or nitrogen manifold with water bath heating to 65°C.

6.6. Syringe filter, PALL/Acrodisc 0.2 um Nylon membrane, 25 mm, or equivalent. Do not use PTFE type filters.

6.7. 300 µL autosampler vials, polypropylene, with polypropylene screw caps, Waters PN 1860004112, or equivalent.

6.8. SPE columns

6.8.1. Phenomenex [redacted] or equivalent. This specific cartridge should have a pKA conjugate above 8.

6.8.2. Phenomenex [redacted] or equivalent, which is used for tissue samples.

6.9. Vacuum manifold for Solid Phase Extraction (SPE) Supelco Visiprep, or equivalent. A manual vacuum manifold with column adapters, disposable liners, and column reservoirs for cartridge extraction.

6.10. Miscellaneous laboratory apparatus (beakers, test tubes, volumetric flasks, pipettes, etc.). These should be disposable where possible, or marked and segregated for high-level versus low-level use.

6.10.1. Manifold liners must be rinsed using the following steps:

6.10.1.1. Take approximately 75 liners and place them into a 10 oz. poly snap cap.

6.10.1.2. Pour MeOH until all the liners are submerged.

6.10.1.3. Pour out 30 – 40 mL of MeOH from the poly snap cap, close the cap, and shake 3 times.

6.10.1.4. Pour out all of the MeOH from the snap cap into a waste container.

6.10.1.5. Rinse the liner with nano pure water. (This can be done by the handful).

6.10.1.6. Place clean liners into a new 10 oz. snap cap.

6.11. pH indicator paper, VWR Chemicals pH Test 0-14, or equivalent.

6.12. Centrifuge (Thermo Scientific Sorvall Legend X1, or equivalent), capable of reaching at least 4500 rpm.

6.13. Vortex Mixer (Scientific Industries model SI-0236 or equivalent).

6.14. Shaker table (Eberbach model 6010, or equivalent) for soil extractions.

6.15. Desiccator, part # B002VBW9XW or equivalent.

6.16. Drierite desiccant, part # 23005-UOM-EA or equivalent.

6.17. Oven, capable of maintaining a temperature of 104°C (+/- 1°C), Symphony part # 15-103-0503, or equivalent.

6.18. Pre-weighed 47 mm filters, Environmental Express part # F93447MM or equivalent.

6.19. Vacuum pump, CPS Products VP2D Pro-set 2 State, part # UX-07164-83 or equivalent.

6.20. Liquid Chromatography/Tandem Mass Spectrometer (LC/MS/MS) –The instrument described below, or equivalent, may be used for this method. The HPLC is equipped with a refrigerated autosampler, an injection valve, and a pump capable of variable flow rate. The use of a column heater is required to maintain a stable temperature throughout the analytical run. Data is processed using Chrom Peak Review, version 2.3 or equivalent. The MS/MS is capable of running in the NI-ESI mode at the recommended flow rate with a minimum of 10 scans per peak.

6.20.1. SCIEX LC/MS/MS
This system consists of a Shimadzu HPLC interfaced with a SCIEX 5500 Triple Quad MS, a SCIEX 7500 Triple Quad MS, or equivalent. The instrument control and data acquisition software is SCIEX Analyst version 1.6.3 (SCIEX 5500), SCIEX OS version 3.3.6.44 (SCIEX 7500), or equivalent.

6.20.1.1. Shimadzu CTO-20AC HPLC equipped with 3 LC-20AD pumps and one DGU-20 degassing unit or equivalent (SCIEX 5500), Shimadzu CTO-40C HPLC equipped with two LC-40D XR pumps and one DGU-405 degassing unit or equivalent (SCIEX 7500).

6.20.1.2. [redacted], or equivalent.

6.20.1.3. PFAS Isolator column, [redacted] or equivalent. This is plumbed between the UPLC pumps and autosampler valve to minimize PFAS background from the UPLC solvent lines and filters.

6.21. Inline filter, Part #F-HC-30, PromoChrom Technologies or equivalent.

6.22. Phenomenex [redacted] or equivalent.

6.23. Phenomenex [redacted] or equivalent.

6.24. Automated SPE unit – PromoChrom Technologies, PN SPE-03 or equivalent.

6.25. Preventive and routine maintenance is described in the table below.

**Table 6.23**
**HPLC/MS/MS Preventative Maintenance**

| **As Needed:** | **Daily (When in use)** |
|---|---|
| Change pump seals.<br>Change in-line filters in autosampler (HPLC).<br>Check/replace in-line frit if excessive pressure or poor performance.<br>Replace column if no change following in-line frit change.<br>Clean corona needle.<br>Replace sample inlet tube in APCI (10.1 cm).<br>Replace fused silica tube in ESI interface.<br>Clean lenses.<br>Clean skimmer.<br>Ballast rough pump 30 minutes.<br>Create all eluents in Reagent module, label eluent containers with TALS label and place 2nd label into maintenance log when put into use. | Check solvent reservoirs for sufficient level of solvent.<br>Verify that pump is primed, operating pulse free.<br>Check needle wash reservoir for sufficient solvent.<br>Verify capillary heater temperature functioning.<br>Verify vaporizer heater temperature.<br>Verify rough pump oil levels.<br>Verify turbo-pump functioning.<br>Verify nitrogen pressure for auxiliary and sheath gasses.<br>Verify that corona and multiplier are functioning. |
| **Semi-Annually** | **Annually** |
| Replace rough-pump oil (4-6 months).<br>Replace oil mist and odor elements.<br>Replace activated alumina filter if applicable | Vacuum system components including fans and fan covers.<br>Clean/replace fan filters, if applicable. |

## 7) Reagents and Standards

7.1. Reagent grade chemicals shall be used in all tests whenever available. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on the Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

Note: For all instrumentation eluents (mobile phases) and automated SPE units, when practical and feasible, once the volume is consumed the container should either be replaced in its entirety or the container cleaned by rinsing the container with new eluent prior to filling the container. Document in the instrument logbook which action occurred and the reagent ID. If any debris is found in the container, stop using that container until it is properly cleaned.

7.1.1. Acetic acid, glacial.

7.1.2. Acetonitrile, HPLC Grade. 4 L container.
7.1.2.1. Due to the size of the 4 L container, when used as a mobile phase, the container should either be replaced in its entirety or refilled as needed.

7.1.3. Ammonium acetate (solid salt).

7.1.4. Ammonium acetate (5 mM in water): Prepared by weighing 0.385 g of ammonium acetate and dissolving in 1 L of water. This solution has volatile components, thus it should be replaced every 7 days or sooner.

7.1.5. Ammonium hydroxide ($NH_4OH$), 30% in water, ACS reagent grade, Fisher product number A669S-500, or equivalent.

7.1.6. Ammonium hydroxide ($NH_4OH$), [redacted] (v/v): Prepared by diluting [redacted] into 990 mL of [redacted] for a total of 1 L.

7.1.7. Formic Acid, greater than 96% purity or equivalent, ACS reagent grade, Fisher product number A117, or equivalent.

7.1.8. Formic Acid, [redacted], in water: Prepared by dissolving [redacted] brought to [redacted]. Replace after 2 years.

7.1.9. Methanol (MeOH).

7.1.10. Potassium Hydroxide (KOH) 85% assay (solid), Fisher Part number P250-1 or equivalent.

7.1.11. Potassium hydroxide, [redacted] (w/v): Prepared by weighing [redacted] of potassium hydroxide and brought to [redacted].

7.1.12. Sodium hydroxide 1N, used for pH adjustments.

7.1.13. Ottawa Sand (blank matrix for solid samples).

7.1.14. Store bought vegetable oil (blank matrix for tissue samples).

7.1.15. Water, Nanopure or Millipore, must be free of interference and target analytes. (Referred to reagent water in the SOP).

7.1.16. Nitrogen, Ultra High Purity, used for the ESI interface, collision cell, and concentration of extracts.

7.1.17. Air, Ultra-Pure, used for vacuum and source gas.

7.1.18. [redacted], prepared by diluting [redacted] or equivalent volume in respect to the ratio.

7.1.19. Instrument Blanks solution (95% MeOH, 5% H2O): Prepare by combining 19 mL of MeOH and 1.0 mL reagent water.

7.2. Standards

7.2.1. The 40 PFAS analytes specified in Method 1633 are purchased as high purity solids (98% or greater) or as certified solutions. See *SAC-QA-SOP71665* for more details. Standard materials are verified when compared to a second source material at the time of initial calibration. The solid stock material is stored at room temperature or as specified by the manufacturer or vendor.

7.2.2. As of this writing, only PFOS, PFOA, PFNA, PFHxS, FOSA, Et-FOSA, Me-FOSA, Et-FOSE, Me-FOSE, Et-FOSAA and Me-FOSAA are commercially available as technical mixtures. These reference standards of the technical mixtures for these specific PFAS are used to ensure that all appropriate peaks are included during peak integration.

7.2.3. If solid material is used for preparing a standard, stock standard solutions are prepared from the solids and are stored at 0 - 6°C. Stock standard solutions should be brought to room temperature before using. Standards are monitored for signs of degradation or evaporation. Standard solutions must be replaced at least annually from the date of preparation.

7.2.3.1. If using solid material, be certain to account for the density of the material when preparing the standard. See *SAC-QA-SOP71665* for more details.

7.2.4. PFBS, PFHxS, PFHpS, PFOS, PFDS, and many other PFAS are not available in the acid form, but rather as their corresponding salts, such as sodium or potassium. The standards are prepared and corrected for their salt content according to the equation below.

$$Mass_{acid} = \text{Measured } Mass_{salt} \times MW_{acid} / MW_{salt}$$

Where: $MW_{acid}$ is the molecular weight of PFAA

$MW_{salt}$ is the molecular weight of the purchased salt.

For example, the molecular weight of PFOS is 500.1295 and the molecular weight of NaPFOS is 523.1193. Therefore, the amount of NaPFOS used must be adjusted by a factor of 0.956.

7.2.5. For the primary source calibration solutions, individual solutions for each PFAS (both native and isotopically labelled) are purchased from Wellington Laboratories, or other reputable vendors, and are predominantly at a concentration of 50 ug/mL in basic methanol. In the case of the sulfonic compounds, the concentration is 50 ug/mL of the alkali (potassium or sodium) salt. The laboratory uses the concentration of the acid form when determining the concentration of individual sulfonic acids in solution (See Section 7.2.4 above). See *SAC-QA-SOP71665* for details about solutions being in basic conditions to prevent esterification.

7.2.6. While PFAS standards commercially purchased are supplied in glass ampoules, all subsequent transfers or dilutions performed by the analyst must be prepared and stored in polypropylene or HDPE containers. Vortex all standard solutions prior to removing aliquots.

7.3. 1633 IM/LCS Spike Solution, 15-100 ng/mL

The 1633 IM/LCS spike solution is made in 500 mL of a mixed stock solution in methanol at a nominal concentration listed below. This mixed stock is used as the spiking solution during sample preparation, as well an intermediate for the calibration curve, using the recipe below:

**Table 7.3**
**1633 IM/LCS Spike Solution Recipe**
**The solutions below are combined and diluted to 500 mL in methanol**

| Analyte | Stock Conc. (µg/mL) | Aliquot (mL) | 1633 IM/LCS Conc. (µg/mL) | Analyte | Stock Conc. (µg/mL) | Aliquot (mL) | 1633 IM/LCS Conc. (µg/mL) |
|---|---|---|---|---|---|---|---|
| PFBA | 50 | 0.4 | 0.040 | 6:2 FTS | 47.4 | 0.4 | 0.0381 |
| PFPeA | 50 | 0.2 | 0.020 | 8:2 FTS | 47.9 | 0.4 | 0.0384 |
| PFHxA | 50 | 0.2 | 0.020 | FOSA | 50 | 0.2 | 0.020 |
| PFHpA | 50 | 0.2 | 0.020 | Me-FOSA | 50 | 0.2 | 0.020 |
| PFOA | 50 | 0.2 | 0.020 | Et-FOSA | 50 | 0.2 | 0.020 |
| PFNA | 50 | 0.2 | 0.020 | Me-FOSAA | 50 | 0.2 | 0.020 |
| PFDA | 50 | 0.2 | 0.020 | Et-FOSAA | 50 | 0.2 | 0.020 |
| PFUdA | 50 | 0.2 | 0.020 | Me-FOSE | 50 | 1.0 | 0.100 |
| PFDoA | 50 | 0.2 | 0.020 | Et-FOSE | 50 | 1.0 | 0.100 |
| PFTrDA | 50 | 0.2 | 0.020 | HFPO-DA | 50 | 0.15 | 0.015 |
| PFTeDA | 50 | 0.2 | 0.020 | 4,8-dioxa-3H- PFNA (DONA) | 47.1 | 0.2 | 0.0189 |
| PFBS | 44.2 | 0.2 | 0.0178 | PFMPA | 50 | 0.2 | 0.020 |
| PFPeS | 46.9 | 0.2 | 0.0188 | PFMBA | 50 | 0.2 | 0.020 |
| PFHxS | 45.5 | 0.2 | 0.0182 | NFDHA | 50 | 0.2 | 0.020 |

| Table 7.3<br>1633 IM/LCS Spike Solution Recipe<br>The solutions below are combined and diluted to 500 mL in methanol | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Analyte** | **Stock Conc. (µg/mL)** | **Aliquot (mL)** | **1633 IM/LCS Conc. (µg/mL)** | **Analyte** | **Stock Conc. (µg/mL)** | **Aliquot (mL)** | **1633 IM/LCS Conc. (µg/mL)** |
| PFHpS | 47.6 | 0.2 | 0.0191 | 9CI-PF3ONS | 46.6 | 0.2 | 0.0187 |
| PFOS | 46.6 | 0.2 | 0.0186 | 11CI-PF3OUdS | 47.1 | 0.2 | 0.0188 |
| PFNS | 48 | 0.2 | 0.0192 | PFEESA (PES) | 44.6 | 0.2 | 0.01784 |
| PFDS | 48.2 | 0.2 | 0.0193 | 3:3 FTCA | 50 | 0.4 | 0.040 |
| PFDoS | 48.4 | 0.2 | 0.0194 | 5:3 FTCA | 50 | 1.0 | 0.100 |
| 4:2 FTS | 46.7 | 0.4 | 0.0375 | 7:3 FTCA | 50 | 1.0 | 0.100 |
| TFSI | 97.84 | 0.1 | 0.0196 | PFHxDA | 50 | 0.2 | 0.020 |
| PFPrA | 50 | 1.0 | 0.100 | PFODA | 50 | 0.2 | 0.020 |

7.3.1. 1633 EXT IM/LCS Spike Solution, 92-110 ng/mL

The 1633 EXT IM/LCS solution is made in 100 mL of a mixed stock solution in methanol at a nominal concentration listed below. This mixed stock is used as the spiking solution during sample preparation, as well an intermediate for the calibration curve, using the recipe below:

| Table 7.3.1.<br>1633 EXT IM/LCS Spike Solution Recipe<br>The solutions below are combined and diluted to 100 mL in methanol | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Analyte** | **Stock Conc. (µg/mL)** | **Aliquot (mL)** | **1633 EXT IM/LCS Conc. (µg/mL)** | **Analyte** | **Stock Conc. (µg/mL)** | **Aliquot (mL)** | **1633 EXT IM/LCS Conc. (µg/mL)** |
| 10:2 FTS | 48.3 | 0.2 | 0.097 | 8:2 FTUCA | 50 | 0.2 | 0.1 |
| 6:2 diPAP | 48.65 | 0.2 | 0.097 | PFPrS | 46 | 0.2 | 0.092 |
| 62/82 diPAP | 48.8 | 0.2 | 0.098 | PFECHS | 46.2 | 0.2 | 0.092 |
| 8:2 diPAP | 48.91 | 0.2 | 0.098 | PFTrDS | 48.6 | 0.2 | 0.097 |
| FBSA | 50 | 0.2 | 0.1 | PFUdS | 48.4 | 0.2 | 0.097 |
| 10:2 FTCA | 50 | 0.2 | 0.1 | HFPO-TrA | 95 | 0.2 | 0.1 |
| 10:2 FTUCA | 50 | 0.2 | 0.1 | HFPO-TeA | 95 | 0.2 | 0.098 |
| 6:2 FTCA | 50 | 0.2 | 0.1 | 1-OSA | 89.84 | 0.2 | 0.1 |
| 6:2 FTUCA | 50 | 0.2 | 0.1 | 10:2 diPAP | 95 | 0.2 | 0.11 |
| FHxSA | 50 | 0.2 | 0.1 | PF6OTeA | 95.86 | 0.2 | 0.1 |
| 8:2 FTCA | 50 | 0.2 | 0.1 | | | | |

7.3.1.1. 1633 EXT IM/Low Level LCS Spike Solution, 18-22 ng/mL

The 1633 EXT IM/Low level LCS spike solution is made using 10 mL of 1633 EXT IM/LCS spike solution, 92-110 ng/mL, and bring the final volume up to 50 mL. This mixed stock is used as the spiking solution during sample preparation, as well an intermediate for the calibration curve, using the recipe below:

| Table 7.3.1.1.<br>1633 EXT IM/Low Level LCS Spike Solution Recipe<br>The solutions below are diluted to 50 mL in methanol | | | | | |
|---|---|---|---|---|---|
| **Analyte** | **1633 EXT IM/LCS Conc. (µg/mL)** | **1633 EXT IM/Low Level LCS Conc. (µg/mL)** | **Analyte** | **1633 EXT IM/LCS Conc. (µg/mL)** | **1633 EXT IM/Low Level LCS Conc. (µg/mL)** |
| 10:2 FTS | 0.097 | 0.019 | 8:2 FTUCA | 0.1 | 0.020 |
| 6:2 diPAP | 0.097 | 0.019 | PFPrS | 0.092 | 0.018 |
| 62/82 diPAP | 0.098 | 0.020 | PFECHS | 0.092 | 0.018 |
| 8:2 diPAP | 0.098 | 0.020 | PFTrDS | 0.097 | 0.019 |
| FBSA | 0.1 | 0.020 | PFUdS | 0.097 | 0.019 |
| 10:2 FTCA | 0.1 | 0.020 | HFPO-TrA | 0.1 | 0.020 |
| 10:2 FTUCA | 0.1 | 0.020 | HFPO-TeA | 0.098 | 0.020 |
| 6:2 FTCA | 0.1 | 0.020 | 1-OSA | 0.1 | 0.020 |
| 6:2 FTUCA | 0.1 | 0.020 | 10:2 diPAP | 0.11 | 0.022 |
| FHxSA | 0.1 | 0.020 | PF6OTeA | 0.1 | 0.020 |
| 8:2 FTCA | 0.1 | 0.020 | | | |

7.3.2. 1633 EXT IM/Table 3 LCS Spike Solution, 100 ng/mL

The 1633 EXT/Table 3 LCS spike solution is made in 500 mL of a mixed stock solution in methanol at a nominal concentration listed below. This mixed stock is used as the spiking solution during sample preparation, as well an intermediate for the calibration curve, using the recipe below:

**Table 7.3.2.**
**1633 EXT IM/Table 3 LCS Spike Solution Recipe**
**The solutions below are combined and diluted to 500 mL in methanol**

| Analyte | Stock Conc. (µg/mL) | Aliquot (mL) | 1633 EXT IM/LCS Conc. (µg/mL) | Analyte | Stock Conc. (µg/mL) | Aliquot (mL) | 1633 EXT IM/LCS Conc. (µg/mL) |
|---|---|---|---|---|---|---|---|
| PS acid | 100 | 0.05 | 0.1 | PEPA | 100 | 0.05 | 0.1 |
| Hydro-PS acid | 100 | 0.05 | 0.1 | PFPE-1 | 100 | 0.05 | 0.1 |
| R-PSDA | 100 | 0.05 | 0.1 | PFMOAA | 100 | 0.05 | 0.1 |
| Hydro-PSDA | 100 | 0.05 | 0.1 | PFO2HxA | 100 | 0.05 | 0.1 |
| R-PSDCA | 100 | 0.05 | 0.1 | PFO3OA | 100 | 0.05 | 0.1 |
| EVE acid | 100 | 0.05 | 0.1 | PFO4DA | 100 | 0.05 | 0.1 |
| Hydro-EVE acid | 100 | 0.05 | 0.1 | PFO5DoA | 100 | 0.05 | 0.1 |
| MTP | 100 | 0.05 | 0.1 | PMPA | 100 | 0.05 | 0.1 |
| NVHOS | 100 | 0.05 | 0.1 | R-EVE | 100 | 0.05 | 0.1 |

7.3.2.1. 1633 EXT IM/P3 LCS Spike Solution, 20 ng/mL

The 1633 EXT IM/P3 LCS Spike Solution is made using 200 mL of 1633 EXT IM/Table 3 LCS spike solution, 100 ng/mL, and bring the final volume up to 1 L. This mixed stock is used as the spiking solution during sample preparation, as well an intermediate for the calibration curve, using the recipe below:

**Table 7.3.2.1.**
**1633 EXT IM/P3 LCS Spike Solution Recipe**
**The solutions below are diluted to 1 L in methanol**

| Analyte | 1633 EXT IM/Table 3 Conc. (µg/mL) | 1633 EXT IM/P3 Conc. (µg/mL) | Analyte | 1633 EXT IM/Table 3 Conc. (µg/mL) | 1633 EXT IM/P3 Conc. (µg/mL) |
|---|---|---|---|---|---|
| PS acid | 0.1 | 0.02 | PEPA | 0.1 | 0.02 |
| Hydro-PS acid | 0.1 | 0.02 | PFPE-1 | 0.1 | 0.02 |
| R-PSDA | 0.1 | 0.02 | PFMOAA | 0.1 | 0.02 |
| Hydro-PSDA | 0.1 | 0.02 | PFO2HxA | 0.1 | 0.02 |
| R-PSDCA | 0.1 | 0.02 | PFO3OA | 0.1 | 0.02 |
| EVE acid | 0.1 | 0.02 | PFO4DA | 0.1 | 0.02 |
| Hydro-EVE acid | 0.1 | 0.02 | PFO5DoA | 0.1 | 0.02 |
| MTP | 0.1 | 0.02 | PMPA | 0.1 | 0.02 |
| NVHOS | 0.1 | 0.02 | R-EVE | 0.1 | 0.02 |

7.3.3. 1633 EXT IM/PRC Spike Solution, 10000 ng/mL (10 ppm), 1000 ng/mL (1 ppm), 25 ng/mL (25 ppb)

The 1633 EXT IM/PRC spike is made at three different concentrations. All three spikes have a final volume of 5 mL. The 1 ppm spike is added to all extracts prior to analysis and all three spikes are used as intermediate solutions for preparation of the instrument calibration standards.

7.3.3.1. 10 µg/mL spike is made by diluting 1 mL of 50 ug/mL M2PFOA(PRC) in 4 mL of methanol.

7.3.3.2. 1 µg/mL spike is made by diluting 0.5 mL of the 10 ppm spike in 4.5 mL of methanol.

7.3.3.3. 25 ppb spike is made by diluting 125 µL of the 1 ppm spike in 4.785 mL of methanol.

7.4. 1633 Isotope Dilution Analyte Solution (Extracted Internal Standards), 10-25 ng/mL

The 1633 Isotope Dilution Analyte Solution is made in 1L of a mixed stock solution in methanol at a nominal concentration listed below. This mixed stock is used as the spiking solution during sample preparation, as well an intermediate for the calibration curve, using the recipe below:

**Table 7.4**
**1633-Isotope Dilution Analyte Solution (Extracted Internal Standard) Recipe**
**The solutions below are combined and diluted to 1 L with Methanol.**

| IDA | Stock Conc. (µg/mL) | Aliquot (mL) | IDA Mix Conc. (µg/mL) | IDA | Stock Conc. (µg/mL) | Aliquot (mL) | IDA Mix Conc. (µg/mL) |
|---|---|---|---|---|---|---|---|
| 13C4-PFBA | 50 | 0.2 | 0.01 | 13C8-PFOS | 47.9 | 0.2 | 0.00958 |
| 13C5-PFPeA | 50 | 0.2 | 0.01 | 13C2-4:2FTS | 46.9 | 0.5 | 0.02345 |
| 13C5-PFHxA | 50 | 0.2 | 0.01 | 13C2-6:2FTS | 47.6 | 0.5 | 0.0238 |
| 13C4-PFHpA | 50 | 0.2 | 0.01 | 13C2-8:2FTS | 48.0 | 0.5 | 0.024 |
| 13C8-PFOA | 50 | 0.2 | 0.01 | 13C8-FOSA | 50 | 0.5 | 0.025 |
| 13C9-PFNA | 50 | 0.2 | 0.01 | d3-MeFOSA | 50 | 0.2 | 0.01 |

| Table 7.4<br>1633-Isotope Dilution Analyte Solution (Extracted Internal Standard) Recipe<br>The solutions below are combined and diluted to 1 L with Methanol. | | | | | | | |
|---|---|---|---|---|---|---|---|
| **IDA** | **Stock Conc. (µg/mL)** | **Aliquot (mL)** | **IDA Mix Conc. (µg/mL)** | **IDA** | **Stock Conc. (µg/mL)** | **Aliquot (mL)** | **IDA Mix Conc. (µg/mL)** |
| 13C6-PFDA | 50 | 0.2 | 0.01 | d5-EtFOSA | 50 | 0.2 | 0.01 |
| 13C7-PFUdA | 50 | 0.2 | 0.01 | d3-MeFOSAA | 50 | 0.5 | 0.025 |
| 13C2-PFDoA | 50 | 0.2 | 0.01 | d5-EtFOSAA | 50 | 0.5 | 0.025 |
| 13C2-PFTeDA | 50 | 0.2 | 0.01 | d7-Me-FOSE | 50 | 0.5 | 0.025 |
| 13C3-PFBS | 46.6 | 0.2 | 0.00932 | d9-Et-FOSE | 50 | 0.5 | 0.025 |
| 13C3-PFHxS | 47.4 | 0.2 | 0.00948 | 13C3-HFPO-DA | 50 | 0.5 | 0.025 |
| 13C3-PFPrA | 48.5 | 0.2 | 0.0097 | 13C2_PFHxDA | 50 | 0.2 | 0.01 |

7.4.1. 1633 EXT Isotope Dilution Analyte Solution (Extracted Internal Standards), 10-25 ng/mL

The 1633 EXT Isotope Dilution Analyte Solution is made in 200 mL of a mixed stock solution in the solution described in Section 7.4., then spike in the stock solutions at a nominal concentration listed below. This mixed stock is used as the spiking solution during sample preparation, as well an intermediate for the calibration curve, using the recipe in Section 7.4. along with the recipe below:

| Table 7.4.1.<br>1633 EXT Isotope Dilution Analyte Solution Recipe<br>The solutions below are combined and diluted to 200 mL in methanol | | | | | | | |
|---|---|---|---|---|---|---|---|
| **IDA** | **Stock Conc. (µg/mL)** | **Aliquot (mL)** | **EXT IDA Mix Conc. (µg/mL)** | **IDA** | **Stock Conc. (µg/mL)** | **Aliquot (mL)** | **ETX IDA Mix Conc. (µg/mL)** |
| 13C4-6:2diPAP | 48.6534 | 0.1 | 0.00973 | 13C-10:2 FTCA | 50 | 0.25 | 0.025 |
| 13C4-8:2diPAP | 48.8688 | 0.1 | 0.00977 | 13C-6:2 FTCA | 50 | 0.25 | 0.025 |
| 13C-10:2 FTUCA | 50 | 0.1 | 0.01 | 13C-8:2 FTCA | 50 | 0.25 | 0.025 |
| 13C-6:2 FTUCA | 50 | 0.1 | 0.01 | 13C2 10:2 FTS | 48.33 | 0.25 | 0.02416 |
| 13C-8:2 FTUCA | 50 | 0.1 | 0.01 | | | | |

7.5. 1633 Internal Standard Solution, 23-62.5 ng/mL

The 1633 Internal standard solution is made in 400 mL of a mixed stock solution in methanol at a nominal concentration listed below. This mixed stock is used as the spiking solution during sample preparation, as well an intermediate for the calibration curve, using the recipe below:

| Table 7.5<br>1633 Internal Standard Solution Recipe<br>The solutions below are combined and diluted to 400 mL with Methanol. | | | | | | | |
|---|---|---|---|---|---|---|---|
| **IDA** | **Stock Conc. (µg/mL)** | **Aliquot (mL)** | **IDA Mix Conc. (ug/mL)** | **IDA** | **Stock Conc. (µg/mL)** | **Aliquot (mL)** | **IDA Mix Conc. (ug/mL)** |
| 13C3-PFBA | 50 | 0.2 | 0.0250 | 13C2-PFDA | 50 | 0.2 | 0.0250 |
| 13C2-PFHxA | 50 | 0.5 | 0.0625 | 18O2-PFHxS | 47.4 | 0.2 | 0.0237 |
| 13C4-PFOA | 50 | 0.5 | 0.0625 | 13C4-PFOS | 47.9 | 0.2 | 0.0240 |
| 13C5-PFNA | 50 | 0.2 | 0.0250 | | | | |

7.6. Calibration Standards

Calibration solutions are prepared from the standards described in Sections 7.3, 7.4, and 7.5, above. For each level, a 200 mL volumetric flask is filled with 10 mL of water, and methanol added. The appropriate amount (see table below) of the solutions are added, and then the flask is filled to the mark with methanol to achieve the ratio of 95% methanol to 5% water, v/v.

| Table 7.6<br>1633 Calibration Solution Recipe<br>The solutions below are combined and final volume to 200 mL in methanol | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **PFAS Standards** | **CS-1** | **CS-2** | **CS-3** | **CS-4** | **CS-5** | **CS-6** | **CS-7** | **CS-8** | **CS-9** |
| 1633 IM/LCS Spike Solution (0.02 µg/mL) | 0.25 | 0.5 | 1.25 | 5 | 10 | 25 | 50 | 100 | 150 |
| 1633 IDA Solution (0.01-0.025 µg/mL) | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| 1633 IS Solution (0.025 0.0625 µg/mL) | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

7.6.1. Calibration Standards for the Extended List

Calibration solutions are prepared from the standards described in Sections 7.3, 7.4, and 7.5, above. For each level, a 200 mL volumetric flask is filled with 10 mL of water, and methanol added. The appropriate amount (see table below) of the solutions are added, and then the flask is filled to the mark with methanol to achieve the ratio of 95% methanol to 5% water, v/v.

| Table 7.6.1.<br>1633 Extended List Calibration Solution Recipe<br>The solutions below are combined and final volume to 200 mL in methanol | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **PFAS Standards** | **CS-1** | **CS-2** | **CS-3** | **CS-4** | **CS-5** | **CS-6** | **CS-7** | **CS-8** |
| 1633 IM/LCS Spike Solution (0.02 µg/mL) | 0.25 | 0.5 | 1.25 | 5 | 10 | 25 | 50 | 100 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1633 EXT IM/LCS Spike Solution (0.1 µg/mL) | - | - | - | - | 2 | 5 | 10 | 20 |
| 1633 EXT IM/Low Level LCS Spike Solution (0.02 µg/mL) | 0.25 | 0.5 | 1.25 | 5 | - | - | - | - |
| 1633 EXT IM/Table 3 LCS Spike Solution (0.1 µg/mL) | - | - | - | - | 2 | 5 | 10 | 20 |
| 1633 EXT IM/ P3 LCS Spike Solution (0.02 µg/mL) | 0.25 | 0.5 | 1.25 | 5 | - | - | - | - |
| 1633 EXT IM/PRC Spike (10 µg/mL) | - | - | - | - | - | - | 0.1 | 0.2 |
| 1633 EXT IM/PRC Spike (1 µg/mL) | - | - | - | 0.1 | 0.2 | 0.5 | - | - |
| 1633 EXT IM/PRC Spike (0.025 µg/mL) | 0.2 | 0.4 | 1 | - | - | - | - | - |
| 1633 EXT IDA Solution (0.01-0.025 µg/mL) | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| 1633 IS Solution (0.025 0.0625 µg/mL) | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

7.6.2. Initial Calibration (ICAL) Levels (ng/mL)

| Compound | CS-1 | CS-2 | CS-3 | CS-4 | CS-5 | CS-6 | CS-7 | CS-8 | CS-9 |
|---|---|---|---|---|---|---|---|---|---|
| PFPrA | 0.125 | 0.25 | 0.625 | 2.5 | 5 | 12.5 | 25 | 50 | 75 |
| PFBA | 0.05 | 0.1 | 0.25 | 1 | 2 | 5 | 10 | 20 | 30 |
| PFPeA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 | 15 |
| PFHxA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 | 15 |
| PFHpA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 | 15 |
| PFOA * | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 | 15 |
| PFNA* | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 | 15 |
| PFDA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 | 15 |
| PFUdA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 | 15 |
| PFDoA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 | 15 |
| PFTrDA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 | 15 |
| PFTeDA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 | 15 |
| PFBS | 0.022 | 0.044 | 0.111 | 0.444 | 0.888 | 2.22 | 4.44 | 8.88 | 13.32 |
| PFPeS | 0.024 | 0.047 | 0.118 | 0.47 | 0.94 | 2.35 | 4.7 | 9.4 | 14.1 |
| PFHxS* | 0.023 | 0.046 | 0.114 | 0.456 | 0.912 | 2.28 | 4.56 | 9.12 | 13.68 |
| PFHpS | 0.024 | 0.048 | 0.119 | 0.477 | 0.954 | 2.385 | 4.77 | 9.54 | 14.31 |
| PFOS* | 0.023 | 0.047 | 0.116 | 0.465 | 0.93 | 2.325 | 4.65 | 9.3 | 13.95 |
| PFNS | 0.024 | 0.048 | 0.12 | 0.481 | 0.962 | 2.405 | 4.81 | 9.62 | 14.43 |
| PFDS | 0.024 | 0.049 | 0.121 | 0.485 | 0.97 | 2.425 | 4.85 | 9.7 | 14.46 |
| PFDoS | 0.024 | 0.048 | 0.121 | 0.482 | 0.964 | 2.41 | 4.82 | 9.64 | 14.55 |
| 4:2 FTS | 0.047 | 0.0935 | 0.234 | 0.934 | 1.868 | 4.67 | 9.34 | 18.68 | 28.14 |
| 6:2 FTS | 0.048 | 0.0952 | 0.238 | 0.952 | 1.904 | 4.76 | 9.52 | 19.04 | 28.56 |
| 8:2 FTS | 0.048 | 0.096 | 0.24 | 0.96 | 1.92 | 4.8 | 9.6 | 19.2 | 28.8 |
| FOSA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 | 15 |
| Me-FOSA* | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 | 15 |
| Et-FOSA* | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 | 15 |
| MeFOSAA* | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 | 15 |
| EtFOSAA* | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 | 15 |
| Me-FOSE* | 0.125 | 0.25 | 0.625 | 2.5 | 5 | 12.5 | 25 | 50 | 15 |
| Et-FOSE* | 0.125 | 0.25 | 0.625 | 2.5 | 5 | 12.5 | 25 | 50 | 15 |
| HFPO-DA | 0.018 | 0.038 | 0.094 | 0.375 | 0.75 | 1.875 | 3.75 | 7.5 | 11.25 |
| DONA | 0.024 | 0.047 | 0.118 | 0.473 | 0.946 | 2.365 | 4.73 | 9.46 | 14.19 |
| PFMPA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 | 15 |
| PFMBA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 | 15 |
| NFDHA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 | 15 |
| 9Cl-PF3ONS | 0.023 | 0.047 | 0.117 | 0.467 | 0.934 | 2.335 | 4.67 | 9.34 | 14.01 |
| 11CI-PF3OUdS | 0.024 | 0.047 | 0.118 | 0.472 | 0.944 | 2.36 | 4.72 | 9.44 | 14.16 |
| PFEESA (PES) | 0.022 | 0.045 | 0.111 | 0.445 | 0.89 | 2.23 | 4.45 | 8.9 | 13.38 |
| 3:3 FTCA | 0.05 | 0.1 | 0.25 | 1 | 2 | 5 | 10 | 20 | 30 |
| 5:3 FTCA | 0.125 | 0.25 | 0.625 | 2.5 | 5 | 12.5 | 25 | 50 | 75 |
| 7:3 FTCA | 0.125 | 0.25 | 0.625 | 2.5 | 5 | 12.5 | 25 | 50 | 75 |
| TFSI | 0.025 | 0.049 | 0.122 | 0.489 | 0.978 | 2.446 | 4.892 | 9.784 | 14.622 |
| 13C2-PFOA (PRC) | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 | 15 |
| PFHxDA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 | 15 |
| PFODA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 | 15 |
| **Labeled Isotope Dilution Analytes (IDA)** | | | | | | | | | |
| 13C3-PFPrA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13C4-PFBA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13C5-PFPeA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13C5-PFHxA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13C4-PFHpA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 13C8-PFOA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13C9-PFNA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13C6-PFDA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13C7-PFUdA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13C2-PFDoA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13C2-PFTeDA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13C3-PFBS | 0.932 | 0.932 | 0.932 | 0.932 | 0.932 | 0.932 | 0.932 | 0.932 | 0.932 |
| 13C3-PFHxS | 0.946 | 0.946 | 0.946 | 0.946 | 0.946 | 0.946 | 0.946 | 0.946 | 0.946 |
| 13C8-PFOS | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 |
| 13C2-4:2 FTS | 2.345 | 2.345 | 2.345 | 2.345 | 2.345 | 2.345 | 2.345 | 2.345 | 2.345 |
| 13C2-6:2FTS | 2.38 | 2.38 | 2.38 | 2.38 | 2.38 | 2.38 | 2.38 | 2.38 | 2.38 |
| 13C2-8:2FTS | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 |
| 13C8-FOSA | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| d3-MeFOSA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| d5-EtFOSA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| d3-MeFOSAA | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| d5-EtFOSAA | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| d7-Me-FOSE | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| d9-Et-FOSE | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| 13C3-HFPO-DA | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| **Internal Standard (IS)** | | | | | | | | | |
| 13C3-PFBA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13C2-PFHxA | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| 13C4-PFOA | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| 13C5-PFNA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13C2-PFDA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 18O2-PFHxS | 0.946 | 0.946 | 0.946 | 0.946 | 0.946 | 0.946 | 0.946 | 0.946 | 0.946 |
| 13C4-PFOS | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 |

** Both branched and linear isomers are used.*
***Note:*** *Sample extracts are in 95%/5% MeOH/$H_2O$.*
***Note:*** *The above calibration levels are provided only as an example. The actual ICAL level used for each analytical batch will depend upon the LOQ requirements of the program.*

7.6.3. Initial Calibration (ICAL) Levels for the Extended List (ng/mL)

| Compound | CS-1 | CS-2 | CS-3 | CS-4 | CS-5 | CS-6 | CS-7 | CS-8 |
|---|---|---|---|---|---|---|---|---|
| HFPO-TA | 0.049 | 0.024 | 0.123 | 0.491 | 0.981 | 2.453 | 4.907 | 9.814 |
| HFPO-TeA | 0.050 | 0.025 | 0.124 | 0.500 | 0.999 | 2.498 | 5.000 | 9.990 |
| 1-OSA | 0.025 | 0.050 | 0.125 | 0.500 | 1.000 | 2.502 | 5.004 | 10.008 |
| PF6OTeA | 0.025 | 0.050 | 0.125 | 0.500 | 1.000 | 2.500 | 4.999 | 9.998 |
| 10:2 FTS | 0.024 | 0.048 | 0.121 | 0.483 | 0.966 | 2.415 | 4.830 | 9.660 |
| 6:2 diPAP | 0.024 | 0.049 | 0.122 | 0.487 | 0.973 | 2.433 | 4.865 | 9.730 |
| 6:2/8:2 diPAP | 0.024 | 0.049 | 0.122 | 0.488 | 0.976 | 2.440 | 4.880 | 9.760 |
| 8:2 diPAP | 0.024 | 0.049 | 0.122 | 0.489 | 0.978 | 2.446 | 4.891 | 9.782 |
| FBSA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| 10:2 FTCA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| 10:2 FTUCA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| 6:2 FTCA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| 6:2 FTUCA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| FHXSA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| 8:2 FTCA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| 8:2 FTUCA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| PFPrS | 0.023 | 0.046 | 0.115 | 0.46 | 0.92 | 2.3 | 4.6 | 9.2 |
| PFECHS | 0.023 | 0.046 | 0.116 | 0.462 | 0.924 | 2.31 | 4.62 | 9.24 |
| PFTrDS | 0.024 | 0.049 | 0.122 | 0.486 | 0.972 | 2.43 | 4.86 | 9.72 |
| PFUdS | 0.024 | 0.048 | 0.121 | 0.484 | 0.968 | 2.42 | 4.84 | 9.68 |
| PS acid | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| Hydro-PS acid | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| R-PSDA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| Hydro-PSDA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| R-PSDCA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| EVE acid | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| Hydro-EVE acid | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| MTP | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| NVHOS | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| PEPA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| PFPE-1 | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| PFMOAA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| PFO2HxA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| PFO3OA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| PFO4DA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| PFO5DoA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| PMPA | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| R-EVE | 0.025 | 0.05 | 0.125 | 0.5 | 1 | 2.5 | 5 | 10 |
| **Extended IDAs** | | | | | | | | |
| 13C4-6:2 diPAP | 0.973 | 0.973 | 0.973 | 0.973 | 0.973 | 0.973 | 0.973 | 0.973 |
| 13C4-8:2 diPAP | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 | 0.977 |
| 13C-10:2 FTUCA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13C-6:2 FTUCA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13C-8:2 FTUCA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13C-10:2 FTCA | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| 13C-6:2 FTCA | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| 13C-8:2 FTCA | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| 132-10:2 FTS | 2.416 | 2.416 | 2.416 | 2.416 | 2.416 | 2.416 | 2.416 | 2.416 |

** Both branched and linear isomers are used.*
***Note:*** *Sample extracts are in 95%/5% MeOH/$H_2O$.*
***Note:*** *The above calibration levels are provided only as an example. The actual ICAL level used for each analytical batch will depend upon the LOQ requirements of the program.*
***Note:*** *Internal standard calibration levels for extended list analytes are the same as the 1633 standard list analytes.*

7.6.4. Additionally, a standard of the bile acids (TDCA, TUDCA and TCDCA), at 1.0 ug/mL, that also contains the IDA and IS, is to be analyzed after the initial calibration and at the beginning of an analytical sequence after the initial LCS in the analytical sequence, but prior to samples on non-ICAL days.

7.6.5. The bile salt standard is identified as WDM in the TALS/Chrom worklist.

7.6.6. The WDM should be linked to all samples in the WL.

7.7. Initial Calibration Verification Standard (ICV)

7.7.1. The ICV is prepared with individual stock solutions that are purchased from a vendor. When available, individual stock solutions are purchased from a vendor other than Wellington laboratories. If not available, a second laboratory chemist will prepare the intermediate mixed solution for the ICV.

7.7.1.1. ICV MIX: 20 mL of combined stock for the analytes listed below is created, using the recipe below, and methanol as the final solvent. This is stored in a polypropylene bottle at 0-6°C. This is valid for 6 months.

**Table 7.7.1.1**
**ICV-MIX Recipe**

| Analyte | Stock Conc. (µg/mL) | Aliquot (mL) | ICV-MIX Conc. (µg/mL) | Analyte | Stock Conc. (µg/mL) | Aliquot (mL) | ICV-MIX Conc. (µg/mL) |
|---|---|---|---|---|---|---|---|
| 11Cl-PF3OUdS | 47.2 | 0.9 | 2.124 | PFDA | 50 | 0.8 | 2 |
| 9Cl-PF3ONS | 46.7 | 0.9 | 2.1015 | PFDoA | 50 | 0.8 | 2 |
| br-NEtFOSAA | 50 | 0.8 | 2 | PFHpA | 50 | 0.8 | 2 |
| br-NMetFOSAA | 50 | 0.8 | 2 | PFHxA | 50 | 0.8 | 2 |
| br-PFNA | 50 | 0.8 | 2 | br-PFHxS | 45.6 | 0.9 | 2.052 |
| br-PFOA | 50 | 0.8 | 2 | br-PFOS | 46.5 | 0.9 | 2.0925 |
| NaDONA | 47.3 | 0.9 | 2.1285 | PFTeDA | 50 | 0.8 | 2 |
| HFPO-DA | 50 | 0.8 | 2 | PFTrDA | 50 | 0.8 | 2 |
| PFBSA | 44.4 | 0.9 | 1.998 | PFUdA | 50 | 0.8 | 2 |

7.7.2. ICV-IM: 50 mL of a combined stock for the analytes listed below is created, using the recipe below, and methanol as the final solvent:

**Table 7.7.2**
**ICV-IM Recipe**

| Analyte | Stock Conc. (µg/mL) | Aliquot (mL) | ICV-IM Conc. (µg/mL) | Analyte | Stock Conc. (µg/mL) | Aliquot (mL) | ICV-IM Conc. (µg/mL) |
|---|---|---|---|---|---|---|---|
| PFBA | 50 | 0.5 | 0.5 | FOSA | 50 | 0.5 | 0.5 |
| PFPeA | 50 | 0.5 | 0.5 | Et-FOSA | 50 | 0.5 | 0.5 |
| PFPeS | 46.9 | 0.5 | 0.469 | Me-FOSA | 50 | 0.5 | 0.5 |
| PFHpS | 47.6 | 0.5 | 0.476 | Et-FOSE | 50 | 0.5 | 0.5 |
| PFNS | 48 | 0.5 | 0.480 | Me-FOSE | 50 | 0.5 | 0.5 |
| PFDS | 48.2 | 0.5 | 0.482 | 4:2 FTS | 46.7 | 0.5 | 0.467 |
| TFSI | 97.84 | 0.25 | 0.489 | PFHxDA | 50 | 0.5 | 0.5 |
| PFPrA | 50 | 0.5 | 0.500 | PFODA | 50 | 0.5 | 0.5 |
| PFDoS | 48.4 | 0.5 | 0.484 | 6:2 FTS | 47.4 | 0.5 | 0.474 |
| | | | | 8:2 FTS | 47.9 | 0.5 | 0.479 |

7.7.3. ICV-IM2: 50 mL of a combined stock for the analytes listed below is created, using the recipe below, and methanol as the final solvent:

**Table 7.7.3**
**ICV-IM2 Recipe**

| Analyte | Stock Conc. (µg/mL) | Aliquot (mL) | ICV-IM Conc. (µg/mL) | Analyte | Stock Conc. (µg/mL) | Aliquot (mL) | ICV-IM Conc. (µg/mL) |
|---|---|---|---|---|---|---|---|
| 3:3 FTCA | 50 | 0.5 | 0.5 | PFEESA (PES) | 44.5 | 0.5 | 0.445 |
| 5:3 FTCA | 50 | 0.5 | 0.5 | PFMPA | 50 | 0.5 | 0.5 |
| 7:3 FTCA | 50 | 0.5 | 0.5 | PFMBA | 50 | 0.5 | 0.5 |
| | | | | NFDHA | 50 | 0.5 | 0.5 |

7.7.4. Finally, the ICV solution is created, at a nominal concentration of 2.5 ng/mL for target analytes (sulfonic acids slightly less), and the same concentrations as the calibration solutions for IS and IDA, by filling a 200 mL flask with 10 mL of water, then adding methanol. After adding the solutions below, the contents are diluted to the mark with methanol:

**Table 7.7.4**
**1633 ICV Recipe**

| PFAS Standards | Volume (mL) to add in 200 mL FV |
|---|---|
| ICV MIX | 0.25 |
| 1633 ICV_IM | 1 |
| 1633 ICV_IM2 | 1 |
| 1633 EIS Mix | 20 |
| 1633 NIS Mix | 8 |

7.7.5. The screening internal standard is created at a nominal concentration of 1.05 ng/mL by filling a 100 mL flask with 60 mL of methanol. After adding the solution below, the contents are diluted to mark with methanol.

**Table 7.7.5**
**1633 Screening Internal Standard**

| PFAS Standards | Volume (mL) to add in 100 mL FV |
|---|---|
| 1633 EIS Mix | 4.2 |
| 1633 NIS Mix | 4.2 |

7.7.6. 1633 IM/LCS ICV Spike Solution, 15-100 ng/mL

The 1633 IM/LCS ICV spike solution is made in 50 mL of a mixed stock solution in methanol at a nominal concentration listed below. When available, individual stock solutions are purchased from a vendor other than Wellington laboratories. If not available, a second laboratory chemist will prepare the intermediate mixed solution. This mixed stock is used as an intermediate for the Initial Calibration Verification solution, using the recipe below:

**Table 7.7.6.**
**1633 IM/LCS ICV Spike Solution Recipe**
**The solutions below are combined and diluted to 50 mL in methanol**

| Analyte | Stock Conc. (µg/mL) | Aliquot (mL) | 1633 IM/LCS Conc. (µg/mL) | Analyte | Stock Conc. (µg/mL) | Aliquot (mL) | 1633 IM/LCS Conc. (µg/mL) |
|---|---|---|---|---|---|---|---|
| PFBA | 45.34 | 0.04 | 0.036 | 6:2 FTS | 45.18 | 0.04 | 0.036 |
| PFPeA | 45.01 | 0.02 | 0.018 | 8:2 FTS | 46.8 | 0.04 | 0.037 |
| PFHxA | 46.73 | 0.02 | 0.019 | FOSA | 50 | 0.02 | 0.020 |
| PFHpA | 50 | 0.02 | 0.020 | Me-FOSA | 50 | 0.02 | 0.020 |
| PFOA | 50 | 0.02 | 0.020 | Et-FOSA | 50 | 0.02 | 0.020 |
| PFNA | 50 | 0.02 | 0.020 | Me-FOSAA | 50 | 0.02 | 0.020 |
| PFDA | 50 | 0.02 | 0.020 | Et-FOSAA | 50 | 0.02 | 0.020 |
| PFUdA | 46.53 | 0.02 | 0.019 | Me-FOSE | 50 | 0.10 | 0.100 |
| PFDoA | 48.27 | 0.02 | 0.019 | Et-FOSE | 50 | 0.10 | 0.100 |
| PFTrDA | 47.80 | 0.02 | 0.019 | HFPO-DA | 50 | 0.015 | 0.015 |
| PFTeDA | 45.30 | 0.02 | 0.018 | 4,8-dioxa-3H- PFNA (DONA) | 100 | 0.01 | 0.020 |
| PFBS | 44.4 | 0.02 | 0.018 | PFMPA | 50 | 0.02 | 0.020 |
| PFPeS | 46.91 | 0.02 | 0.019 | PFMBA | 50 | 0.02 | 0.020 |
| PFHxS | 45.60 | 0.02 | 0.018 | NFDHA | 50 | 0.02 | 0.020 |
| PFHpS | 45.66 | 0.02 | 0.018 | 9CI-PF3ONS | 88.66 | 0.01 | 0.018 |
| PFOS | 46.50 | 0.02 | 0.019 | 11CI-PF3OUdS | 94.32 | 0.01 | 0.019 |
| PFNS | 48.10 | 0.02 | 0.019 | PFEESA (PES) | 50 | 0.02 | 0.020 |
| PFDS | 48.2 | 0.02 | 0.019 | 3:3 FTCA | 50 | 0.04 | 0.040 |
| PFDoS | 48.5 | 0.02 | 0.019 | 5:3 FTCA | 50 | 0.10 | 0.100 |
| 4:2 FTS | 44.14 | 0.04 | 0.035 | 7:3 FTCA | 100 | 0.05 | 0.100 |
| TFSI | 97.48 | 0.01 | 0.020 | PFHxDA | 50 | 0.02 | 0.020 |
| PFPrA | 50 | 0.10 | 0.100 | PFODA | 50 | 0.02 | 0.020 |

7.7.7. 1633 EXT IM/LCS ICV Spike Solution, 92-110 ng/mL

The 1633 EXT IM/LCS ICV spike solution is made in 10 mL of a mixed stock solution in methanol at a nominal concentration listed below. When available, individual stock solutions are purchased from a vendor other than Wellington laboratories. If not available, a second laboratory chemist will prepare the intermediate mixed solution. This mixed stock is used as an intermediate for the Initial Calibration Verification solution, using the recipe below:

| Table 7.7.7.<br>1633 EXT IM/LCS ICV Spike Solution Recipe<br>The solutions below are combined and diluted to 10 mL in methanol | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Analyte** | **Stock Conc. (µg/mL)** | **Aliquot (mL)** | **1633 IM/LCS Conc. (µg/mL)** | **Analyte** | **Stock Conc. (µg/mL)** | **Aliquot (mL)** | **1633 IM/LCS Conc. (µg/mL)** |
| 10:2 FTS | 45.41 | 0.022 | 0.1 | 8:2 FTUCA | 50 | 0.02 | 0.1 |
| 6:2 diPAP | 48.65 | 0.02 | 0.097 | PFPrS | 46 | 0.02 | 0.092 |
| 62/82 diPAP | 48.8 | 0.02 | 0.098 | PFECHS | 46.2 | 0.02 | 0.092 |
| 8:2 diPAP | 48.91 | 0.02 | 0.098 | PFTrDS | 48.6 | 0.02 | 0.097 |
| FBSA | 50 | 0.02 | 0.1 | PFUdS | 48.4 | 0.02 | 0.097 |
| 10:2 FTCA | 50 | 0.02 | 0.1 | HFPO-TrA | 50 | 0.02 | 0.1 |
| 10:2 FTUCA | 50 | 0.02 | 0.1 | HFPO-TeA | 50 | 0.02 | 0.1 |
| 6:2 FTCA | 50 | 0.02 | 0.1 | 1-OSA | 50 | 0.02 | 0.1 |
| 6:2 FTUCA | 50 | 0.02 | 0.1 | 10:2 diPAP | 50 | 0.02 | 0.1 |
| FHxSA | 50 | 0.02 | 0.1 | PF6OTeA | 50 | 0.02 | 0.1 |
| 8:2 FTCA | 50 | 0.02 | 0.1 | | | | |

7.7.8. 1633 EXT IM/PRC ICV Spike Solution, 2500 mg/mL (2.5 ppm)
The 1633 EXT IM/PRC ICV spike is made by diluting 0.25 mL of 50 ug/mL M2PFOA(PRC) in 4.75 mL of methanol for a final volume of 5 mL.

7.7.9. Initial Calibration Verification Standard (ICV) for the Extended List
The Initial Calibration Verification solution is prepared from the solutions described in Sections 7.3.2, 7.4.1, 7.5, 7.7.6, 7.7.7, 7.7.8 above. A 200 mL volumetric flask is filled with 10 mL of water and methanol is added. The appropriate amount (see table below) of the solutions are added, then the flask is filled to the mark with methanol to achieve the ratio of 95% methanol to 5% water, v/v.

| Table 7.7.9.<br>1633 Extended List ICV Recipe | |
|---|---|
| **PFAS Standards** | **Volume (mL) to add in 200 mL FV** |
| 1633 IM/LCS ICV Spike Solution (0.02 µg/mL) | 25 |
| 1633 EXT IM/LCS ICV Spike Solution (0.1 µg/mL) | 5 |
| 1633 EXT IM/Table 3 LCS Spike Solution (0.1 µg/mL) | 5 |
| 1633 EXT IM/PRC Spike (25 µg/mL) | 0.2 |
| 1633 EXT IDA Solution (0.01-0.025 µg/mL) | 20 |
| 1633 IS Solution (0.025 0.0625 µg/mL) | 8 |

## 8) Sample Collection, Preservation, Shipment and Storage

Laboratory default requirements for sample containers, sample size, preservation and holding time are detailed in the table below.

| Table 8<br>Sample Collection, Preservation, and Storage Requirements | | | | |
|---|---|---|---|---|
| **Matrix** | **Sample Container** | **Minimum Sample Size** | **Preservation** | **Holding Time[1]** |
| Water | 125 mL HDPE Bottle | 125 mL | 0-6°C | 28 days if 0-6°C or 90 days if stored at ≤ -20°C[2] |
| Soil/Sediment | 4 oz. HDPE wide-mouth container | 100 g | 0-6°C | 90 days[3] |
| Tissue[4] | 4 oz. HDPE wide-mouth container | 50 g | ≤ -20 °C | 90 days[3] |

*[1] Extraction holding time is calculated from date of collection. Analytical holding time is determined from date of extraction.*

*[2] By default, aqueous samples for Method 1633 are stored at 0-6°C and held for up to 28 days prior to extraction. Potential issues can be observed in aqueous samples with NMeFOSE, NEtFOSE, NMeFOSAA, and NEtFOSAA, after 7 days of storage at 0-6°C. These issues are more likely to elevate the observed concentrations of other PFAS compounds via the transformation of these precursors if they are present in the sample. Clients must inform the laboratory if these analytes are compounds of concern for the site. Aqueous samples are to be protected from light and at <6 °C until shipped to the laboratory. When shipped sufficient ice must be used to maintain sample temperature at <6 °C for up to 48 hours to allow for shipping delays.*

*[3] By default, solid and tissue samples for Method 1633 are stored at 0-6°C or frozen, respectively, and held for up to 90 days prior to extraction. Potential issues can be observed in samples with NFDHA after 3 days of collection. Clients must inform the laboratory if this analyte is a compound of concern for the site. Soilid samples are to be protected from light and at <6 °C until shipped to the laboratory. When shipped sufficient ice must be used to maintain sample temperature at <6 °C for up to 48 hours to allow for shipping delays.*

*[4] Whole fish samples can be shipped at <6 °C from the time of collection to maximum of 24 hours. Once received, sample receiving must verify that the sample is <6 °C. For longer shipments, the samples must be frozen before shipment. Once received, the laboratory must store the sample at or below -20 °C. The 90 day tissue holding time starts when any processing is done by the laboratory (filleting, homogenization, etc.).*

8.1. Extracts are stored at 0-6°C and must be analyzed within 90 days of extraction.

8.1.1. If 11Cl-PF3OUdS and/or 9Cl-PF3ONS are analytes of interest, the holding time is reduced to 28 days. Clients must inform the laboratory if these analytes are analytes of interest (i.e. a compound of concern for the site).

8.2. Unless otherwise specified by client or regulatory program, after analysis, samples and extracts are retained for a minimum of 30 days after provision of the project report and then disposed of in accordance with applicable regulations.

8.3. Aqueous Samples

8.3.1. Procedures used to collect samples from still waters in particular must consider that enrichment. For example, if the purpose of the sampling is to characterize the PFAS content of the waterbody, samples should be collected from below the surface to avoid the enrichment in the surface layer. Conversely, if the purpose is to make a worse case assessment of the transfer of PFAS from the waterbody to the atmosphere or biota in contact with the surface layer, the sampling procedures should include the surface layer. The specific procedures used should be documented.

8.4. Compositing Samples

8.4.1. If composite sampling is requested, a manual composite sample can be created by collecting multiple small-volume samples in appropriately sized HDPE containers, manually combining them in a 125-mL HDPE container in the laboratory, rinsing each of the original containers with the basic methanol, using the rinsates to rinse the 125-mL containers, and then adding the combined rinsate to the SPE cartridge.

8.5. Biphasic samples

8.5.1. Samples denoted as aqueous (groundwaters, surface waters, and wastewaters) with less than 50 mg of solids content are prepared and handled as a liquid sample (Section 11.2). Compare the sample to a reference container with 50 mg solid content. Note in the benchsheet whether the sample passed the visual TSS evaluation or not. If the sample contains more than 50 mg solids, determine the total suspended solids (TSS) in the sample to then assess an appropriate dilution. ***(NOTE: Dilution due to TSS is not an option for DoD/DOE related samples unless prior client authorization has been provided.)*** If required contractually, contact the client for authorization to extract the sample at a smaller aliquot or as a solid. Detailed descriptions of any deviations from the procedure must be documented in the LIMS NCM program.
TSS Procedure (be certain to use the 125 mL container)

8.5.1.1. Use a pre-weighed filter (ProWeigh filter).

8.5.1.2. Label each dish with a sample identifier.

8.5.1.3. Scan each dish into the "Dish Value" field of the TALS batch.

8.5.1.4. Copy the documented weight into the TALS batch as the tare weight.

8.5.1.5. Assemble the needed filtering apparatus.

8.5.1.6. Insert the reweighed filter into the apparatus.

8.5.1.7. Condition the filter with 10 mL of reagent water.

8.5.1.8. Filter 10.0 ± 0.02 mL of well mixed sample through the filter.

8.5.1.9. Dry the filter for ~10 seconds by drawing vacuum through that single port.

8.5.1.10. Use tweezers to carefully transfer the filter from the filtering apparatus to its reweighed dish.

8.5.1.11. Dry the filter for a minimum of 1 hour at 104 ± 1°C.

8.5.1.12. Transfer the filter to a desiccator for 1 hour or until cool.

8.5.1.13. Weigh the filter and residue using the analytical balance in Gen Chem.

8.5.1.14. Enter this value into the TALS batch as the "WT1" value.

8.5.1.15. Make sure the following values are entered correctly into the TALS batch.

- Initial Amount = 10 mL
- Final Amount = 10 mL
- Nominal Amount Used = 10 mL (on batch information page)

8.5.1.16. TALS will calculate the TSS as follows:

**Equation 1**

$$TSS\ (\frac{mg}{L}) = \frac{Weight\ after\ drying\ (WT1)(mg) - Tare\ Weight\ (mg)}{0.01\ L}$$

8.5.1.17. If the TSS >400 mg/L (50 mg/125 mL), then extract the sample at a reduced volume.

8.5.1.18. An appropriate dilution will target a TSS of <400 mg/L, i.e. if TSS = 800 mg/L then prep at 2X, if TSS = 3690 mg/L then prep at 10X, etc.

8.5.1.18.1. Factors of 2, 5 and 10 should be used when determining the appropriate dilution.

8.5.2. Samples considered solids (biosolids, sediments, and soils) are prepared and handled as solid samples following appropriate homogenization as per Section 11.5. Correction for moisture content prior to extraction is required, unless noted otherwise per client requirements. Use the percent moisture results in the LIMS to determine the appropriate amount to extract.

8.5.2.1. Use the "1633 Soil Sample Size Calculator" template found on the public drive\QA\Operations Spreadsheets.

8.5.2.2. Refer to the "Revision History & Information" tab for instructions.

8.5.3. In the event that results are required individually for the solid and aqueous phases of a sample, the phases are separated via centrifugation, and extracted separately using the appropriate preparation (Section 11.2 for the aqueous phase and Section 11.5 for the solid phase). The extracts are analyzed, and results reported for each phase separately.

## 9) Quality Control

9.1. Initial Demonstration of Capability (IDOC)
The initial demonstration and method detection limit (MDL) studies described in Section 13 must be acceptable before analysis of samples may begin.

9.2. Batches are defined at the sample preparation step. Batches should be kept together through the whole analytical process as far as possible, but it is not mandatory to analyze prepared extracts on the same instrument or in the same sequence. Refer to the QC program document (*SAC-QA-P-QP71748*) for further details of the batch definition.

9.2.1. The quality control batch is a set of up to 20 samples of the same matrix processed using the same procedure and reagents within the same time period. The quality control batch must contain a low-level laboratory control sample (LLCS), a laboratory control sample (LCS), and a method blank. Laboratory generated QC samples (Blank, LLCS, LCS) do not count toward the maximum 20 samples in a batch. Field QC samples are included in the batch count. In some cases, at client request, a matrix spike/matrix spike duplicate (MS/MSD) or a sample duplicate (DU) may be included in the batch. In the event that multiple MS/MSDs or DUs are run with a batch due to client requirements, the additional MS/MSDs do not count toward the maximum 20 samples in a batch.

9.3. One method blank (MB, laboratory reagent blank) must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. For aqueous samples, the method blank is an aliquot of laboratory reagent water. For solid samples, the method blank is an aliquot of Ottawa sand wetted with reagent water. For tissue samples, the method blank is an aliquot of store purchased vegetable oil. The method blank is processed in the same manner and at the same time as the associated samples. Corrective actions must be documented on a Non-Conformance memo, and then implemented when target analytes are detected in the method blank above the reporting limit or when IDA recoveries are outside of the control limits. Re-extraction of the blank, other batch QC and the affected samples are required when the method blank is deemed unacceptable. See policy *SAC-QA-P-QP71748* for specific acceptance criteria.

9.3.1. If the MB produces a peak within the retention time window of any of the analytes, determine the source of the contamination and eliminate the interference before processing samples.

9.3.2. The method blank must not contain any analyte at or above the reporting limit, greater than 1/3 the regulatory compliance limit or at or above 10% of the measured concentration of that analyte in the associated samples, whichever is higher.

9.3.2.1. DoD/DOE QSM: in addition to the above criteria, the method blank must not contain any analyte at or above ½ the reporting limit or LOQ.

9.3.3. If there is no target analyte greater than the RL in the samples associated with an unacceptable method blank, the data may be reported with qualifiers. Such action should be taken in consultation with the client.

9.3.4. Re-extraction and reanalysis of samples associated with an unacceptable method blank is required when reportable concentrations are determined in the samples.

9.3.5. Refer to *SAC-QA-P-QP71748* for further details of the corrective actions.

9.3.6. The position of the method blank in the SPE manifold during automated SPE extraction is rotated across batches.

9.4. A laboratory control sample (LCS), defined as OPR (on-going precision and recovery) in Method 1633, must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. The LCS is an aliquot of laboratory matrix (e.g.reagent water for aqueous samples and Ottawa sand for solids) fortified with analytes of known identity and concentration. The LCS must be processed in the same manner and at the same time as the associated samples. Corrective actions must be documented on a Non-Conformance memo, then implemented when recoveries of any fortified analyte is outside of the control limits. Re-extraction of the blank, other batch QC, and all associated samples are required if the LCS is deemed unacceptable. See *SAC-QA-P-QP71748* for specific acceptance criteria.

9.4.1. The control limits for the LCS are stored in TALS and are the limits listed in the reference method. If the LCS is outside of control limits perform the following:

9.4.1.1. Re-analyze LCS extract. If acceptable, report.

9.4.1.2. If LCS has high bias and samples are ND, report and narrate.

9.4.1.3. If the LCS has a low bias, or if there are detections for critical chemicals of concern, evaluate and re-extract the LCS and all associated samples, if sufficient sample material is available.

9.4.2. For DoD/DOE QSM, the lower recovery limits based on historical values must be greater than or equal to 40%, unless the method specifies different.

9.5. Low-level LCS (LLCS), defined as LLOPR (low-level on-going precision and recovery) in Method 1633, must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. The LLCS is an aliquot of laboratory matrix (e.g. reagent water for aqueous samples and Ottawa sand for solids) fortified with analytes of known identity and at a concentration of twice the RL. The LLCS must be processed in the same manner and at the same time as the associated samples. Corrective actions must be documented on a Non-Conformance memo, then implemented when recoveries of any

fortified analyte is outside of the control limits. Re-extraction of the blank, other batch QC, and all associated samples are required if the LLCS is deemed unacceptable. See *SAC-QA-P-QP71748* for specific acceptance criteria.

9.5.1. The control limits for the LLCS are stored in TALS and are the limits listed in the reference method. If the LLCS is outside of control limits perform the following:

9.5.1.1. Re-analyze LLCS extract. If acceptable, report.

9.5.1.2. If LLCS has high bias and samples are ND, report and narrate.

9.5.1.3. If the LLCS has a low bias, or if there are detections for critical chemicals of concern, evaluate and re-extract the LCS and all associated samples, if sufficient sample material is available.

9.5.2. For DoD/DOE QSM, the lower recovery limits based on historical values must be greater than or equal to 40%, unless the method specifies different. The LCS/LLCS must be in control for DoD/DOE QSM batches, but a high bias and ND sample can be reported and narrated as this is specified in the reference method.

9.6. A laboratory duplicate (DU) is not required for this method but can be processed per client request. A DU is a second aliquot of a selected field sample that must be processed in the same manner and at the same time as the associated samples. Any RPD failures must be documented on a nonconformance memo. RPD limits are stored in TALS.

9.7. Matrix spikes are not required for this method because any deleterious effect of the matrix is evident in the recoveries of the IDA. A matrix spike/matrix spike duplicate (MS/MSD or MS/SD) can be processed per client request. An MS/MSD pair is aliquots of a selected field sample spiked with analytes of known identity and concentration. The MS/MSD pair must be processed in the same manner and at the same time as the associated samples. Fortified analytes with recoveries or precision outside of the control limits must be within the control limits in the LCS. Corrective actions must be documented on a nonconformance memo, and then implemented when recoveries of any fortified analyte are outside of the control limits provided by TALS or by the client. Recovery limits for MS/MSD are the same as those used for the LCS.

9.8. A laboratory control sample duplicate (LCSD) is required when insufficient sample volume is provided to process either a DU and/or MS/SD pair, or is requested by the client. The LCSD is evaluated in the same manner as the LCS. See *SAC-QA-P-QP71748* for specific acceptance criteria.

9.9. Instrument blanks (RB or CCB) are required at the beginning of an analytical sequence, after high-level samples (>UCL) and every CCV. The blank should contain IDA and IS to quantitate results. The blank should not contain any analyte > MDL. See *SAC-QA-P-QP71748* for specific acceptance criteria.

9.10. Initial calibration verification (ICV) –A second source standard is analyzed with the initial calibration curve. The concentration should be at the mid-range of the curve.
Corrective actions for the ICV include:
- Rerun the ICV.
- Remake or acquire a new ICV.
- Evaluate the instrument conditions.
- Evaluate the initial calibration standards.
- Rerun the initial calibration.

9.11. Isotope Dilution Analytes

9.11.1. The IDA solution is added to each field and QC sample at the time of extraction, as described in Section 11. As described in Section 7, this solution consists of isotopically labeled analogs of the analytes of interest.

9.11.2. IDA recoveries are flagged if they are outside of the acceptance limits stored in TALS. If IDA recoveries are outside of these limits, please check the following:

9.11.2.1. Check for errors and correct. Re-analyze the extract if needed.

9.11.2.2. IF IDA out high: ND samples, report and narrate.

9.11.2.3. If detections but IDA <200% (<350% for FTSs), report and narrate.

9.11.2.4. If detections and IDA >200% (>350% for FTSs), dilute 10X, re-analyze, report and narrate.

9.11.2.5. If IDA low, but >5% and S/N >10:1, narrate and report.

9.11.2.6. If IDA <5%, then contact client to re-extract at smaller aliquot.

9.11.3. For DoD/DOE QSM, limits based on historical recoveries (method defined) are required. (i.e. Sections 9.11.2.3 - 9.11.2.6 do not apply) If the IDA is not listed in the reference method, the lower recovery limit must be greater than or equal to 20%. If IDA recoveries are outside of these limits, additional clean-up is needed. If the recoveries cannot be met after clean-up then re-extract a smaller aliquot.

9.11.3.1. If the IDA recovery is just outside of the control limits, re-analyze the extract at 1X prior to re-extraction. If in control, report the data.

9.12. Ion Ratio

9.12.1. Compare the quantifier/qualifier SRM transition ratio in the sample to the SRM transition ratio in the standard.

$$Ion\ Ratio = \frac{Area\ Quantitation\ Ion\ (1^{\circ}\ Transition)}{Area\ Qualitative\ Ion\ (2^{\circ}\ Transition)}$$

**Equation 2**

9.12.2. The quantifier/qualifier SRM ion ratio should be within ±50% of the quantifier/qualifier SRM ion ratios calculated from the mid-level ICAL point.

9.12.2.1. Ion ratios must be in control in calibration solutions. If they are outside of limits, stop the analysis and correct the issues.

9.12.2.2. If data is reported to the MDL, the ratio should also be within ±50% of the quantifier/qualifier SRM ion ratios calculated from the initial daily CCV.

9.12.2.3. Please note that two transitions are monitored for PFPeA, but no corrective action is required if the ratio is outside of the limits due to the extremely poor response for the qualifier transition.

9.12.2.4. If the ion ratio is outside of the control limits review the following: Check for error, if none found report as outlined below.

9.12.2.5. If outside limits and value <RL report as ND at RL.

9.12.2.6. If outside limits but within 2X rule, report and narrate.

9.12.2.7. If ratio outside 2X rule then report as ND at elevated RL, apply G flag and narrate.

9.12.2.8. If the ratio is out due to branched isomer contribution, report as positive and narrate.

9.12.2.9. If outside limits and RT window due to matrix report as ND at elevated RL, apply G flag and narrate.

9.12.2.10. 2X Rule: If the ion ratio <0.5X the lower control limit or > 2X the upper control limit, then do not report the analyte. It should be either ND at the RL or elevate the RL as needed (G flag). As an example if the target ion ratio is 4.00. The Chrom determined limits are 2.00-6.00. If the ratio is < 1.00 (2.00 X 0.5) or > 12.00 (6.00 X 2) follow the specifications above.

9.12.3. For DoD/DOE QSM, if the ion ratio does not meet criteria after corrective actions, (extract clean-up, sample dilution, etc.), then data should be qualified "I" if the ratio is not met.

9.12.3.1. The 2X rule does NOT apply to DoD/DOE QSM samples.

9.13. Internal Standards

Internal standards (IS) are added into every field sample, QC sample, standard, and instrument blank. They are used for quantitation of the IDA.

9.13.1. The area of the IS in field and QC samples should be within 50-200% of the mean area corresponding IS in the most recent initial calibration, i.e. use CCVISAV.

9.13.2. If IS fails, re-analyze fresh aliquot of extract. If in control, report. If the failure confirms examine project specific requirements. Contact client as to additional measures to take.

9.14. Instrument Sensitivity Check (ISC)

9.14.1. The ISC, defined within TALS as CCVL, is to be analyzed at the beginning of the analytical sequence (see frequency for DoD as specified in Section 11.10.2) and is to meet all CCV criteria.

9.15. Bile Salts Standard

9.15.1. The bile salt standard, defined within TALS as WDM, is to be analyzed after the initial calibration and at the beginning of an analytical sequence after the initial LCS in the analytical sequence, but prior to samples on non-ICAL days (See frequency for DoD as specified in Section 11.10.2) and should have a 60 second separation from the earliest eluting branched PFOS isomers.

## 10) Calibration

10.1. For details of the calculations used to generate the regression equations, and how to use the factors generated by these equations, refer to SOP *NDSC-QA-QP44940* "Calibration Curves and Selection of Calibration Points".

10.2. Routine instrument operating conditions are listed in the table in Section 11.9.

10.3. Instrument Tuning & Mass Calibration

10.3.1. Mass Calibration is performed by instrument manufacturer service representatives in accordance with the manufacturer's procedures during installation, and annually thereafter. In addition, the mass calibration must be verified with respect to the ion masses.

10.3.2. Instrument tuning is done initially when the method is first developed and thereafter as needed during troubleshooting. Tuning is done by infusing each individual compound (native and/or IDA) into the mobile phase using a tee fitting at a point just before the entrance to the electrospray probe. The responses for the parent and daughter ions for each compound are observed and optimized for sensitivity and resolution. Mass assignments are reviewed and updated as needed. The mass assignments must be within ± 0.5 amu of the values shown in the table in Section 11.9.

10.3.3. Once the optimal mass assignments (within ±0.5 amu of true) are made immediately following the initial tune, the lowest level standard from the initial calibration curve is assessed to ensure that a signal to noise ratio greater than 10 to 1 (S/N > 10:1) is achieved for each PFAS analyte. The first level standard from the initial calibration curve is used to evaluate the tune stability on an ongoing basis. The instrument mass windows are set initially at ± 0.5 amu of the true value;

therefore, continued detection of the analyte transition with S/N > 10:1 serves as verification that the assigned mass remains within ± 0.5 amu of the true value, which meets the tune criterion.

10.4. A new calibration curve must be generated after major changes to the system or when the continuing calibration criteria cannot be met. Major changes include, but are not limited to, new columns or pump seals. A new calibration is not required after minor maintenance.

10.5. With the exception of the circumstances delineated in SOP *NDSC-QA-QP44940*, it is not acceptable to remove points from a calibration curve. In any event, at least six points must be included in the calibration curve. Average Response Factor and linear fit calibrations require six points.

10.6. A fixed injection volume is used for quantitation purposes and is to be the same for both the sample and standards.

10.7. All units used in the calculations must be consistently uniform, such as concentration in ng/mL.

10.8. Initial Calibration
Refer to Section 12.4.5 for details relating to setting retention times and evaluating retention times.

10.8.1. A number of analytical standards of different analyte concentrations are used to generate the curve. Each standard is injected once to obtain the peak response for each analyte at each concentration. These standards define the working range of the analysis.

10.8.1.1. A minimum of six analytical standards is used when using average response factor and/or linear calibration fits, five of which must be ≥ RL.

10.8.2. Calibration is by average response factor or linear fit.

10.8.2.1. For average response factor (RFa), the relative standard deviation (RSD) for all compounds must be ≤ 20% for the curve to be valid.

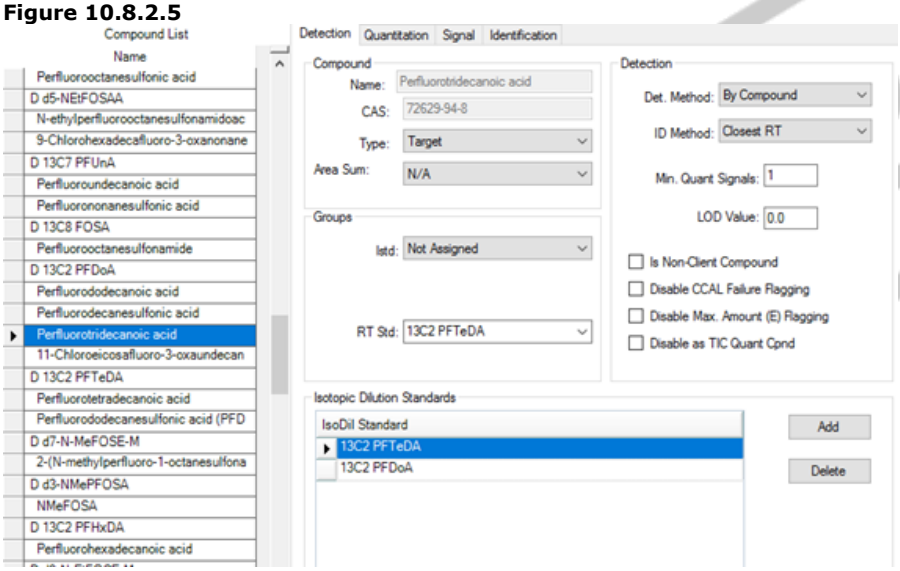
10.8.2.2. Alternatively, for average response factor (RFa), the relative standard error (RSE) for all compounds must be ≤ 20% for the curve to be valid.

10.8.2.3. For linear fits, the intercept of the line must be less than ½ the reporting limit, and the relative standard error (RSE) must be ≤ 20%.

10.8.2.4. While not a requirement, analyte read back should be 70-130% of the true value. The correlation coefficient, r, and the coefficient of determination, r^2, are no longer considered appropriate metrics for linearity and shall not be used in conjunction with this method.

10.8.2.5. Please note for this method PFTrDA is quantitated against the average areas of the IDA 13C2-PFTeDA and 13C2-PFDoA. In order to set this quantitation up correctly in Chrom, be certain to update the analyte PFTrDA per the example below (Figure 10.8.2.5).

**Figure 10.8.2.5**




10.8.2.6. For those native analytes that have an identically labeled variant (IDA) the RRF for that analyte should be close to 1.0 (0.90-1.10).
10.8.2.6.1. If not, then evaluate the historical RRF for that analyte on the particular instrument in question.
10.8.2.6.2. If the RRF is not consistent with historical values (within 10%), either re-tune and re-analyze ICAL or analyze a known sample (SRM/PT) to demonstrate acceptable analyte quantitation.

10.9. Calibration Curve Fits

10.9.1. Linear regression or quadratic curves may be used to fit the data to a calibration function. Detailed descriptions and formulas for each fitting type can be found in SOP *NDSC-QA-QP44940*, "Calibration Curves and Selection of Calibration Points".

10.9.2. The Chrom data system is programmed to complement the calibration evaluation guidelines in policy *NDSC-QA-QP44940* by evaluating calibration curve fits in the order listed below. An optimal fit is recommended to the analyst, who may override based on evaluation of the residuals for each calibration level, as per SOP *NDSC-QA-QP44940*.
Average Response Factor
Linear, 1/concentration$^2$ weighting
Linear, 1/concentration weighting

10.9.3. The linear curve uses the following function:

**Equation 3**

$$y = bx + c$$

Where:

$$\frac{Area\ (Analyte)}{Area\ (IDA)} \times Concentration(IDA)$$

y = 
x = concentration
b = slope
c = intercept

10.9.4. Evaluation of Calibration Curves
The following requirements must be met for any calibration to be used:
The signal to noise ratio for each analyte with primary and confirmation masses must be greater than or equal to 3:1 and for those analytes with a single mass the signal to noise ratio must be greater than or equal to 10:1 in the lowest calibration standard.
Response must increase with increasing concentration.
The absolute value of the intercept of a regression line (linear or non-linear) at zero response must be less than the reporting limit.
There should be no carryover at or above 1/2 MRL after a high CAL standard.
If these criteria are not met, instrument conditions and standards will be checked, and the ICAL successfully repeated before continuing.

10.9.5. Weighting of Calibration Points
In linear and quadratic calibration fits, the points at the lower end of the calibration curve have less absolute variance than points at the high concentration end of the curve. This can cause severe errors in quantitation at the low end of the calibration. Because accuracy at the low end of the curve is very important for this analysis, it is preferable to increase the weighting of the lower concentration points. 1/concentration or 1/x weighting is encouraged. Visual inspection of the line fitted to the data is important in selecting the best fit.

10.9.6. Bile Salts Interference Check (Identified as WDM within TALS)
The laboratory must analyze a bile salts standard (TDCA, TCDCA and TUDCA, plus IDA and IS) after the initial calibration and prior to the analysis of samples (at the beginning of the analytical sequence, after the LCS), to check for interferences caused by bile salts. The laboratory must establish chromatographic conditions to ensure the bile salt (TDCA) does not cause interference during the analysis of samples. To demonstrate successful separation the retention time of TDCA must be at least 1 minute outside the retention time window of the PFOS isomers. This is demonstrated as a comparison of the RT of TDCA (measured at the apex of the TCDA peak) separated by at least 1.4 minutes from the RT of the linear isomer of PFOS (measured at the apex of the peak of the linear isomer of PFOS). If adequate separation is not achieved, adjust the chromatographic conditions and reevaluate the separation of TDCA from PFOS.

10.10. Initial Calibration Blank (ICB)

10.10.1. Immediately following the ICAL, a calibration blank is analyzed that consists of an injection of final extract solvent containing both IDA and IS.

10.10.2. The result for the calibration blank must be less than the MDL.

10.10.3. If the ICB is greater than the MDL then the source of contamination must be identified and any necessary cleaning completed, and then the instrument should be recalibrated.

10.11. Initial Calibration Verification (ICV)

10.11.1. Following the ICAL and the ICB, an ICV standard obtained from a different source or vendor than the ICAL standards is analyzed. This ICV standard is a mid-range standard.

10.11.2. The recovery for the ICV must be equal to or within 70-130% for all natives and IDA.

10.11.3. See Section 9.10 for corrective actions in the event that the ICV does not meet the criteria above.

10.12. Continuing Calibration Verification (CCV)
Analyze a CCV at the beginning of a run, the end of a run, and after every 10 samples to determine if the calibration is still valid. The exception is after an acceptable curve and ICV are run 10 samples can be analyzed before a CCV is required. The CCVs are at the mid-level range of the curve. The curve and ICV do not need to be run every day. To start an analytical sequence on days when an ICAL is not performed, a CCVL (low standard at the RL) is analyzed at the beginning of the analytical sequenced and if it meets acceptance criteria, the analytical sequence can be started.

10.12.1. The recovery for the CCV standards must be equal to or within 70-130% for all natives and IDA.

10.12.1.1. If the analyte in a CCV fails due to high recovery for the target or the IDA, but that analyte is not detected in the sample extract, then the sample extract need not be re-analyzed, i.e. high and ND. Report the data with narration.

10.12.2. If this is not achieved, the instrument has drifted outside the calibration limits. The instrument must be recalibrated.

## 11) Procedure

11.1. One-time procedural variations are allowed only if deemed necessary in the professional judgment of a supervisor to accommodate variation in sample matrix, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using a non-conformance memo (NCM). The NCM process is described in more detail in SOP *QA-SOP70881*. The NCM shall be filed in the project file and addressed in the case narrative.
Any deviations from this procedure identified after the work has been completed must be documented in an NCM, with a cause and corrective action described.
Differences for samples analyzed in accordance with the DoD/DOE QSM version 6.0 or higher are called out as needed in the procedures below.

11.2. **Water Sample Preparation**
**NOTE: Any dilution or sub-sampling of the sample MUST be approved by the client, unless noted otherwise in the project/login notes.**

11.2.1. Visually inspect samples for the presence of settled and/or suspended sediment/particulates. Samples > 50 mg solids should be mitigated. See Section starting at 8.5.1.1 for TSS procedure. Compare sample to comparison/reference bottle. If the sample should be processed as a solid or biphasic or reduced volume, contact the client for guidance prior to such action, if contractually required. Invert samples to homogenize prior to adding any spiking solutions.

11.2.1.1. If the TSS > 400 mg/L, centrifugation can be used to mitigate the sample in lieu of/or in conjunction with dilution.

11.2.1.1.1. If the sample fails TSS see Section 11.2.13 for details

11.2.1.1.2. If the TSS > 400 mg/L, but < 2000 mg/L, a 5X prep dilution may be performed with client approval. Check project notes and documents.

11.2.2. Unknown samples may be screened prior to extraction using the following:

11.2.2.1. Pipet 100 uL of sample into a 300uL vial.

11.2.2.2. Add 100 uL of the screen internal standard into the vial.

11.2.2.3. Vortex.

11.2.2.4. Submit for analysis.

11.2.2.5. The screening analysis is to follow the same analytical specifications as the definitive analysis, i.e. ICAL, CCV and all analytes.

11.2.2.6. Evaluate the screening results to determine the appropriate volume to extract:

- If < 1 ng/mL (on-column) = 1X (125 mL)
- If > 1 ng/mL but < 5 ng/mL = 10 X (12.5 mL)
- If > 5 ng/mL but < 50 ng/mL = 100X (1.25 mL)
- If > 50 ng/mL but < 500 ng/mL = 1000X (0.125 mL)
- If > 500 ng/mL but < 5000 ng/mL = 10,000X (0.0125 mL)

11.2.3. Weigh the sample container prior to extraction and then weigh the sample container after extraction to determine the initial volume. Unless otherwise directed by client, use the entire sample volume, and spike directly into the sample container.

11.2.3.1. If the sample is identified as a landfill leachate, prep at 25 mL. The sample should be collected in an appropriately sized container, i.e., 25 mL. If a 25 mL volume container is not used, document as such and that a 25 mL aliquot was used for the analysis.

11.2.4. Prepare additional aliquots of a field sample for the DU and/or MS/MSD, if requested.

11.2.5. Prepare 125 mL aliquots of reagent water to be used as the method blank, LLCS, and LCS (and LCSD if required). Ensure all containers are clean, properly labeled, and meet quality assurance requirements prior to use. Not all 125 mL containers will fit the automated SPE units (Promochrom). Check containers prior to extraction to determine if they are compatible for automation. If not, the extract the sample manually.

11.2.5.1. Some samples may be submitted in 250 mL or 500 mL containers. If so then these distinct containers are to be processed in extraction batches by themselves and the associated laboratory QC samples are to mimic that sample size, i.e. 250 mL containers are in their own batch and QC samples are 250 mL. 500 mL containers are in their own batch and QC samples are 500 mL.

11.2.5.1.1. 250 mL and 500 mL containers are not compatible with the automated SPE units and will require manual extraction.

11.2.5.2. All fortification levels indicated below are used for the 250 mL and 500 mL sample sizes. There is no need to adjust those levels.

11.2.5.3. Ensure that samples of 250 mL or 500 mL are associated to the correct TALS prep code: i.e. 1633_SPE_250, 1633A_SPE_250, 1633_SPE_500 or 1633A_SPE_500 as appropriate. Contact the project manager to update the login appropriately.

11.2.6. Check that the pH is 6.5 ± 0.5 using narrow range pH paper (Section 6.13). If necessary, adjust pH with acetic acid and/or NaOH.

11.2.7. Vortex the LCS/Matrix PFC Spike and IDA PFC solutions prior to use, after letting the standards come up to room temperature for at least 30 minutes.

11.2.8. Add 0.500 mL of the EIS solution (Section 7.4) into each sample and QC sample, for a fixed concentration of 1-2.5 ng/mL in the final sample vial.

11.2.8.1. If extended list analytes are requested, fortify with 0.200 mL of the extended list EIS solution.

11.2.9. Fortify the LCS/LCSD and MS/MSD (if requested) with 0.250 mL of the LCS/Matrix PFC Spike solution (Section 7.3), for a fixed concentration of 1-5 ng/mL in the final sample vial.

11.2.9.1. If extended list analytes are requested, fortify with 0.250 mL of 1633 extended list spikes 1 and 2 (F1633_SP and EXT1633_SP2).

11.2.10. Fortify the LLCS with the 25 uL of the LCS/Matrix PFS Spike solution (Section 7.3), for a fixed concentration of 0.1-0.5 ng/mL in the final sample vial.

11.2.10.1. If extended list analytes are requested, fortify with 25 uL of 1633 extended list spikes 1 and 2 (F1633_SP and EXT1633_SP2).

11.2.11. Swirl or vortex all samples after adding spike solutions.

11.2.12. Allow samples to equilibrate for ~30 minutes before proceeding.

11.2.13. If a sample fails TSS perform the following steps:
TSS above 400 mg/L will likely require sample manipulation to effectively mitigate impacts on the solid phase extraction process and there may be impacts on data quality objectives. Every effort should be made in the field to properly collect samples with less than 50 mg of suspended solids. If sample dilution is required, this will result in elevated final reporting limits. In most cases a dilution factor less than 5X is sufficient which would result in RLs being elevated by up to 5X. Eurofins analyst will conduct a visual inspection of the sample and use professional judgement to determine the necessary dilution. If sample dilution is not acceptable for the project DQOs or significantly high TSS is anticipated e.g. >2,000 mg/L in a 125mL sample, the laboratory will centrifuge the sample according to the following procedure. This approach must be agreed to as part of the project DQOs up front and the analyst will proceed accordingly without further client consultation. Centrifugation can only be performed if the solids have high enough density to form a pellet or mass at the bottom of the bottle. Please note, not all samples will form such a mass, and the solids will not be extracted as a separate sample. With the use of isotope dilution, once labeled surrogates (EIS) are added to the sample, they distribute between all phases of the sample system (solid fraction, aqueous fraction, air/water interface, and water/container interface). These surrogates (EIS) are then used for recovery correction and the total PFAS concentration can be accurately reported for the whole sample, provided surrogate (EIS) recoveries are acceptable. A potential outcome of this approach is poor recoveries of the labeled surrogates (EIS) that will preferentially sorb to the particulates leading to qualified QC in the final results. This is the primary reason the 1633 method was written to include sample dilution as a mitigation option which would not lead to qualified QC results.

**Note: If the TSS>10% then process the sample as a solid.**

11.2.13.1. Fortify sample with EIS solution per Section 11.2.8, and follow Sections 11.2.11 and 11.2.13.1.1. If needed, transfer the sample to centrifuge tubes, retaining the original sample container. If the client container will fit into the centrifuge do not transfer sample contents, i.e. spin in the original container.

11.2.13.2. Centrifuge the sample at ~3500 RPM for ~5 minutes.

11.2.13.3. Decant the supernatant back into the original bottle for extraction, if transferred. If transferred into centrifuge tubes, retain tubes to rinse solid plug (residue) with two 5 mL rinses of reagent water prior to sample elution (Section 11.3.6).

11.2.13.3.1. This might mean having to interrupt the automated SPE procedure if automation is used to extract the sample.

11.2.13.4. If centrifuged within the original container proceed to Section 11.3 being careful not to load the solid plug onto the SPE until the container is rinsed with elution solvent (Section 11.4.1).

11.2.13.5. Document via NCM that the sample required centrifugation.

11.2.13.6. If using the Promochrom for automated SPE, proceed to section 11.9.

11.3. Solid Phase Extraction (SPE) of Aqueous Samples

11.3.1. Condition the SPE cartridges by passing the following without drying the column.

11.3.1.1. Use Phenomenex [redacted] or equivalent.

***Note:*** *The cartridges should not be allowed to go dry until the final elution step with methanol. At all of the other transition steps, the solvent/sample level should be stopped at the top of the column before the next liquid is added.*

**Warning: The use of a vacuum system creates the risk of glassware implosion. Inspect all glassware prior to use. Glassware with chips, scratches, rub marks, or cracks must not be used.**

**Warning: Ensure the vacuum exhaust hose used during the filtering is securely anchored inside of a fume hood so that vapors are not pumped into the working environment.**

11.3.2. Wash with [redacted] $NH_4OH$/methanol.

11.3.3. Wash with [redacted] formic acid/$H_2O$. Close valve when ~ 200 uL remains on top to keep column wet. After this step, the columns cannot go dry until the completion of loading and rinsing samples.

11.3.4. Appropriately label the columns and add the reservoir to the column. Be certain to rotate method blank samples through each sample port on the automated SPE manifold units, such that each new batch uses a different port for the method blank. See PromoChrom (automated SPE manifold) logbook to determine port location from batch to batch. Due to the random association of components used in a manual SPE manifold unit, this is not a critical factor.

11.3.5. Pour the samples into the reservoirs attached to the SPE columns and with vacuum, pull the entire sample volume (125 mL) through the cartridge at a rate of approximately 2 to 5 drops per second.

11.3.5.1. If the SPE column should plug (flow rate <1 drop per minute) prior to the entire content of the sample container passing through the column do the following in steps 1-5. Refer to *SAC-LC-WI81787* for when the SPE clogs for DoD work.

1. Stop adding sample to the reservoir.
2. Return any remaining sample volume back to the original container.
3. Weigh the original container and record this weight into the worksheet notes field within the TALS extraction batch.
4. Determine the full volume of sample fortified by using the "Gross Weight" –– default tare weight of a sample container (20.5 g).
5. Enter this value into the "Initial Amount" field in the TALS extraction batch.

6. Proceed to Section 11.4, noting that additional vacuum or pressure might be needed to elute the SPE column.

7. Should the SPE column plug, file an NCM stating such.

11.3.5.2. At least 50% of the sample must pass through the SPE column. If this does not occur then re-extract the sample at a reduced volume.

11.3.5.3. If a DoD/DOE sample plugs the SPE contact the PM immediately and initiate mitigation, i.e. centrifugation or dilution prior to re-extraction. This should all be performed in coordination with client approval. See *SAC-LC-WI81787* for details about TALS data entry.

11.3.6. After the entire sample has been loaded onto the column, rinse the sample container with a [redacted] and pour into the column reservoir.

11.3.7. After the final loading of the sample but before completely passed through the column, rinse the SPE column with 1 mL water.

11.3.8. Vacuum dry for ~20 minutes.

11.3.9. Load the first [redacted] soak for ~5 minutes, and elute to waste. Load the second [redacted] and elute to waste.

11.3.10. Vacuum dry for ~15 minutes.

11.4. SPE Elution of Aqueous Samples – using 15 mL polypropylene test tubes as receiving tubes in the SPE manifold.

11.4.1. Add the collection tubes to the manifold. Rinse sample bottles with [redacted] and transfer to the column reservoir onto the cartridge. Elute the analytes from the cartridge by pulling the [redacted] through using low vacuum such that the solvent exits the cartridge in a drop wise fashion.

11.4.1.1. If the samples were fortified, centrifuged, and decanted prior to extraction, then elute the samples as follows.

11.4.1.1.1. Add elution solvent into the original parent bottle.

11.4.1.1.2. Shake the elution solvent in the bottle to ensure that all surfaces areas are washed.

11.4.1.1.3. Decant the elution solvent into the secondary bottle used for phase separation and proceed with the same shaking/mixing step as the parent bottle (Step 11.4.1.1.2).

11.4.1.1.4. Decant the solution into the first centrifuge tube. Repeat the step until all of the tubes are rinsed.

11.4.1.1.5. If necessary, re-centrifuge the final tube if the sediment has been stirred up. Load the final rinsed elution solvent into the cartridge for elution.

11.4.1.1.6. If the elution is split into two loading steps, then repeat the process.

11.4.2. Air dry and weigh the bottles (record as the tare weight in TALS) to get the sample volume extracted.

11.4.3. Vortex the IS solution prior to use, after letting standard come up to room temperature for at least 30 minutes.

11.4.4. Add 200 uL of NIS (Section 7.5) at 25-62.5 ng/mL concentration, into the centrifuge tube.

11.4.5. Add 0.25 mL of DI reagent water.

11.4.6. Adjust the volume to 5 mL with the eluting solvent. Cap and vortex.

11.4.7. This will generate a final extract that is 95:5 methanol: water.

11.4.8. Transfer a portion of the extract to a 0.3 mL polypropylene micro vial and submit for analysis. Archive the rest of the extract in a refrigerator for re-injection and dilution.

11.5. **Solid, Biosolids, and Tissue Sample Preparation and Extraction**

11.5.1. Visually inspect soil samples. Homogenize the entire sample in accordance with SOP *SAC-QA-SOP71742*. If the sample cannot be mixed in the container, pour into a larger QC'd PFAS-free container and mix thoroughly. Transfer the sample label to the new container.

11.5.2. All solid and biosolids samples must have their default mass increased by the percent moisture content prior to extraction. (Does not apply to tissue)

11.5.2.1. Review TALS for the percent moisture results. Use the following equation to determine what adjustment is needed to the default masses listed in Section 11.5.3.

11.5.2.1.1. Dry wt. adjusted mass = default mass X (1+ percent moisture as a decimal).

11.5.2.1.2. Do not add more that 2X the default mass, regardless of percent moisture value.

11.5.2.1.3. Use the "1633 Soil Sample Size Calculator" template found on the public drive\QA\Operations Spreadsheets.

11.5.2.1.4. Refer to the "Revision History & Information" tab for instructions.

11.5.3. Weigh a representative dry weight adjusted 2 g for soils, and 0.5 g for biosolids or a 2 g wet weight for tissue into a 50 mL centrifuge tube. Weigh additional sample amounts for the sample duplicate, matrix spike, and matrix spike duplicate analyses, if they are requested.

11.5.3.1. Do not batch solid sample, tissues and biosolids samples together due to the different masses.

11.5.4. For the method blank, LLCS and LCS matrix, use 2 g each of Ottawa sand or 0.5 g of Ottawa sand for biosolids. For tissue, use 2 grams of sand with ~0.02 mL of vegetable oil**.**

11.5.5. Vortex the LCS/Matrix Spike and 1633 EIS solutions prior to use, after letting the standards come up to room temperature for at least 30 minutes.

11.5.6. For soils/biosolids, add 0.500 mL of the 1633 EIS solution (Section 7.4) into each sample and QC sample, for a fixed concentration of 1-2.5 ng/mL in the final sample vial. For tissue samples, add 1 mL of the 1633 EIS solution.

11.5.6.1. If extended list analytes are requested, fortify with 0.500 mL of the extended list EIS solution.

11.5.7. Fortify the LCS and MS/MSD (if requested) with 0.250 mL of the LCS/Matrix Spike solution (Section 7.3), for a fixed concentration of 1 - 5 ng/mL in the final sample vial. For tissue samples, fortify the LCS/LCSD and MS/MSD (if requested) with 0.5 mL of the LCS/Matrix Spike solution.

11.5.7.1. If extended list analytes are requested, fortify with 0.250 mL of 1633 extended list spikes 1 and 2 (F1633_SP and EXT1633_SP2).

11.5.8. Fortify the LLCS with 40 uL of the LCS/Matrix Spike solution (Section 7.3), for a fixed concentration of 0.16-0.80 ng/mL in the final sample vial. For tissue samples, fortify the LLCS with 80 uL of the LCS/Matrix Spike solution.

11.5.8.1. If extended list analytes are requested, fortify with 40 uL of 1633 extended list spikes 1 and 2 (F1633_SP and EXT1633_SP2).

11.5.9. Cap the tubes, vortex samples, and allow the spike to settle into the sample matrix for at least 30 minutes.

11.5.10. For soils, add [redacted] to each sample. For tissues, add 10 mL of 0.3% NH4OH/methanol. Cap and vortex.

11.5.11. Extract the samples in an ultrasonic water bath for ~1 hour. The temperature of this water bath will be kept at ambient room temperature in a range of 16 - 25ºC.

11.5.12. After the completion of extraction, centrifuge each sample at ~3500 rpm for ~5 minutes.

11.5.13. Collect and decant the [redacted] or [redacted] into a new 125 mL container.

11.5.14. For soils, add another [redacted] solution to the residue, briefly shake to mix, and centrifuge at ~3500 rpm for ~5 minutes. For tissues, add another [redacted] solution to the residue, briefly shake to mix, and centrifuge at ~3500 rpm for ~5 minutes.

11.5.15. Combine the rinsate to the first corresponding 125 mL containers.

11.5.16. Bring the volume up to [redacted]. Check that the pH is 6.5 ± 0.5 using narrow range pH paper (Section 6.13). If necessary, adjust pH with acetic acid and/or NaOH.

11.5.17. If using the Promochrom for automated SPE, proceed to section 11.9.

11.6. Solid Phase Extraction (SPE) of Solid, Biosolids and Tissue Samples

11.6.1. Condition the SPE cartridges by passing the following without drying the column.

11.6.1.1. Use Phenomenex [redacted] or equivalent for waters and soils extraction. For tissues, use Phenomenex [redacted] or equivalent.

***Note:*** *The cartridges should not be allowed to go dry until the final elution step with methanol. At all of the other transition steps, the solvent/sample level should be stopped at the top of the column before the next liquid is added.*

**Warning: The use of a vacuum system creates the risk of glassware implosion. Inspect all glassware prior to use. Glassware with chips, scratches, rub marks, or cracks must not be used.**

**Warning: Ensure the vacuum exhaust hose used during the filtering is securely anchored inside of a fume hood so that vapors are not pumped into the working environment.**

11.6.2. Wash with [redacted].

11.6.3. Wash with [redacted]. Close valve when ~ 200 uL remains on top to keep column wet. After this step, the columns cannot go dry until the completion of loading and rinsing samples.

11.6.4. Appropriately label the columns and add the reservoir to the column. Be certain to rotate method blank samples through each sample port on the SPE manifold, such that each new batch uses a different port for the MB.

11.6.5. Add samples to the columns and with vacuum, pull the entire 125 mL aliquot of the sample through the cartridge at a rate of approximately 2 to 5 drops per second.

11.6.6. After the entire sample has been loaded onto the column, rinse the centrifuge tube with a [redacted] and pour into the column reservoir.

11.6.7. After the final loading of the sample but before completely passed through the column, rinse the SPE column with 1 mL water.

11.6.8. Vacuum dry for ~20 minutes.

11.6.9. Load the first [redacted] soak for ~5 minutes, and elute to waste. Load the second [redacted] and elute to waste.

11.6.10. Vacuum dry for ~15 minutes.

11.7. SPE Elution of Solid, Biosolids and Tissue Samples – using 15 mL polypropylene test tubes as receiving tubes in the SPE manifold.

11.7.1. Rinse centrifuge tubes with [redacted] and transfer to the column reservoir onto the cartridge. Elute the analytes from the cartridge by pulling the [redacted] through using low vacuum such that the solvent exits the cartridge in a dropwise fashion.

11.8. Final volume for Solid, Biosolids and Tissue Sample extracts

11.8.1. Vortex the 1633 NIS solution prior to use, after letting standard come up to room temperature for at least 30 minutes.

11.8.2. Add 200 uL of 1633 NIS (Section 7.5) at 25-62.5 ng/mL concentration into a new centrifuge tube.

11.8.3. Add 250 uL of reagent water.

11.8.4. Adjust the volume to 5 mL with the eluting solvent. Cap and vortex.

11.8.5. This will generate a final extract that is 95:5 methanol: water

11.8.6. Transfer a portion of the extract to a 0.3 mL polypropylene micro vial and submit for analysis. Archive the rest of the extract in a refrigerator for re-injection and dilution.

11.9. Automated Solid Phase Extraction using PromoChrom SPE-03.

***Note:*** *Always pre-clean the unit prior to use. Prior to setting up samples, check the label to confirm the container is from ESS as those lids will fit the PromoChrom units. If the containers are NOT from ESS, consult with your supervisor.*

11.9.1. Check solvent bottles for sufficient levels of solvent and check the level in the waste container. Solvents are tracked in the in the LCMS Reagent Logbook QA-876 located underneath the PromoChroms.

11.9.2. From the drop down menu, select "clean sys-004". This method will run as indicated below:

**Table 11.9.2.1**
**Clean cycle for PromoChrom automated SPE**

| | |
|---|---|
| Step 1 | Clean sample lines with 6 mL of methanol at a flow rate of 20 mL/min. |
| Step 2 | Clean sample lines with 5mL of methanol at a flow rate of 5 mL/min. |
| Step 3 | Clean sample lines with 5mL of methanol at a flow rate of 5 mL/min. |
| Step 4 | Remove methanol from sample bottle into waste of 8mL of sample at a flow rate of 15 mL/min. |
| Step 5 | Clean rinse line with 6 mL of methanol into sample bottle at a flow rate of 20 mL/min. |
| Step 6 | Purge air through sample lines with 3 mL at a flow rate of 20 mL/min. |
| | |

| | |
|---|---|
| Step 7 | Clean sample lines with 5mL of methanol at a flow rate of 20 mL/min. |
| Step 8 | Clean sample lines with 5mL of methanol at a flow rate of 20 mL/min. |
| Step 9 | Remove methanol from sample bottle into waste of 10mL of sample at a flow rate of 15 mL/min. |

11.9.3. After samples have been batched in TALS and fortified with isotope dilution analyte, they are ready to load onto the PromoChrom automated SPE unit.

11.9.4. Clean the adapters with methanol.

11.9.5. Remove the cleaning bottles from the unit and add the F-HC-30 Inline filter to the top of the cap, between the cap and the line leading into the PromoChrom. Then screw the sample bottles onto the clean caps.

11.9.6. Pierce the bottle on the top right corner using the provided lancet.

11.9.7. Install the new SPE cartridge by twisting them into the adapter.

11.9.7.1. Be certain to rotate the method blank samples through each sample port on the automated SPE manifold units, such that each new batch uses a different port for the method blank. See PromoChrom QA-589 (automated SPE manifold) logbook to determine port location from batch to batch. Due to the random association of components used in a manual SPE manifold unit, this is not a critical factor.

11.9.8. Set up labeled collection tubes into

11.9.9. From the drop down menu, select '1633 Final'. This method will run as follows:

**Table 11.9.9.1**
**1633 Final Run Cycle for PromoChrom Automated SPE**

| | |
|---|---|
| Step 1 | Condition cartridge with [redacted] at a flow rate of 8 mL/min. |
| Step 2 | Condition cartridge with [redacted] at a flow rate of 8 mL/min. |
| Step 3 | Pouring sample through cartridge at a flow rate of 5 mL/min. |
| Step 4 | Rinse bottle with [redacted] with flow rate of 70 mL/min. Push 1 mL of air through rinse line. |
| Step 5 | Remove [redacted] with flow rate of 5 mL/min from the sample bottle to the cartridge. |
| Step 6 | Shake sample bottle for 20 seconds. |
| Step 7 | Remove any remaining volume from sample bottle at a flow rate of 5mL/min. |
| Step 8 | Blow down cartridge with Nitrogen for 15 minutes. |
| Step 9 | Rinse bottle with [redacted] with a flow rate of 70 mL/min. Push 1 mL of air through rinse line. |
| Step 10 | Remove [redacted] with flow rate of 5 mL/min from the sample bottle to the cartridge. |
| Step 11 | Remove any remaining volume from sample bottle at a flow rate of 5mL/min. |
| Step 12 | Shake sample bottle for 20 seconds. |
| Step 13 | Air purge and remove any remaining volume from sample bottle at a flow rate of 5mL/min. |
| Step 14 | Blow down cartridge with Nitrogen for 10 minutes. |
| Step 15 | Pause step. Add Strata GCB 25mg/1mL IC Cartridge. Manually resume promochrom run. |
| Step 16 | Rinse sample bottle with [redacted] and elute into collection tubes. |
| Step 17 | Pause step. Ensure elution is completed before manually resuming run. |
| Step 18 | End. |

11.9.10. Take tare weight of empty sample bottles and proceed to section 11.4.3.

11.9.11. If you need to centrifuge or decant aqueous samples for Promochrom extraction, use the following procedure.

11.9.11.1. Fortify the sample with IDA solution.

11.9.11.2. Shake the bottle and allow to equilibrate for 30 minutes.

11.9.11.3. Shake the bottle and transfer the entire contents of the bottle to a new container for centrifugation.

11.9.11.4. Centrifuge the sample at 1,400 RCF for 10 minutes.

11.9.11.5. Decant the supernatant back into the original bottle for extraction.

11.9.11.6**. After elution, rinse the residual solids on the centrifuge container with 2x5 mL of water, decanting back into the original container for SPE.**

11.9.11.7**. Follow the SOP procedures for rinsing the SPE cartridge, drying the cartridge, and allow the original sample container to dry.**

11.9.11.8. Rinse the original sample container with the elution solvent and elute the sample.

11.9.11.9. Document in the case narrative which samples were centrifuged.

11.10. Instrument Analysis

Suggested operating conditions are listed in Tables 11.9-1 through 11.9-4 for the SCIEX LCMS systems:

**Table 11.10 - 1.1A**
**Recommended LC Instrument Operating Conditions for 5500**
*Some parameters may be optimized for specific instrument performance requirements.

| **HPLC Conditions (Shimadzu HPLC)** | | | | |
|---|---|---|---|---|
| **Column (Column temp = 45°C)** | [redacted] | | | |
| **Mobile Phase Composition** | A = [redacted] | | B = [redacted] | |
| **Gradient Program** | Time | %A | %B | Flow Rate - mL/min |
| | 0 | [redacted] | | |
| | 0.01 | | | |
| | 7.00 | | | |
| | 11.00 | | | |
| | 14.00 | | | |
| | 14.01 | | | |
| | Maximum pressure limit = 9,000 psi | | | |
| | **Injection Size** | 10 uL (fixed amount throughout the sequence). | | |
| | **Run Time** | ~16.00 min | | |
| | **Mass Spectrometer Interface Settings (SCIEX 5500)** Source/Gas and Compound Parameters | | | |
| Declustering Potential (DP) | [redacted] | | | |
| Entrance Potential (EP) | | | | |
| Collision Energy (CE) | | | | |
| Collision Cell Exit Potential (CXP) | | | | |
| Curtain Gas (CUR) | | | | |
| Collision Gas (CAD) | | | | |
| IonSpray Voltage (IS) | | | | |
| Temperature (TEM) | | | | |
| Ion Source Gas 1 (GS1) | | | | |
| Ion Source Gas 2 (GS2) | | | | |

**Table 11.10 - 1.1B**
**Recommended LC Instrument Operating Conditions for 7500**
*Some parameters may be optimized for specific instrument performance requirements.

| **HPLC Conditions (Shimadzu HPLC)** | | | | |
|---|---|---|---|---|
| **Column (Column temp = 45°C)** | [redacted] | | | |
| **Mobile Phase Composition** | A = [redacted] | | B = [redacted] | |
| **Gradient Program** | Time | %A | %B | Flow Rate - mL/min |
| | 0 | [redacted] | | |
| | 0.01 | | | |
| | 7.00 | | | |
| | 11.00 | | | |
| | 14.00 | | | |
| | 14.01 | | | |
| | Maximum pressure limit = 9,000 psi | | | |
| | **Injection Size** | 5 uL (fixed amount throughout the sequence). | | |
| | **Run Time** | ~16.00 min | | |
| | **Mass Spectrometer Interface Settings (SCIEX 7500)** Source/Gas and Compound Parameters | | | |
| Curtain Gas (CUR) | [redacted] | | | |
| Collision Gas (CAD) | | | | |
| IonSpray Voltage (IS) | | | | |
| Temperature (TEM) | | | | |
| Ion Source Gas 1 (GS1) | | | | |
| Ion Source Gas 2 (GS2) | | | | |

**Table 11.10 - 1.1C**
**Recommended LC Instrument Operating Conditions for 7500 (Extended List)**
*Some parameters may be optimized for specific instrument performance requirements.

| **HPLC Conditions (Shimadzu HPLC)** | | | | |
|---|---|---|---|---|
| **Column (Column temp = 45°C)** | [redacted] | | | |
| **Mobile Phase Composition** | A = [redacted] | | B = [redacted] | |
| **Gradient Program** | Time | %A | %B | Flow Rate - mL/min |
| | 0 | [redacted] | | |
| | 0.01 | | | |
| | 3.50 | | | |
| | 7.00 | | | |
| | 11.00 | | | |
| | 12.00 | | | |
| | 14.00 | | | |
| | 14.01 | | | |
| | Maximum pressure limit = 9,000 psi | | | |
| | **Injection Size** | 5 uL (fixed amount throughout the sequence). | | |
| **Run Time** | ~16.00 min | | | |
| **Mass Spectrometer Interface Settings (SCIEX 7500)** Source/Gas and Compound Parameters | | | | |

| Table 11.10 - 1.1C<br>Recommended LC Instrument Operating Conditions for 7500 (Extended List)<br>*Some parameters may be optimized for specific instrument performance requirements. | |
|---|---|
| **HPLC Conditions (Shimadzu HPLC)** | |
| Curtain Gas (CUR) | [redacted] |
| Collision Gas (CAD) | |
| IonSpray Voltage (IS) | |
| Temperature (TEM) | |
| Ion Source Gas 1 (GS1) | |
| Ion Source Gas 2 (GS2) | |

**Table 11.10 - 2**
**Masses/Transitions Utilized for 5500 and 7500**

*Some parameters may be optimized for specific instrument performance requirements.

| ID | Comments | Q1 | Q3 | RT |
|---|---|---|---|---|
| 11CI-PF3OUdS | Native Analyte | 630.9 | 450.9 | 7.66 |
| 11CI-PF3OUdS_2 | Native Analyte | 632.9 | 452.9 | 7.66 |
| 13C2_PFDA | Internal Standard | 515.1 | 470.1 | 5.18 |
| 13C2_PFDoA | Isotope Dilution Analyte | 615.1 | 570 | 6.74 |
| 13C2_PFHxA | Internal Standard | 315.1 | 270 | 2.52 |
| 13C2_PFHXA_2 | Internal Standard | 315.1 | 119.4 | 2.52 |
| 13C2_PFTeDA | Isotope Dilution Analyte | 715.2 | 670 | 8.25 |
| 13C3_HFPO-DA | Isotope Dilution Analyte | 286.9 | 168.9 | 2.71 |
| 13C3_HFPO-DA_2 | Isotope Dilution Analyte | 286.9 | 184.9 | 2.71 |
| 13C3_PFBA | Internal Standard | 216 | 172 | 1.90 |
| 13C3_PFBS | Isotope Dilution Analyte | 302.1 | 79.9 | 2.55 |
| 13C3_PFBS_2 | Isotope Dilution Analyte | 302.1 | 98.9 | 2.55 |
| 13C3_PFHxS | Isotope Dilution Analyte | 402.1 | 79.9 | 3.84 |
| 13C3_PFHxS_2 | Isotope Dilution Analyte | 402.1 | 98.8 | 3.84 |
| 13C4_PFBA | Isotope Dilution Analyte | 216.8 | 171.9 | 1.88 |
| 13C4_PFHpA | Isotope Dilution Analyte | 367.1 | 322 | 3.06 |
| 13C2-PFOA (PRC) | Native Analyte | 415 | 370 | 3.70 |
| 13C4_PFOA | Internal Standard | 417.1 | 372 | 3.70 |
| 13C4_PFOS | Internal Standard | 502.8 | 79.9 | 5.40 |
| 13C4_PFOS_2 | Internal Standard | 502.8 | 98.9 | 5.40 |
| 13C5_PFHxA | Isotope Dilution Analyte | 318 | 273 | 5.40 |
| 13C5_PFHxA_2 | Isotope Dilution Analyte | 318 | 120.3 | 2.52 |
| 13C5_PFNA | Internal Standard | 468 | 423 | 4.42 |
| 13C5_PFPeA | Isotope Dilution Analyte | 268.3 | 223 | 4.42 |
| 13C6_PFDA | Isotope Dilution Analyte | 519.1 | 474.1 | 5.18 |
| 13C7_PFUdA | Isotope Dilution Analyte | 570 | 525.1 | 5.94 |
| 13C8_PFOA | Isotope Dilution Analyte | 421.1 | 376 | 3.70 |
| 13C8_PFOS | Isotope Dilution Analyte | 507.1 | 98.9 | 5.40 |
| 13C8_PFOS_2 | Isotope Dilution Analyte | 507.1 | 79.9 | 5.40 |
| 13C8_PFOSA | Isotope Dilution Analyte | 506.1 | 77.8 | 6.61 |
| 13C9_PFNA | Isotope Dilution Analyte | 472.1 | 427 | 4.42 |
| 18O2_PFHxS | Internal Standard | 403 | 83.9 | 3.83 |
| 3:3 FTCA | Native Analyte | 241 | 177 | 2.05 |
| 3:3 FTCA_2 | Native Analyte | 241 | 117 | 2.05 |
| 4.2FTS_2 | Native Analyte | 327.1 | 80.9 | 2.38 |
| 4:2 FTS | Native Analyte | 327.1 | 307 | 2.38 |
| 5:3 FTCA | Native Analyte | 341 | 237.1 | 2.79 |
| 5:3 FTCA_2 | Native Analyte | 341 | 217 | 2.79 |
| 6:2 FTS | Native Analyte | 427.1 | 407 | 3.42 |
| 6:2 FTS_2 | Native Analyte | 427.1 | 80.9 | 3.42 |
| 7:3 FTCA | Native Analyte | 441 | 316.9 | 4.05 |
| 7:3 FTCA_2 | Native Analyte | 441 | 336.9 | 4.05 |
| 8:2 FTS | Native Analyte | 527.1 | 507 | 4.82 |
| 8:2 FTS_2 | Native Analyte | 527.1 | 80.8 | 4.82 |
| 9CI-PF3ONS | Native Analyte | 530.8 | 351 | 6.02 |
| 9CI-PF3ONS_2 | Native Analyte | 532.8 | 353 | 6.02 |
| d3MeFOSA | Isotope Dilution Analyte | 515 | 219 | 9.56 |
| d3-MeFOSAA | Isotope Dilution Analyte | 573.2 | 419 | 9.56 |
| d5EtFOSA | Isotope Dilution Analyte | 531.1 | 219 | 9.87 |
| d5-EtFOSAA | Isotope Dilution Analyte | 589.2 | 419 | 5.56 |
| d7N-MeFOSE | Isotope Dilution Analyte | 623.2 | 58.9 | 9.41 |
| d9N-EtFOSE | Isotope Dilution Analyte | 639.2 | 58.9 | 9.72 |
| DONA | Native Analyte | 376.9 | 250.9 | 3.29 |
| DONA_2 | Native Analyte | 376.9 | 84.8 | 3.29 |
| EtFOSA | Native Analyte | 526 | 219 | 9.88 |
| EtFOSA_2 | Native Analyte | 526 | 169 | 9.78 |
| HFPO-DA | Native Analyte | 284.9 | 168.9 | 2.71 |
| HFPO-DA_2 | Native Analyte | 284.9 | 184.9 | 2.71 |
| 13C2-4:2FTS | Isotope Dilution Analyte | 329.1 | 80.9 | 2.38 |
| 13C2-4:2FTS_2 | Isotope Dilution Analyte | 329.1 | 309 | 2.38 |
| 13C2-6:2FTS | Isotope Dilution Analyte | 429.1 | 80.9 | 3.41 |
| 13C2-6:2FTS_2 | Isotope Dilution Analyte | 429.1 | 409 | 3.41 |

**Table 11.10 - 2**
**Masses/Transitions Utilized for 5500 and 7500**

*Some parameters may be optimized for specific instrument performance requirements.

| ID | Comments | Q1 | Q3 | RT |
|---|---|---|---|---|
| 13C2-8:2FTS | Isotope Dilution Analyte | 529.1 | 80.9 | 4.82 |
| 13C2-8:2FTS_2 | Isotope Dilution Analyte | 529.1 | 509 | 4.82 |
| MeFOSA | Native Analyte | 511.9 | 219 | 9.56 |
| MeFOSA_2 | Native Analyte | 511.9 | 169 | 9.56 |
| N-EtFOSAA | Native Analyte | 584.2 | 419.1 | 5.57 |
| N-EtFOSAA_2 | Native Analyte | 584.2 | 526 | 5.57 |
| N-EtFOSE | Native Analyte | 630 | 58.9 | 9.74 |
| NFDHA | Native Analyte | 295 | 201 | 2.48 |
| NFDHA_2 | Native Analyte | 295 | 84.9 | 2.48 |
| N-MeFOSAA | Native Analyte | 570.1 | 419 | 5.24 |
| N-MeFOSAA_2 | Native Analyte | 570.1 | 483 | 5.24 |
| N-MeFOSE | Native Analyte | 616.1 | 58.9 | 9.43 |
| PFBA | Native Analyte | 212.8 | 168.9 | 1.88 |
| PFBS | Native Analyte | 298.7 | 79.9 | 2.55 |
| PFBS_2 | Native Analyte | 298.7 | 98.8 | 2.55 |
| PFDA | Native Analyte | 512.9 | 469 | 5.18 |
| PFDA_2 | Native Analyte | 512.9 | 219 | 5.18 |
| PFDoA | Native Analyte | 613.1 | 569 | 6.74 |
| PFDoA_2 | Native Analyte | 613.1 | 319 | 6.74 |
| PFDoS | Native Analyte | 699.1 | 79.9 | 8.49 |
| PFDoS_2 | Native Analyte | 699.1 | 98.8 | 8.49 |
| PFDS | Native Analyte | 599 | 79.9 | 7.04 |
| PFDS_2 | Native Analyte | 599 | 98.8 | 7.04 |
| PFEESA (PES) | Native Analyte | 314.8 | 134.9 | 2.82 |
| PFEESA_2 (PES_2) | Native Analyte | 314.8 | 82.9 | 2.82 |
| PFHpA | Native Analyte | 363.1 | 319 | 3.06 |
| PFHpA_2 | Native Analyte | 363.1 | 169 | 3.06 |
| PFHpS | Native Analyte | 449 | 79.9 | 4.60 |
| PFHpS_2 | Native Analyte | 449 | 98.8 | 4.60 |
| PFHxA | Native Analyte | 313 | 269 | 2.52 |
| PFHxA_2 | Native Analyte | 313 | 118.9 | 2.52 |
| PFHxS | Native Analyte | 398.7 | 79.9 | 3.84 |
| PFHxS_2 | Native Analyte | 398.7 | 98.9 | 3.84 |
| PFMBA | Native Analyte | 279 | 85.1 | 2.27 |
| PFMPA | Native Analyte | 229 | 84.9 | 2.01 |
| PFNA | Native Analyte | 463 | 419 | 4.42 |
| PFNA_2 | Native Analyte | 463 | 219 | 4.42 |
| PFNS | Native Analyte | 548.8 | 79.9 | 6.22 |
| PFNS_2 | Native Analyte | 548.8 | 98.8 | 6.22 |
| PFOA | Native Analyte | 413 | 369 | 3.71 |
| PFOA_2 | Native Analyte | 413 | 169 | 3.71 |
| PFOS | Native Analyte | 498.9 | 79.9 | 5.41 |
| PFOS_2 | Native Analyte | 498.9 | 98.8 | 5.41 |
| PFOSA | Native Analyte | 498.1 | 77.9 | 6.6 |
| PFOSA_2 | Native Analyte | 498.1 | 478 | 6.6 |
| PFPeA | Native Analyte | 263 | 219 | 2.18 |
| PFPeA_2 | Native Analyte | 263 | 68.9 | 2.18 |
| PFPeS | Native Analyte | 349.1 | 79.9 | 2.18 |
| PFPeS_2 | Native Analyte | 349.1 | 98.9 | 3.13 |
| PFTeDA | Native Analyte | 713 | 168.9 | 8.25 |
| PFTeDA_2 | Native Analyte | 713 | 219 | 8.25 |
| 13C2 PFTeDA | Isotope Dilution Analyte | 715.2 | 670 | 8.25 |
| PFTrDA | Native Analyte | 663 | 619 | 7.52 |
| PFTrDA_2 | Native Analyte | 663 | 168.9 | 7.52 |
| PFUdA | Native Analyte | 563.1 | 519 | 5.96 |
| PFUdA_2 | Native Analyte | 563.1 | 269.1 | 9.96 |
| PFPrA | Native Analyte | 163 | 119 | 1.08 |
| 13C3 PFPrA | Isotope Dilution Analyte | 166 | 121 | 1.1 |
| TFSI_1 | Native Analyte | 280.1 | 147.1 | 3.07 |
| TFSI_2 | Native Analyte | 280.1 | 77.9 | 3.07 |
| PFHxDA_1 | Native Analyte | 813 | 769 | 9.08 |
| PFHxDA_2 | Native Analyte | 813 | 169 | 9.08 |
| 13C2 PFHxDA | Isotope Dilution Analyte | 815 | 770 | 9.08 |
| PFODA_1 | Native Analyte | 913 | 869 | 9.62 |
| PFODA_2 | Native Analyte | 913 | 169 | 9.62 |
| TDCA | Native Analyte | 498.29 | 106.98 | 0 |
| TCDCA | Native Analyte | 498.29 | 123.90 | 0 |
| TUDCA | Native Analyte | 499.29 | 123.90 | 0 |

**Table 11.10 - 3**
**Extended List Masses/Transitions Utilized for 5500 and 7500**

*Some parameters may be optimized for specific instrument performance requirements.

| ID | Comments | Q1 | Q3 | RT |
|---|---|---|---|---|
| MTP | Native Analyte | 175 | 97 | 0.84 |

**Table 11.10 - 3**
**Extended List Masses/Transitions Utilized for 5500 and 7500**
*Some parameters may be optimized for specific instrument performance requirements.

| ID | Comments | Q1 | Q3 | RT |
|---|---|---|---|---|
| PFMOAA | Native Analyte | 179 | 84.9 | 0.24 |
| R-EVE | Native Analyte | 405 | 217 | 1.92 |
| Hydrolyzed PSDA | Native Analyte | 439.1 | 342.9 | 2.01 |
| R-PSDA | Native Analyte | 441 | 241 | 2.01 |
| PMPA | Native Analyte | 229 | 185 | 2.04 |
| PFO2HxA | Native Analyte | 245 | 85 | 2.25 |
| PFPrS | Native Analyte | 249.1 | 80 | 2.30 |
| PEPA | Native Analyte | 278.9 | 234.9 | 2.47 |
| 1-OSA | Native Analyte | 193.3 | 80 | 2.49 |
| NVHOS | Native Analyte | 297 | 135 | 2.51 |
| PFO3OA | Native Analyte | 311.1 | 85.2 | 3.00 |
| FBSA | Native Analyte | 297.9 | 78 | 3.18 |
| 6:2 FTUCA | Native Analyte | 356.858 | 292.9 | 3.41 |
| 6:2 FTUCA_2 | Native Analyte | 356.858 | 243 | 3.41 |
| 13C-6:2 FTUCA | Isotope Dilution Analyte | 356.858 | 293.9 | 3.41 |
| 6:2 FTCA | Native Analyte | 377.1 | 313.1 | 3.44 |
| 6:2 FTCA_2 | Native Analyte | 377.1 | 63 | 3.44 |
| 13C-6:2 FTCA | Isotope Dilution Analyte | 378.883 | 293.9 | 3.44 |
| PFPE-1 | Native Analyte | 378.9 | 184.9 | 4.08 |
| PFO4DA | Native Analyte | 377 | 85 | 4.58 |
| Hydro-EVE Acid | Native Analyte | 427 | 282.9 | 4.75 |
| EVE-Acid | Native Analyte | 407 | 262.9 | 4.76 |
| R-PSDCA | Native Analyte | 397 | 217 | 5.42 |
| 8:2 FTUCA | Native Analyte | 456.856 | 392.9 | 6.12 |
| 8:2 FTUCA_2 | Native Analyte | 456.856 | 343 | 6.12 |
| 13C-8:2 FTUCA | Isotope Dilution Analyte | 458.856 | 393.9 | 6.12 |
| 8:2 FTCA | Native Analyte | 477 | 393.1 | 6.16 |
| 8:2 FTCA_2 | Native Analyte | 477 | 63.2 | 6.16 |
| 13C-8:2 FTCA | Isotope Dilution Analyte | 478.846 | 393.9 | 6.16 |
| FHxSA | Native Analyte | 397.9 | 78 | 6.16 |
| PS Acid | Native Analyte | 442.804 | 145.8 | 6.33 |
| Hydro PS Acid | Native Analyte | 463 | 286 | 6.17 |
| PFO5DA | Native Analyte | 442.9 | 85 | 6.47 |
| PFECHS | Native Analyte | 460.8 | 380.9 | 6.54 |
| PFECHS_2 | Native Analyte | 460.8 | 98.9 | 6.54 |
| HFPO-TrA | Native Analyte | 495 | 185 | 7.17 |
| PFO6TeA | Native Analyte | 508.8 | 85 | 7.78 |
| 10:2 FTUCA | Native Analyte | 556.86 | 492.9 | 8.12 |
| 13C-10:2 FTUCA | Isotope Dilution Analyte | 558.86 | 493.9 | 8.12 |
| 10:2 FTCA | Native Analyte | 576.795 | 493 | 8.12 |
| 10:2 FTCA_2 | Native Analyte | 576.795 | 63.1 | 8.12 |
| 13C-10:2 FTCA | Isotope Dilution Analyte | 578.795 | 493.9 | 8.12 |
| 10:2 FTS | Native Analyte | 627 | 607 | 8.89 |
| 10:2 FTS_2 | Native Analyte | 627 | 79.96 | 8.89 |
| 13C2-10:2 FTS | Isotope Dilution Analyte | 633 | 612 | 8.89 |
| HFPO-TeA | Native Analyte | 351 | 185 | 9.48 |
| 6:2-DiPAP | Native Analyte | 788.792 | 96.9 | 9.79 |
| 6:2-DiPAP_2 | Native Analyte | 788.792 | 78.9 | 9.79 |
| 13C4-6:2-DiPAP | Isotope Dilution Analyte | 792.817 | 96.9 | 9.79 |
| 13C4-6:2-DiPAP_2 | Isotope Dilution Analyte | 792.817 | 78.9 | 9.79 |
| PFUdS | Native Analyte | 649 | 80 | 10.02 |
| PFUdS_2 | Native Analyte | 649 | 99 | 10.02 |
| 6:2/8:2-DiPAP | Native Analyte | 888.7 | 96.9 | 10.77 |
| 6:2/8:2-DiPAP | Native Analyte | 888.7 | 78.9 | 10.77 |
| PFTrDS | Native Analyte | 749 | 80 | 11.13 |
| PFTrDS_2 | Native Analyte | 749 | 99 | 11.13 |
| 8:2-DiPAP | Native Analyte | 988.743 | 96.9 | 11.66 |
| 8:2-DiPAP_2 | Native Analyte | 988.743 | 78.9 | 11.66 |
| 13C4-8:2-DiPAP | Isotope Dilution Analyte | 992.774 | 96.9 | 11.66 |
| 13C4-8:2-DiPAP_2 | Isotope Dilution Analyte | 992.774 | 78.9 | 11.66 |

**Table 11.10 – 4**
**Recommended Instrument Operating Conditions**
*Some parameters may be optimized for specific instrument performance requirements.

**Mass Spectrometer Scan Settings (SCIEX 5500)**

| RT | ID | MRM (win) | Dwell Weight | DP (volts) | EP (volts) | CE (volts) | CXP (volts) |
|---|---|---|---|---|---|---|---|
| 0 | TDCA | 500 | 1 | [redacted] | | | |
| 0 | TCDCA | 60 | 1 | | | | |
| 0 | TUDCA | 60 | 1 | | | | |
| 1.87 | 13C3_PFBA | 60 | 1 | | | | |
| 1.87 | 13C4_PFBA | 60 | 1 | | | | |

**Table 11.10 – 4**
**Recommended Instrument Operating Conditions**
*Some parameters may be optimized for specific instrument performance requirements.

**Mass Spectrometer Scan Settings (SCIEX 5500)**

| RT | ID | MRM (win) | Dwell Weight | DP (volts) | EP (volts) | CE (volts) | CXP (volts) |
|---|---|---|---|---|---|---|---|
| 1.87 | PFBA | 60 | 1 | [redacted] | | | |
| 2.65 | PFMPA | 60 | 1 | | | | |
| 2.96 | 3:3 FTCA | 30 | 1 | | | | |
| 2.96 | 3:3 FTCA_2 | 30 | 1 | | | | |
| 3.51 | 13C5_PFPeA | 60 | 1 | | | | |
| 3.51 | PFPeA | 60 | 1 | | | | |
| 3.51 | PFPeA_2 | 60 | 1 | | | | |
| 3.85 | PFMBA | 60 | 1 | | | | |
| 4.22 | 4.2FTS_2 | 60 | 1 | | | | |
| 4.22 | 4:2 FTS | 60 | 1 | | | | |
| 4.22 | 13C2-4:2FTS | 60 | 1 | | | | |
| 4.22 | 13C2-4:2FTS_2 | 60 | 1 | | | | |
| 4.36 | 13C3_PFBS | 60 | 1 | | | | |
| 4.36 | 13C3_PFBS_2 | 60 | 1 | | | | |
| 4.36 | NFDHA | 60 | 1 | | | | |
| 4.36 | NFDHA_2 | 60 | 1 | | | | |
| 4.36 | PFBS | 60 | 1 | | | | |
| 4.36 | PFBS_2 | 60 | 1 | | | | |
| 4.5 | 13C2_PFHxA | 60 | 1 | | | | |
| 4.5 | 13C2_PFHXA_2 | 60 | 1 | | | | |
| 4.5 | 13C5_PFHxA | 60 | 1 | | | | |
| 4.5 | 13C5_PFHxA_2 | 60 | 1 | | | | |
| 4.5 | PFHxA | 60 | 1 | | | | |
| 4.5 | PFHxA_2 | 60 | 1 | | | | |
| 4.78 | 13C3_HFPO-DA | 60 | 1 | | | | |
| 4.78 | 13C3_HFPO-DA_2 | 60 | 1 | | | | |
| 4.78 | HFPO-DA | 60 | 1 | | | | |
| 4.78 | HFPO-DA_2 | 60 | 1 | | | | |
| 4.8 | PFEESA (PES) | 60 | 1 | | | | |
| 4.8 | PFEESA_2 (PES_2) | 60 | 1 | | | | |
| 4.85 | 5:3 FTCA | 60 | 1 | | | | |
| 4.85 | 5:3 FTCA_2 | 60 | 1 | | | | |
| 5.25 | 13C4_PFHpA | 60 | 1 | | | | |
| 5.25 | PFHpA | 60 | 1 | | | | |
| 5.25 | PFHpA_2 | 60 | 1 | | | | |
| 5.27 | PFPeS | 60 | 1 | | | | |
| 5.27 | PFPeS_2 | 60 | 1 | | | | |
| 5.5 | DONA | 60 | 1 | | | | |
| 5.5 | DONA_2 | 60 | 1 | | | | |
| 5.67 | 6:2 FTS | 60 | 1 | | | | |
| 5.67 | 6:2 FTS_2 | 60 | 1 | | | | |
| 5.67 | 13C2-6:2FTS | 60 | 1 | | | | |
| 5.67 | 13C2-6:2FTS_2 | 60 | 1 | | | | |
| 5.89 | 13C2_PFOA (PRC) | 120 | 1 | | | | |
| 5.89 | 13C4_PFOA | 120 | 1 | | | | |
| 5.89 | 13C4_PFOA_2 | 120 | 1 | | | | |
| 5.89 | 13C8_PFOA | 120 | 1 | | | | |
| 5.89 | PFOA | 120 | 1 | | | | |
| 5.89 | PFOA_2 | 120 | 1 | | | | |
| 5.96 | 13C3_PFHxS | 120 | 1 | | | | |
| 5.96 | 13C3_PFHxS_2 | 120 | 1 | | | | |
| 5.96 | 18O2_PFHxS | 120 | 1 | | | | |
| 5.96 | PFHxS | 120 | 1 | | | | |
| 5.96 | PFHxS_2 | 120 | 1 | | | | |
| 6.14 | 7:3 FTCA | 60 | 1 | | | | |
| 6.14 | 7:3 FTCA_2 | 60 | 1 | | | | |
| 6.44 | 13C5_PFNA | 120 | 1 | | | | |
| 6.44 | 13C9_PFNA | 120 | 1 | | | | |
| 6.44 | PFNA | 120 | 1 | | | | |
| 6.44 | PFNA_2 | 120 | 1 | | | | |
| 6.54 | PFHpS | 60 | 1 | | | | |
| 6.54 | PFHpS_2 | 60 | 1 | | | | |
| 6.74 | 8:2 FTS | 60 | 1 | | | | |
| 6.74 | 8:2 FTS_2 | 60 | 1 | | | | |
| 6.74 | 13C2-8:2FTS | 60 | 1 | | | | |
| 6.74 | 13C2-8:2FTS_2 | 60 | 1 | | | | |
| 6.95 | 13C2_PFDA | 60 | 1 | | | | |
| 6.95 | 13C6_PFDA | 60 | 1 | | | | |
| 6.95 | PFDA | 60 | 1 | | | | |
| 6.95 | PFDA_2 | 60 | 1 | | | | |
| 6.98 | d3-MeFOSAA | 120 | 1 | | | | |
| 6.98 | N-MeFOSAA | 120 | 1 | | | | |

**Table 11.10 – 4**
**Recommended Instrument Operating Conditions**
*Some parameters may be optimized for specific instrument performance requirements.

**Mass Spectrometer Scan Settings (SCIEX 5500)**

| RT | ID | MRM (win) | Dwell Weight | DP (volts) | EP (volts) | CE (volts) | CXP (volts) |
|---|---|---|---|---|---|---|---|
| 6.98 | N-MeFOSAA_2 | 120 | 1 | [redacted] | | | |
| 7.06 | 13C4_PFOS | 120 | 1 | | | | |
| 7.06 | 13C4_PFOS_2 | 120 | 1 | | | | |
| 7.06 | 13C8_PFOS | 120 | 1 | | | | |
| 7.06 | 13C8_PFOS_2 | 120 | 1 | | | | |
| 7.06 | PFOS | 120 | 1 | | | | |
| 7.06 | PFOS_2 | 120 | 1 | | | | |
| 7.17 | d5-EtFOSAA | 120 | 1 | | | | |
| 7.17 | N-EtFOSAA | 120 | 1 | | | | |
| 7.17 | N-EtFOSAA_2 | 120 | 1 | | | | |
| 7.4 | 9Cl-PF3ONS | 60 | 1 | | | | |
| 7.4 | 9Cl-PF3ONS_2 | 60 | 1 | | | | |
| 7.41 | 13C7_PFUdA | 60 | 1 | | | | |
| 7.41 | PFUdA | 60 | 1 | | | | |
| 7.41 | PFUdA_2 | 60 | 1 | | | | |
| 7.55 | PFNS | 60 | 1 | | | | |
| 7.55 | PFNS_2 | 60 | 1 | | | | |
| 7.86 | 13C2_PFDoA | 60 | 1 | | | | |
| 7.86 | PFDoA | 60 | 1 | | | | |
| 7.86 | PFDoA_2 | 60 | 1 | | | | |
| 7.91 | 13C8_PFOSA | 120 | 1 | | | | |
| 7.93 | PFOSA | 120 | 1 | | | | |
| 7.93 | PFOSA_2 | 120 | 1 | | | | |
| 8 | PFDS | 60 | 1 | | | | |
| 8 | PFDS_2 | 60 | 1 | | | | |
| 8.29 | PFTrDA | 60 | 1 | | | | |
| 8.29 | PFTrDA_2 | 60 | 1 | | | | |
| 8.31 | 11Cl-PF3OUdS | 60 | 1 | | | | |
| 8.31 | 11Cl-PF3OUdS_2 | 60 | 1 | | | | |
| 8.68 | 13C2_PFTeDA | 60 | 1 | | | | |
| 8.68 | PFTeDA | 60 | 1 | | | | |
| 8.68 | PFTeDA_2 | 60 | 1 | | | | |
| 8.83 | PFDoS | 60 | 1 | | | | |
| 8.83 | PFDoS_2 | 60 | 1 | | | | |
| 9.32 | d7N-MeFOSE | 120 | 1 | | | | |
| 9.32 | N-MeFOSE | 120 | 1 | | | | |
| 9.45 | d3MeFOSA | 120 | 1 | | | | |
| 9.45 | MeFOSA | 120 | 1 | | | | |
| 9.45 | MeFOSA_2 | 120 | 1 | | | | |
| 9.64 | d9-N-EtFOSE | 120 | 1 | | | | |
| 9.66 | N-EtFOSE | 120 | 1 | | | | |
| 9.77 | d5-EtFOSA | 120 | 1 | | | | |
| 9.79 | EtFOSA | 120 | 1 | | | | |
| 9.79 | EtFOSA_2 | 120 | 1 | | | | |
| 1.2 | PFPrA | 120 | 1 | | | | |
| 1.2 | 13C3_PFPrA | 120 | 1 | | | | |
| 3.92 | TFSI_1 | 60 | 1 | | | | |
| 3.92 | TFSI_2 | 60 | 1 | | | | |
| 9.09 | PFHxDA_1 | 90 | 1 | | | | |
| 9.09 | PFHxDA_2 | 90 | 1 | | | | |
| 9.09 | 13C2_PFHxDA | 90 | 1 | | | | |
| 9.44 | PFODA_1 | 90 | 1 | | | | |
| 9.44 | PFODA_2 | 90 | 1 | | | | |

**Table 11.10 – 5**
**Recommended Instrument Operating Conditions**
*Some parameters may be optimized for specific instrument performance requirements.

**Mass Spectrometer Scan Settings (SCIEX 7500)**

| RT | ID | MRM (win) | EP (volts) | CE (volts) | CXP (volts) |
|---|---|---|---|---|---|
| 0.86 | PFPrA | 45 | [redacted] | | |
| 0.86 | 13C3_PFPrA | 45 | | | |
| 1.95 | PFBA | 45 | | | |
| 1.95 | 13C3_PFBA | 45 | | | |
| 1.95 | 13C4_PFBA | 45 | | | |
| 2.11 | PFMPA | 45 | | | |
| 2.16 | 3:3 FTCA | 30 | | | |
| 2.16 | 3:3 FTCA_2 | 30 | | | |
| 2.34 | PFPeA | 30 | | | |
| 2.34 | PFPeA_2 | 30 | | | |
| 2.34 | 13C5_PFPeA | 30 | | | |

**Table 11.10 – 5**
**Recommended Instrument Operating Conditions**
*Some parameters may be optimized for specific instrument performance requirements.

| Mass Spectrometer Scan Settings (SCIEX 7500) | | | | | |
|---|---|---|---|---|---|
| **RT** | **ID** | **MRM (win)** | **EP (volts)** | **CE (volts)** | **CXP (volts)** |
| 2.48 | PFMBA | 30 | [redacted] | | |
| 3.45 | TFSI_1 | 30 | | | |
| 3.45 | TFSI_2 | 30 | | | |
| 3.12 | HFPO-DA | 30 | | | |
| 3.12 | HFPO-DA_2 | 30 | | | |
| 3.12 | 13C3_HFPO-DA | 30 | | | |
| 3.12 | 13C3_HFPO-DA_2 | 30 | | | |
| 2.79 | NFDHA | 30 | | | |
| 2.79 | NFDHA_2 | 30 | | | |
| 2.85 | PFBS | 30 | | | |
| 2.85 | PFBS_2 | 30 | | | |
| 2.85 | 13C3_PFBS | 30 | | | |
| 2.85 | 13C3_PFBS_2 | 30 | | | |
| 2.85 | PFHxA | 30 | | | |
| 2.85 | PFHxA_2 | 30 | | | |
| 3.24 | PFEESA (PES) | 30 | | | |
| 3.24 | PFEESA_2 (PES_2) | 30 | | | |
| 2.85 | 13C2_PFHxA | 30 | | | |
| 2.85 | 13C2_PFHxA_2 | 30 | | | |
| 2.85 | 13C5_PFHxA | 30 | | | |
| 2.85 | 13C5_PFHxA_2 | 30 | | | |
| 2.65 | 4:2 FTS | 30 | | | |
| 2.65 | 4:2 FTS_2 | 30 | | | |
| 2.65 | 13C2-4:2 FTS | 30 | | | |
| 2.65 | 13C2-4:2 FTS_2 | 30 | | | |
| 3.20 | 5:3 FTCA | 30 | | | |
| 3.19 | 5:3 FTCA_2 | 30 | | | |
| 3.83 | PFPeS | 30 | | | |
| 3.83 | PFPeS_2 | 30 | | | |
| 3.78 | PFHpA | 30 | | | |
| 3.78 | PFHpA_2 | 30 | | | |
| 3.78 | 13C4_PFHpA | 30 | | | |
| 4.24 | DONA | 30 | | | |
| 4.24 | DONA_2 | 30 | | | |
| 5.10 | PFHxS | 80 | | | |
| 5.10 | PFHxS_2 | 80 | | | |
| 5.10 | 13C3_PFHxS | 80 | | | |
| 5.10 | 13C3_PFHxS_2 | 80 | | | |
| 5.10 | 18O2_PFHxS | 80 | | | |
| 5.00 | PFOA | 80 | | | |
| 5.00 | PFOA_2 | 80 | | | |
| 3.87 | 13C2_PFOA (PRC) | 60 | | | |
| 5.00 | 13C4_PFOA | 80 | | | |
| 5.00 | 13C4_PFOA_2 | 80 | | | |
| 5.00 | 13C8_PFOA | 80 | | | |
| 4.63 | 6:2 FTS | 30 | | | |
| 4.63 | 6:2 FTS_2 | 30 | | | |
| 4.63 | 13C2-6:2 FTS | 30 | | | |
| 4.63 | 13C2-6:2 FTS_2 | 30 | | | |
| 5.81 | 7:3 FTCA | 30 | | | |
| 5.81 | 7:3 FTCA_2 | 30 | | | |
| 6.75 | PFHpS | 30 | | | |
| 6.75 | PFHpS_2 | 30 | | | |
| 6.40 | PFNA | 80 | | | |
| 6.40 | PFNA_2 | 80 | | | |
| 4.00 | TUDCA | 80 | | | |
| 4.00 | TCDCA | 80 | | | |
| 6.40 | 13C5_PFNA | 80 | | | |
| 6.40 | 13C9_PFNA | 80 | | | |
| 8.55 | PFOSA | 80 | | | |
| 8.55 | PFOSA | 80 | | | |
| 4.00 | TDCA | 120 | | | |
| 7.60 | PFOS | 90 | | | |
| 7.60 | PFOS_2 | 90 | | | |
| 7.60 | 13C4_PFOS | 90 | | | |
| 7.60 | 13C4_PFOS_2 | 90 | | | |
| 8.55 | 13C8_PFOSA | 80 | | | |
| 7.60 | 13C8_PFOS | 90 | | | |
| 7.60 | 13C8_PFOS_2 | 90 | | | |
| 11.00 | MeFOSA | 60 | | | |
| 11.00 | MeFOSA_2 | 60 | | | |
| 7.61 | PFDA | 40 | | | |

**Table 11.10 – 5**
**Recommended Instrument Operating Conditions**
*Some parameters may be optimized for specific instrument performance requirements.

| Mass Spectrometer Scan Settings (SCIEX 7500) | | | | | |
|---|---|---|---|---|---|
| **RT** | **ID** | **MRM (win)** | **EP (volts)** | **CE (volts)** | **CXP (volts)** |
| 7.61 | PFDA_2 | 40 | | | |
| 11.00 | d3MeFOSA | 60 | | | |
| 7.61 | 13C2_PFDA | 40 | | | |
| 7.61 | 13C6_PFDA | 40 | | | |
| 11.50 | EtFOSA | 60 | | | |
| 11.50 | EtFOSA_2 | 60 | | | |
| 7.23 | 8:2 FTS | 30 | | | |
| 7.23 | 8:2 FTS_2 | 30 | | | |
| 7.23 | 13C2-8:2 FTS | 30 | | | |
| 7.23 | 13C2-8:2 FTS_2 | 30 | | | |
| 8.42 | 9Cl-PF3ONS | 30 | | | |
| 11.50 | d5EtFOSA | 60 | | | |
| 8.42 | 9Cl-PF3ONS_2 | 30 | | | |
| 8.67 | PFNS | 30 | | | |
| 8.67 | PFNS_2 | 30 | | | |
| 8.47 | PFUdA | 30 | | | |
| 8.47 | PFUdA_2 | 30 | | | |
| 8.47 | 13C7_PFUdA | 30 | | | |
| 7.60 | N-MeFOSAA | 80 | | | |
| 7.60 | N-MeFOSAA_2 | 80 | | | |
| 7.60 | d3-MeFOSAA | 80 | | | |
| 7.90 | N-EtFOSAA | 80 | | | |
| 7.90 | N-EtFOSAA_2 | 80 | | | |
| 7.90 | d5-EtFOSAA | 80 | | | |
| 9.39 | PFDS | 30 | | | |
| 9.39 | PFDS_2 | 30 | | | |
| 9.18 | PFDoA | 30 | | | |
| 9.18 | PFDoA_2 | 30 | | | |
| 9.18 | 13C2_PFDoA | 30 | | | |
| 10.85 | N-MeFOSE | 60 | | | |
| 10.85 | d7-N-MeFOSE-M | 60 | | | |
| 11.30 | N-EtFOSE | 60 | | | |
| 9.83 | 11Cl-PF3OUdS | 30 | | | |
| 9.83 | 11Cl-PF3OUdS_2 | 30 | | | |
| 11.30 | d9-N-EtFOSE-M | 60 | | | |
| 9.81 | PFTrDA | 30 | | | |
| 9.81 | PFTrDA_2 | 30 | | | |
| 10.60 | PFDoS | 30 | | | |
| 10.60 | PFDoS_2 | 30 | | | |
| 10.40 | PFTeDA | 30 | | | |
| 10.40 | PFTeDA | 30 | | | |
| 10.40 | 13C2_PFTeDA | 30 | | | |
| 11.46 | PFHxDA | 30 | | | |
| 11.46 | PFHxDA_2 | 30 | | | |
| 11.46 | 13C2_PFHxDA | 30 | | | |
| 12.31 | PFODA | 30 | | | |
| 12.31 | PFODA_2 | 30 | | | |

**Table 11.10 – 6**
**Recommended Instrument Operating Conditions for Additional Analytes**
*Some parameters may be optimized for specific instrument performance requirements.

| Mass Spectrometer Scan Settings (SCIEX 7500) | | | | | |
|---|---|---|---|---|---|
| **RT** | **ID** | **MRM (win)** | **EP (volts)** | **CE (volts)** | **CXP (volts)** |
| 0.84 | MTP | 50 | | | |
| 1.24 | PFMOAA | 60 | | | |
| 1.92 | R-EVE | 45 | | | |
| 2.01 | Hydrolyzed PSDA | 45 | | | |
| 2.01 | R-PSDA | 30 | | | |
| 2.04 | PMPA | 45 | | | |
| 2.25 | PFO2HxA | 30 | | | |
| 2.30 | PFPrS | 30 | | | |
| 2.47 | PEPA | 30 | | | |
| 2.49 | 1-OSA | 45 | | | |
| 2.51 | NVHOS | 30 | | | |
| 3.00 | PFO3OA | 30 | | | |
| 3.18 | FBSA | 45 | | | |
| 3.41 | 6:2 FTUCA | 30 | | | |
| 3.41 | 6:2 FTUCA_2 | 30 | | | |
| 3.41 | 13C-6:2 FTUCA | 30 | | | |
| 3.44 | 6:2 FTCA | 25 | | | |

**Table 11.10 – 6**
**Recommended Instrument Operating Conditions for Additional Analytes**
*Some parameters may be optimized for specific instrument performance requirements.

| Mass Spectrometer Scan Settings (SCIEX 7500) | | | | | |
|---|---|---|---|---|---|
| **RT** | **ID** | **MRM (win)** | **EP (volts)** | **CE (volts)** | **CXP (volts)** |
| 3.44 | 6:2 FTCA_2 | 25 | [redacted] | | |
| 3.44 | 13C-6:2 FTCA | 25 | | | |
| 4.08 | PFPE-1 | 30 | | | |
| 4.58 | PFO4DA | 20 | | | |
| 4.75 | Hydro-EVE Acid | 80 | | | |
| 4.76 | EVE-Acid | 45 | | | |
| 5.42 | R-PSDCA | 45 | | | |
| 6.12 | 8:2 FTUCA | 30 | | | |
| 6.12 | 8:2 FTUCA_2 | 30 | | | |
| 6.12 | 13C-8:2 FTUCA | 30 | | | |
| 6.16 | 8:2 FTCA | 30 | | | |
| 6.16 | 8:2 FTCA_2 | 30 | | | |
| 6.16 | 13C-8:2 FTCA | 30 | | | |
| 6.16 | FHxSA | 45 | | | |
| 6.33 | PS Acid | 60 | | | |
| 6.17 | Hydro PS Acid | 80 | | | |
| 6.47 | PFO5DA | 30 | | | |
| 6.54 | PFECHS | 45 | | | |
| 6.54 | PFECHS_2 | 45 | | | |
| 7.17 | HFPO-TrA | 45 | | | |
| 7.78 | PFO6TeA | 30 | | | |
| 8.12 | 10:2 FTUCA | 30 | | | |
| 8.12 | 13C-10:2 FTUCA | 30 | | | |
| 8.12 | 10:2 FTCA | 30 | | | |
| 8.12 | 10:2 FTCA_2 | 30 | | | |
| 8.12 | 13C-10:2 FTCA | 30 | | | |
| 8.89 | 10:2 FTS | 30 | | | |
| 8.89 | 10:2 FTS_2 | 30 | | | |
| 8.89 | 13C2-10:2 FTS | 30 | | | |
| 9.48 | HFPO-TeA | 30 | | | |
| 9.79 | 6:2-DiPAP | 30 | | | |
| 9.79 | 6:2-DiPAP_2 | 30 | | | |
| 9.79 | 13C4-6:2-DiPAP | 30 | | | |
| 9.79 | 13C4-6:2-DiPAP_2 | 30 | | | |
| 10.02 | PFUdS | 30 | | | |
| 10.02 | PFUdS_2 | 30 | | | |
| 10.77 | 6:2/8:2-DiPAP | 30 | | | |
| 10.77 | 6:2/8:2-DiPAP_2 | 30 | | | |
| 11.13 | PFTrDS | 30 | | | |
| 11.13 | PFTrDS_2 | 30 | | | |
| 11.66 | 8:2-DiPAP | 30 | | | |
| 11.66 | 8:2-DiPAP_2 | 30 | | | |
| 11.66 | 13C4-8:2-DiPAP | 30 | | | |
| 11.66 | 13C4-8:2-DiPAP_2 | 30 | | | |

**Table 11.10 – 7**
**Retention Times & Quantitation**
*Some parameters may be optimized for specific instrument performance requirements.

| Native Compounds | Typical Native RT (minutes) | IDA analog | Typical IDA RT (minutes) | Quantitation Method |
|---|---|---|---|---|
| PFBA | 2.54 | 13C4_PFBA | 2.54 | Isotope Dilution |
| 3:3 FTCA | 2.9 | 13C5_PFPeA | 2.98 | Isotope Dilution |
| PFPeA | 2.97 | 13C5_PFPeA | 2.97 | Isotope Dilution |
| PFBS | 2.98 | 13C3_PFBS | 2.98 | Isotope Dilution |
| PFMBA | 3 | 13C5_PFPeA | 2.97 | Isotope Dilution |
| PFEESA (PES) | 3.09 | 13C5_PFHxA | 2.98 | Isotope Dilution |
| NFDHA | 3.21 | 13C5_PFHxA | 3.35 | Isotope Dilution |
| 4:2 FTS | 3.28 | 13C2_4:2FTS | 3.28 | Isotope Dilution |
| PFHxA | 3.35 | 13C5_PFHxA | 3.35 | Isotope Dilution |
| PFPeS | 3.45 | 13C3_PFHxS | 2.98 | Isotope Dilution |
| HFPO-DA | 3.46 | 13C3_HFPO-DA | 3.46 | Isotope Dilution |
| 5:3 FTCA | 3.7 | 13C5_PFHxA | 3.77 | Isotope Dilution |
| PFMPA | 3.08 | 13C5_PFPeA | 3.77 | Isotope Dilution |
| PFHpA | 3.74 | 13C4_PFHpA | 3.74 | Isotope Dilution |
| PFHxS | 3.74 | 13C3_PFHxS | 3.74 | Isotope Dilution |
| DONA | 3.79 | 13C3_HFPO-DA | 4.5 | Isotope Dilution |
| 6:2 FTS | 4.12 | 13C2_6:2FTS | 4.12 | Isotope Dilution |
| PFOA | 4.14 | 13C8_PFOA | 4.14 | Isotope Dilution |
| 13C2_PFOA (PRC) | 4.14 | 13C8_PFOA | 4.14 | Isotope Dilution |

**Table 11.10 – 7**
**Retention Times & Quantitation**
*Some parameters may be optimized for specific instrument performance requirements.

| Native Compounds | Typical Native RT (minutes) | IDA analog | Typical IDA RT (minutes) | Quantitation Method |
|---|---|---|---|---|
| PFHpS | 4.14 | 13C8_PFOS | 4.5 | Isotope Dilution |
| 7:3 FTCA | 4.5 | 13C5_PFHxA | 4.55 | Isotope Dilution |
| PFOS | 4.5 | 13C8_PFOS | 4.5 | Isotope Dilution |
| PFNA | 4.52 | 13C9_PFNA | 4.52 | Isotope Dilution |
| 9Cl-PF3ONS | 4.69 | 13C3_HFPO-DA | 4.5 | Isotope Dilution |
| PFOSA | 4.82 | 13C8_PFOSA | 4.82 | Isotope Dilution |
| PFNS | 4.83 | 13C8_PFOS | 4.5 | Isotope Dilution |
| PFDA | 4.86 | 13C6_PFDA | 4.86 | Isotope Dilution |
| 8:2 FTS | 4.86 | 13C2_8:2FTS | 4.86 | Isotope Dilution |
| N-MeFOSAA | 5.03 | d3-MeFOSAA | 5.03 | Isotope Dilution |
| PFDS | 5.16 | 13C8_PFOS | 4.5 | Isotope Dilution |
| PFUdA (PFUnA) | 5.19 | 13C7_PFUdA | 5.19 | Isotope Dilution |
| N-EtFOSAA | 5.19 | d5-EtFOSAA | 5.19 | Isotope Dilution |
| N-MeFOSE | 5.25 | d7N-MeFOSE | 5.25 | Isotope Dilution |
| MeFOSA | 5.26 | d3-MeFOSA | 5.26 | Isotope Dilution |
| 11Cl-PF3OUdS | 5.31 | 13C3_HFPO-DA | 4.5 | Isotope Dilution |
| N-EtFOSE | 5.4 | d9N-EtFOSE | 5.4 | Isotope Dilution |
| EtFOSA | 5.44 | d5-EtFOSA | 5.44 | Isotope Dilution |
| PFDoA | 5.47 | 13C2_PFDoA | 5.47 | Isotope Dilution |
| PFDoS | 5.72 | 13C8_PFOS | 4.5 | Isotope Dilution |
| PFTrDA | 5.75 | 13C2_PFDoA/13C2_PFTeDA | 5.47 | Isotope Dilution |
| PFTeDA | 5.99 | 13C2_PFTeDA | 5.99 | Isotope Dilution |
| PFPrA | 1.2 | 13C3_PFPrA | 1.2 | Isotope Dilution |
| TFSI | 3.92 | 13C4_PFBA | 2.09 | Isotope Dilution |
| PFHxDA | 9.09 | 13C2_PFHxDA | 9.09 | Isotope Dilution |
| PFODA | 9.44 | 13C2_PFHxDA | 9.09 | Isotope Dilution |

**Table 11.10 – 8**
**Extended List Retention Times & Quantitation**
*Some parameters may be optimized for specific instrument performance requirements.

| Native Compound | Typical Native RT (minutes) | IDA analog | Typical IDA RT (minutes) | Quantitation Method |
|---|---|---|---|---|
| MTP | 0.84 | 13C4_PFBA | 1.95 | Isotope Dilution |
| PFMOAA | 1.24 | 13C4_PFBA | 1.95 | Isotope Dilution |
| R-EVE | 1.92 | 13C4_PFBA | 1.95 | Isotope Dilution |
| Hydrolyzed PSDA | 2.01 | 13C4_PFBA | 1.95 | Isotope Dilution |
| R-PSDA | 2.01 | 13C4_PFBA | 1.95 | Isotope Dilution |
| PMPA | 2.04 | 13C4_PFBA | 1.95 | Isotope Dilution |
| PFO2HxA | 2.25 | 13C5_PFPeA | 2.34 | Isotope Dilution |
| PFPrS | 2.30 | 13C3_PFBS | 2.85 | Isotope Dilution |
| PEPA | 2.47 | 13C5_PFPeA | 2.34 | Isotope Dilution |
| 1-OSA | 2.49 | 13C3_PFBS | 2.85 | Isotope Dilution |
| NVHOS | 2.51 | 13C4_PFBA | 1.95 | Isotope Dilution |
| PFO2OA | 3.00 | 13C5_PFHxA | 2.85 | Isotope Dilution |
| FBSA | 3.18 | 13C5_PFHxA | 2.85 | Isotope Dilution |
| 6:2 FTUCA | 3.41 | 13C-6:2 FTUCA | 3.41 | Isotope Dilution |
| 6:2 FTCA | 3.44 | 13C-6:2 FTCA | 3.44 | Isotope Dilution |
| PFPE-1 | 4.08 | 13C4_PFHpA | 3.78 | Isotope Dilution |
| PFO4DA | 4.58 | 13C4_PFHpA | 3.78 | Isotope Dilution |
| Hydro-EVE Acid | 4.75 | 13C4_PFHpA | 3.78 | Isotope Dilution |
| EVE-Acid | 4.76 | 13C8_PFOA | 5.00 | Isotope Dilution |
| R-PSDCA | 5.42 | 13C4_PFHpA | 3.78 | Isotope Dilution |
| 8:2 FTUCA | 6.12 | 13C-8:2 FTUCA | 6.12 | Isotope Dilution |
| 8:2 FTCA | 6.16 | 13C-8:2 FTCA | 6.16 | Isotope Dilution |
| FHxSA | 6.16 | 13C8_PFOA | 5.00 | Isotope Dilution |
| PS Acid | 6.33 | 13C8_PFOA | 5.00 | Isotope Dilution |
| Hydro PS Acid | 6.17 | 13C4_PFHpA | 3.78 | Isotope Dilution |
| PFO5DA | 6.47 | 13C8_PFOA | 5.00 | Isotope Dilution |
| PFECHS | 6.54 | 13C8_PFOA | 5.00 | Isotope Dilution |
| HFPO-TrA | 7.17 | 13C3_HFPO-DA | 3.12 | Isotope Dilution |
| PFO6TeA | 7.78 | 13C6_PFDA | 7.61 | Isotope Dilution |

| Table 11.10 – 8<br>Extended List Retention Times & Quantitation<br>*Some parameters may be optimized for specific instrument performance requirements. | | | | |
|---|---|---|---|---|
| **Native Compound** | **Typical Native RT (minutes)** | **IDA analog** | **Typical IDA RT (minutes)** | **Quantitation Method** |
| 10:2 FTUCA | 8.12 | 13C-10:2 FTUCA | 8.12 | Isotope Dilution |
| 10:2 FTCA | 8.12 | 13C-10:2 FTCA | 8.12 | Isotope Dilution |
| 10:2 FTS | 8.89 | 13C2-10:2 FTS | 8.89 | Isotope Dilution |
| HFPO-TeA | 9.48 | 13C3_HFPO-DA | 3.12 | Isotope Dilution |
| 6:2-DiPAP | 9.79 | 13C4-6:2-DiPAP | 9.79 | Isotope Dilution |
| PFUdS | 10.02 | 13C8_PFOS | 7.60 | Isotope Dilution |
| 6:2/8:2-DiPAP | 10.77 | 13C4-6:2-DiPAP | 9.79 | Isotope Dilution |
| PFTrDS | 11.13 | 13C8_PFOS | 7.60 | Isotope Dilution |
| 8:2-DiPAP | 11.66 | 13C4-8:2-DiPAP | 11.66 | Isotope Dilution |

| Table 11.10 – 9<br>Retention Times & Quantitation<br>*Some parameters may be optimized for specific instrument performance requirements. | | | | |
|---|---|---|---|---|
| **IDA** | **Typical IDA RT (minutes)** | **IS analog** | **Typical RT (minutes)** | **Quantitation Method** |
| 13C4_PFBA | 2.08 | 13C3_PFBA | 2.09 | Internal Standard |
| 13C5_PFPeA | 3.71 | 13C2_PFHxA | 4.62 | Internal Standard |
| 13C5_PFHxA | 4.62 | 13C2_PFHxA | 4.62 | Internal Standard |
| 13C4_PFHpA | 5.34 | 13C2_PFHxA | 4.62 | Internal Standard |
| 13C8_PFOA | 5.94 | 13C4_PFOA | 5.94 | Internal Standard |
| 13C9_PFNA | 6.43 | 13C5_PFNA | 4.52 | Internal Standard |
| 13C6_PFDA | 6.88 | 13C2_PFDA | 4.86 | Internal Standard |
| 13C7_PFUnA | 7.32 | 13C2_PFDA | 6.88 | Internal Standard |
| 13C2_PFDoA | 7.72 | 13C2_PFDA | 6.88 | Internal Standard |
| 13C2_PFTeDA | 8.42 | 13C2_PFDA | 6.88 | Internal Standard |
| 13C3_PFBS | 4.50 | 18O2_PFHxS | 6.00 | Internal Standard |
| 13C3_PFHxS | 6.00 | 18O2_PFHxS | 6.00 | Internal Standard |
| 13C8_PFOS | 6.98 | 13C4_PFOS | 6.98 | Internal Standard |
| 13C2_4:2FTS | 4.41 | 18O2_PFHxS | 6.00 | Internal Standard |
| 13C2_6:2FTS | 5.75 | 18O2_PFHxS | 6.00 | Internal Standard |
| 13C2_8:2FTS | 6.72 | 18O2_PFHxS | 6.00 | Internal Standard |
| 13C8_PFOSA | 8.01 | 13C4_PFOS | 6.98 | Internal Standard |
| d3-MeFOSA | 9.49 | 13C4_PFOS | 6.98 | Internal Standard |
| d5-EtFOSA | 9.81 | 13C4_PFOS | 6.98 | Internal Standard |
| d3-MeFOSAA | 6.93 | 13C4_PFOS | 6.98 | Internal Standard |
| d5-EtFOSAA | 7.10 | 13C4_PFOS | 6.98 | Internal Standard |
| d7N-MeFOSE | 9.37 | 13C4_PFOS | 6.98 | Internal Standard |
| d9N-EtFOSE | 9.68 | 13C4_PFOS | 6.98 | Internal Standard |
| 13C3_HFPO-DA | 4.90 | 13C2_PFHxA | 4.62 | Internal Standard |
| 13C3_PFPrA | 1.2 | 13C3_PFBA | 2.09 | Internal Standard |
| 13c2_PFHxDA | 9.09 | 13C2_PFDA | 6.88 | Internal Standard |

| Table 11.10 – 10<br>Extended List Retention Times & Quantitation<br>*Some parameters may be optimized for specific instrument performance requirements. | | | | |
|---|---|---|---|---|
| **IDA** | **Typical IDA RT (minutes)** | **IS analog** | **Typical IS RT (minutes)** | **Quantitation Method** |
| 13C-6:2 FTUCA | 3.41 | 13C2_PFHxA | 2.85 | Internal Standard |
| 13C-6:2 FTCA | 3.44 | 13C2_PFHxA | 2.85 | Internal Standard |
| 13C-8:2 FTUCA | 6.12 | 13C5_PFNA | 6.40 | Internal Standard |
| 13C-8:2 FTCA | 6.16 | 13C2_PFDA | 7.61 | Internal Standard |
| 13C-10:2 FTUCA | 8.12 | 13C2_PFDA | 7.61 | Internal Standard |
| 13C-10:2 FTCA | 8.12 | 13C2_PFDA | 7.61 | Internal Standard |
| 13C2-10:2 FTS | 8.89 | 13C8_PFOS | 7.60 | Internal Standard |
| 13C4-6:2-DiPAP | 9.79 | 13C2_PFDA | 7.61 | Internal Standard |
| 13C4-8:2-DiPAP | 11.66 | 13C2_PFDA | 7.61 | Internal Standard |

11.11.1. Tune and calibrate the instrument as described in Section 10.

11.11.2. A **DoD** analytical sequence **is no more than 20 samples. The example below is for two analytical sequences analyzed back to back and** is as follows:

- CCB (Continuing Calibration Blank)
- CCVL (referred to as an ISC in Method 1633)
- CCV:
- CCB (Continuing Calibration Blank)
- Method blank
- LLCS
- LCS
- WDM (Bile salt interference check)
- 10 samples
- CCV:
- CCB

· 10 more samples
· CCV:
· CCB: (Used to close out the initial analytical sequence and start the second analytical sequence)
· CCVL (referred to as an ISC in Method 1633)
· CCV:
· CCB (Continuing Calibration Blank)
· Method blank
· LLCS
· LCS
· WDM (Bile salt interference check)
· 10 samples
· CCV:
· CCB
· 10 more samples
· CCV:
· CCB

A **Commercial** analytical sequence can run continuously as long as CCV remain in control. The example below is an extended analytical sequence and is as follows:
· CCB (Continuing Calibration Blank)
· CCVL (referred to as an ISC in Method 1633)
· CCV:
· CCB (Continuing Calibration Blank)
· Method blank
· LLCS
· LCS
· WDM (Bile salt interference check)
· 10 samples
· CCV:
· CCB
· 10 more samples
· CCV:
· CCB:
· 10 samples
· CCV:
· CCB
· 10 more samples
· CCV:
· CCB,
· etc.

11.12. Vortex all sample aliquots and standards prior to placing on the autosampler.

11.13. Samples analyzed subsequent to any sample with results at or above the upper calibration limit must be evaluated for potential carryover, and corrective actions taken, as detailed below.

11.13.1. If carryover is suspected, those samples are to be re-analyzed from a fresh extract aliquot (i.e., go aliquot the archive of the extract).

11.13.2. Should there be instrument contamination, as evident by sample carryover, any sample >5X the UCL or instrument blanks with detections > RL:
· Analyze 20 blanks alternating between 1% formic acid/methanol and 1% formic acid/water.
· Then analyze 3 methanol only blanks.
· If the system is clean, resume analyses. Proceed to 11.11.4. If not clean, proceed as directed below.

11.13.3. If the system is still contaminated the following items might need to be cleaned or replaced:
· Reverse flush the analytical column.
· Reverse flush the isolation column.
· Replace the column (isolation, analytical or both).
· Clean the cones/entry port.
· Replace the PEEK tubing in the sample pathway.
· Then, repeat 11.11.2.

11.13.4. Should a high-level sample be analyzed that triggers these steps then detections for those analytes over the next 2-3 days require additional evaluation (are all instrument blanks from the sequence < ½ RL) and possible re-analysis. If sample results replicate and the associated instrument blanks from the sequences are <1/2 RL, then one can assume the system is under control and confirmation of positive detections can stop.

## 12) Calculations/Data Reduction

12.1. If the concentration of the analyte ions exceeds the working range as defined by the calibration standards, then the sample might require to be diluted and reanalyzed, based upon client need. It may be necessary to dilute samples due to matrix.

12.1.1. Sample extracts analyzed subsequent to an extract that has an analyte(s) exceed the working range must be thoroughly evaluated for carryover.

12.1.2. The IDA recoveries in the diluted extract are to meet acceptance limits stored in TALS and have S/N $\geq$ 20:1.

12.2. For DoD/DOE QSM, the sample results must be within the calibration range. The extracts can be diluted up to no more than 100X without diluting out the IDA, in some cases, and thus preserving quantitation via isotope dilution. IDA recovery

must be >5% in the dilution.

12.2.1. If larger than a 100X dilution is needed contact client for course of action.

12.3. Results less than the reporting limit are flagged in the client report as estimated. Generally, the "J" flag is used to denote ≥ MDL and ≤ RL, but the specific flag may change based on client requirements.

12.4. Qualitative Identification

12.4.1. The IS areas in the field samples and the QC samples must be within 50-200% of the mean area of the corresponding IS in the most recent initial calibration. Results for the target analytes are recovery corrected by the method of quantification. IDA recoveries are determined against the IS and are used as general indicators of overall analytical quality. The IS has no impact on the target analyte result.

12.4.2. The ratio requirement does not apply for PFPrA, PFBA, PFPeA, NMeFOSE, NEtFOSE, PFMPA, and PFMBA. Many of the IDA and IS compounds do not produce useful confirmation ions under the instrumental operating parameters. Therefore, monitoring the confirmation ions for the IDA and IS compounds is optional.

12.4.3. The retention times of PFAS with labeled standards should be the same as that of the labeled IDA's to within 0.1 min. For PFAS with no labeled standards, the RT must be within ± 0.4 minutes of the ICAL or the most recent CCV standard.

***Note:*** *The IDA RT and native RT may be offset by 0.02 to 0.04 minutes.*

12.4.4. PFBS, PFHxS, PFOS, PFOA, PFNA, Me-FOSE, Et-FOSE, FOSA, Me-FOSA, Et-FOSA, Me-FOSAA, and Et-FOSAA have multiple chromatographic peaks using the LC conditions specified in the method due to the linear and branch isomers of these compounds. Most PFAS compounds are produced by one of two processes. One gives rise to linear PFAS only while the other process produces both linear and branched isomers. Both branched and linear PFAS compounds can potentially be found in the environment. For the aforementioned compounds that give rise to more than one peak, all chromatographic peaks observed in the standard must be integrated and the areas totaled. Chromatographic peaks in the sample must be integrated in the same way as the calibration standard and concentrations reported as a total for each of these analytes.

12.4.5. The expected retention times (RT) are established in the Chrom data processing module during the processing of the ICAL by selecting Edit>Method>Update RT. Once the retention times are established Chrom will look for a peak within ± 0.25 minutes of the RT. The analyst confirms that the branched isomers present in the quantitative calibration standards for PFOS, PFOA, PFHxS, PFNA, Me-FOSE, Et-FOSE, FOSA, Me-FOSA, Et-FOSA, Et-FOSAA and Me-FOSAA are within the ± 0.25 minute window. If they are not, an adjustment to the RT window is made. The analyst confirms the presence of the branched isomers in the technical (qualitative) standard as well, and adjusts the RT window for an analyte if it is not present within the ± 0.25 minute window.

12.4.5.1. If a peak is detected within this window of ±0.25 minutes, Chrom will assign the absolute retention time at the apex of the peak. Chrom assigns the RT to the most predominant peak within this window. As the linear peak is the predominant peak in calibration solutions for those PFAS that are calibrated with the combination of both branched and linear isomers, those PFAS require additional evaluation in the event that the branched isomer is the predominant peak in a field sample and Chrom has not positively identified the peak due to the RT shift, as the apex may now be the branched isomer.

12.4.5.2. Additional evaluation is required if the field samples contain branched isomers not present in the quantitative or qualitative standards. The analyst confirms that only the peaks present in the calibration standards are included in the peak integration, or adjusts the peak integration to assure that only the peaks present in the standards are identified and quantitated.

12.4.5.3. RT are updated as needed based upon evaluation of the daily CCV.

12.4.6. The signal to noise ratio for both quantitative and qualitative ions/transitions must be ≥ 3:1 or >10:1 if the analyte only has a single transition for a baseline deflection to be considered a peak. If this criterion is not met, the analyte is not considered and reported as "non-detect".

12.5. The ICAL established in Section 10 is used to calculate concentrations for the extracts.

12.6. Extract concentrations are calculated as below. The first equation applies Average Response Factor model, the second to a linear fit, and the third to the quadratic line fit.

$$Concentration\ (ng/mL) = \frac{y}{RRF}$$

**Equation 4**

$$Concentration\ (ng/mL) = \frac{y-c}{b}$$

**Equation 5**

$$Concentration\ (ng/mL) = \frac{-b \pm \sqrt{b^2-4ac-y}}{2a}$$

**Equation 6**

Where:

y = $\frac{Area_{Target}}{Area_{IDA}} \times Concentration(IDA)$

RRF = Relative Response Factor

x = concentration

a = curvature

b = slope

c = intercept

12.7. Water Sample Result Calculation:

$$Concentration\ (ng/L) = \frac{C_{ex}V_t}{V_o}$$

**Equation 7**

Where:

$C_{ex}$ = Concentration measured in sample extract (ng/mL)

$V_t$ = Volume of total extract (mL)

$V_o$ = Volume of water extracted (L), i.e. total volume fortified with IDA

12.8. Soil Sample Result Calculation:

$$Concentration\ (ng/g) = \frac{C_{ex}V_t}{W_sD}$$

**Equation 8**

Where ng/g = mg/kg and:

$C_{ex}$ = Concentration measured in sample extract (ng/mL)

$V_t$ = Volume of total extract (mL)

$W_s$ = Weight of sample extracted (g)

$D$ = Fraction of dry solids, which is calculated as follows:

$$\frac{100 - \%\ moisture\ in\ sample}{100}$$

(for dry weight result)

12.9. IDA Recovery Calculation:

$$\%\ Recovery = \frac{A_{IDA}Q_{IS}}{A_{IS}Q_{IDA}RRF_{IDA}} \times 100$$

**Equation 9**

Where:

$RRF_{IDA}$ = Response Factor for IDA compound

$A_{IDA}$ = Area response for IDA compound

$A_{IS}$ = Area Response for IS compound

$Q_{IS}$ = Amount of IS added

$Q_{IDA}$ = Amount of IDA added

12.10. Raw data, calibration summaries, QC data, and sample results are reviewed by the analyst. These must also be reviewed thoroughly by a second qualified person. See the Data Review Policy (*SAC-QA-P-QP71754*). These reviews are documented in TALS.

## 13) Method Performance

13.1. The group/team leader has the responsibility to ensure that this procedure is performed by an associate who has been properly trained in its use and has the required expertise.

13.2. Method Detection Limit

The laboratory must generate a valid method detection limit for each analyte of interest. The MDL must be below the reporting limit for each analyte. The procedure for determination of the method detection limit is given in 40 CFR Part 136, Appendix B, and further defined in SOP *QA-SOP71736* and policy *SAC-QA-P-QP71748*. MDLs are available in the Quality Assurance Department.

13.2.1. As MDL studies are run on clean laboratory matrices, statistically derived MDL values could be artificially lower than achievable limits in real world samples. Nominal MDL values, set at no lower than ¼ the calculated and verified Reporting Limit (or Limit of Quantitation) will be used as a method to avoid artificially low bias in MDL studies.

13.3. Initial Demonstration of Capability (IDOC)

13.3.1. The method initial demonstration of capability is performed by processing 4 LCS samples and a method blank. Compare the average recovery and RSD to the IPR limits in Table 5 for aqueous samples and Table 7 for solid, biosolids and tissue samples of the reference method, respectively**.**

13.3.2. Each analyst performing this procedure must successfully analyze four LCS QC samples and compare the average recovery and RSD to the IPR limits in Table 5 for aqueous samples and Table 7 for solid, biosolids and tissue samples of the reference method, respectively**. While there are no mean or RSD requirements for IDA, recoveries for each IDA must be within the specified limits. IDOCs are approved by the Quality Assurance Manager and the Technical Director. IDOC records are maintained by the QA staff in the central training files.**

## 14) Pollution Control

14.1. All waste will be disposed of in accordance with Federal, State and Local regulations.

14.2. Solid phase extraction used for water samples greatly reduces the amount of solvent used compared to liquid-liquid extraction.

14.3. Standards and reagents are purchased and prepared in volumes consistent with laboratory use to minimize the volume of expired standards and reagents requiring disposal.

14.4. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this method and the policies in Section 13 of the HSE Manual (*NDSC-US EHS-QP46060*) for "Waste Management and Pollution Prevention."

14.5. Do not allow waste solvent to vent into the hoods. All solvent waste is stored in capped containers unless waste is being transferred.

14.6. Transfer waste solvent from collection cups (tri-pour and similar containers) to jugs and/or carboys as quickly as possible to minimize evaporation.

## 15) Waste Management

Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference *SOP SAC-R-EHS-SOP70446*.

The following waste streams are produced when this method is carried out:

15.1. Assorted test tubes, autovials, syringes, filter discs and cartridges. Dump the dry solid waste into a yellow contaminated lab trash bucket. When the bucket is full or after no more than one year, whichever comes first, tie the plastic bag liner shut and put the lab trash into the hazardous waste – landfill steel collection drum in the H3 closet. When the drum is full or after no more than 75 days, whichever comes first, move it to the waste collection area for shipment.

15.2. Extracted soil samples, used sodium sulfate, paper funnel filters, glass wool, thimbles, and extracted solids saturated with solvents. Dump these materials into an orange contaminated lab trash bucket. When the bucket is full or after no more than one year, whichever comes first, tie the plastic bag liner shut and put the lab trash into the incineration steel collection drum in the H3 closet. When the drum is full or after no more than 75 days, whichever comes first, move it to the waste collection area for shipment.

15.3. Waste Methanol. Collect the waste solvents in tripours during use. Empty the tripours into a 1-liter to 4-liter carboy at the fume hood. When the carboy is full, or at the end of your shift, whichever comes first, empty the carboy into the steel flammable solvent drum in the H3 closet. When the drum is full to between four and six inches of the top, or after no more than 75 days, whichever comes first, move the steel flammable solvent drum to the waste collection area for shipment.

15.4. Mixed water/methanol waste from soil extraction. Collect the waste in the HPLC waste carboy. When full, or after no more than one year, whichever comes first, dump into the blue plastic HPLC collection drum in the H3 closet. When the drum is full to between four and six inches of the top or after no more than 75 days, whichever comes first, move it to the waste collection area for shipment.

15.5. Aqueous acidic waste from the LCMS instrument contaminated with methanol. This is collected in a 1-gallon carboy at the instrument. When the carboy is full, or after no more than one year, whichever comes first, it is emptied into the blue plastic HPLC collection drum in the H3 closet. When the drum is full to between four and six inches of the top or after no more than 75 days, whichever comes first, move it to the waste collection area for shipment.

15.6. Autovials contaminated with methanol. As the autovials are removed from the instrument after analysis, they are collected in open containers at the instrument. After all autovials are removed, the open container must be dumped into a closed satellite collection container in a fume hood, as the punctured septa in the autovial can allow methanol and other contaminants to evaporate into the atmosphere. The satellite collection containers are transferred to the waste disposal area when full or after no more than one year, whichever comes first, where they are disposed through the vial eater or by consolidation into a 30- to 55-gallon open top plastic drum, which is shipped after no more than 90 days.

## 16) Method Modifications

16.1. Modifications from Method 1633 are detailed below:

16.1.1. Water samples are extracted at 125 mL. Soil samples are extracted at 2 g. Tissue sample extract final volume is 10 mL.

16.1.2. The SPE column incorporates [redacted]. Column washing and elution procedures are modified accordingly. Loose carbon is no longer used.

16.1.3. The calibration scheme has been updated to align with the current Eurofins LC/MS instrumentation and sensitivity.

16.1.4. Additional analytes have been added.

16.1.5. The analytical column, while still C18 based, has been changed.

16.1.6. Extraction solvents have been updated to improve method performance.

16.1.7. The solid and tissue extraction procedures were updated to improve method performance.

16.1.8. The Qualitative Identification Standard is not analyzed as all components identified in the reference method now have quantitative grade equivalents which are incorporated into the calibration solutions.

16.1.9. IDA corrective action/acceptability logic elucidated. See Section 9.11.2.

16.1.10. Mass Transition Ion Ratio corrective action/acceptability logic elucidated. See Section 9.12 (2X rule).

16.1.11. Immediately following the loading of aqueous samples onto the SPE columns, sample bottles are rinsed with reagent water, and the reagent water added to the column reservoir. This step is in addition to the basic methanol rinse as part

of the SPE elution step.

16.1.12. The mass transition for 13C4-PFOA is 417 > 372, not 417 > 172 as listed in the reference method. Signal strength is much stronger using this transition set.

16.1.13. The molarity of the eluent mobile phase is changed from 2 mM to 5 mM as to improve analyte responsiveness and instrument performance.

16.1.14. The mass transition for PFTeDA is 713 > 168.9 and 713 > 219, not 713 > 669 and 713 > 168.9, as listed in the reference method. Signal strength is significantly stronger using this transition set.

16.1.15. pH adjustment to aqueous samples are made with acetic acid and 1N NaOH and not formic acid and ammonium hydroxide as listed in the reference method.

16.1.16. The cleaning of the SPE manifolds has been updated to reflect our current practice, which was modified from the reference method by using methanol instead of methanolic ammonium hydroxide.

***Note:*** *A detailed comparison of the reference method specifications vs. Eurofins' application of method 1633/1633A is maintained by the QA department.*

## 17) Appendices

17.1. Table 17.1, Water IDA Limits. See the reference method for IDA limits for leachates, soil/sediment, tissue and biosolids.

**TABLE 17.1**
**Water IDA Limits**

| IDA | Lower Limit | Upper Limit |
|---|---|---|
| 13C4 PFBA | 5 | 130 * |
| 13C PFPeA | 40 | 130 |
| 13C PFHxA | 40 | 130 |
| 13C PFHpA | 40 | 130 |
| 13C PFOA | 40 | 130 |
| 13C PFNA | 40 | 130 |
| 13C PFDA | 40 | 130 |
| 13C PFUnA | 30 | 130 |
| 13C PFDoA | 10 | 130 |
| 13C PFTeDA | 10 | 130 |
| 13C PFBS | 40 | 135 |
| 13C PFHxS | 40 | 130 |
| 13C PFOS | 40 | 130 |
| 13C PFOSA | 40 | 130 |
| d3 NEtFOSA | 10 | 130 |
| d5 NMeFOSA | 10 | 130 |
| d9 NEtFOSE | 10 | 130 |
| d7 NMeFOSE | 10 | 130 |
| d5 NEtFOSAA | 25 | 135 |
| d3 NMeFOSAA | 40 | 170 |
| 13C 4:2 FTS | 40 | 200 |
| 13C 6:2 FTS | 40 | 200 |
| 13C 8:2 FTS | 40 | 300 |
| 13C HFPO-DA | 40 | 130 |

* Recovery of $_{13}C_4$-PFBA can be problematic in some field samples. Although the lower limit for recovery for this EIS is set below 10%, laboratories should routinely track recovery of this EIS and take reasonable steps to ensure that recovery is at least 10% in the majority of samples

QA-SOP70881 Nonconformance and Corrective Action System
QA-SOP71736 Detection and Quantitation Limits (Addendum to CA-Q-S-006) [Quality Assurance Procedure]
NDSC-US-EHS-QP46060 Environmental Health and Safety (HSE) Manual
NDSC-US-TS-QP44940 Calibration Curves and the Selection of Calibration Points
SAC-LC-WI81787 Procedure to Employ When the SPE Clogs for 1633/1633A DoD Work
SAC-QA-P-QP71748 Quality Control Program
SAC-QA-P-QP71754 Technical Data Review Requirements
SAC-QA-QAM-QM69954 Quality Assurance Manual
SAC-QA-SOP71665 Standards and Reagents and Quality Control Check Procedures [Quality Assurance Procedure]
SAC-QA-SOP71742 Subsampling and Compositing of Samples [Method ASTM D 6323-98]
SAC-R-EHS-SOP70446 Waste Disposal
SAC-R-EHS-SOP70477 Sacramento Addendum to Environmental Health & Safety Manual
SAC-T-OP-SOP70329 Cleaning of Glassware (Organics)

End of document

**Version history**

| Version | Approval | Revision information | |
|---|---|---|---|
| 3.1 | 01.AUG.2025 | | |
| 3.2 | 26.AUG.2025 | | |
| 3.3 | 27.AUG.2025 | | |

# ATTACHMENT B

## Field Forms

# Daily Field Activity Log

GSI ENVIRONMENTAL

GSI Job No. _____ Date: _____

Project: _____ Personnel: _____

| *TIME* | *ACTIVITY* |
|---|---|
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# GSI ENVIRONMENTAL INC.
## GSI PERSONNEL ONLY
## DAILY TAILGATE SAFETY MEETING

Project/Location: _____ GSI Job No._____

_____ Date: _____

Site Safety Officer:_____

Meeting Conducted By: _____

Meeting Attended By:

| NAME | SIGNATURE | TIME ONSITE-OFFSITE |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

_____ ***Non-GSI*** Personnel Present (Use Attachment A).

| Task | Hazard(s)* | PPE |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

| *Hazard | Hazard Description | How to Mitigate |
|---|---|---|
| Mechanical (M) | | |
| Weather (W) | | |
| Chemical (C) | | |
| Biological (B) | | |
| Other (O) | | |

Air Quality Monitoring: _____ Required (See record on Attachment B.) _____ Not Required

Site Safety Officer: _____ *"I have reviewed project tasks/hazards with the field team and have visually inspected the work area for proper housekeeping and other potential hazards (e.g., slip, trip, pinch points)."*

Signature: _____ Date: _____

HEAVY EQUIPMENT USE (IF APPLICABLE – USE ATTACHMENT A)

Type of Equipment & Model: _____ Company: _____

ACCIDENTS/INJURIES/INCIDENTS

(Description of incident and actions taken. Attach additional sheets as needed.)

# FIELD INSTRUMENT CALIBRATION LOG

GSI ENVIRONMENTAL

GSI Job No.: _____ Date of Last Calibration: _____

Project Name: _____ Date Instrument Calibrated and Used: _____

Name of Person Performing Calibration: _____

## EQUIPMENT

| Equipment Type(s).: | Manufacturer(s): | Model/Model Number(s): | Vendor Serial Number(s): |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |

## CALIBRATION STANDARDS / CALIBRATION

| Equipment Type (e.g. "1") | Parameter for Calibration | Calibration Standard Value (Include +/-) | Units | Expiration Date | Time | Instrument Response | Instrument Temperature (F˚/C˚) | % or Numeric Deviation | Pass/Fail |
|---|---|---|---|---|---|---|---|---|---|
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Note:

1. % or numeric deviation criteria for the following **water quality** calibration parameters: turbidity = ± 10%; pH = ± 0.2 standard units; specific conductance = ± 5%; ORP = ± 10 mV; DO = ± 0.2 mg/L.
2. % or numeric deviation criteria for the following **PID** calibration parameters: zero check = + 1 ppm, calibration gas check = ± 5%.

GSI ENVIRONMENTAL

# PRIVATE DRINKING WATER SAMPLING FORM

## Project Information

Client: _____ Date: _____

Project: _____ Personnel: _____

GSI Job No.: _____ Weather: _____

## Owner/Usage Information

Physical Address: _____

Person Spoken to: _____

Landowner or Renter: _____

If Renter, Landowner Name and contact information: _____

Well location on property: _____

_____

_____

*Preferred Contact Information:*

Phone: _____ Mailing Address: _____

E-mail: _____ _____

_____

*Owner's notes/observations about the well and drinking water:*

Primary Use: _____

Recent Usage Rate: _____

Current Water Treatment and Location (if any): _____

_____

_____

_____

_____

_____

Additional Notes: _____

GSI ENVIRONMENTAL

# PRIVATE DRINKING WATER SAMPLING FORM

## Sample Collection

Initial Sample - or- Confirmation Sample (circle one)

Sampling Point (circle one):

Upstream of pressure tank/ treatment

Tap on pressure tank

Kitchen/bathroom tap if present

Describe sampling location: _____

_____

Treatment Upstream of the Sampling Point: _____

_____

Duration Purged Before Collecting the Sample: _____

Flow rate during Purge (if sample collected upstream of pressure tank): _____

_____

_____

*Water Quality Parameters (If sample collected upstream of the pressure tank or other treatment devices):*

| Temp (°C) | pH (s.u.) | SPC (µS/cm) | DO (mg/L) | ORP (mV) | Turbidity (NTU) |
|---|---|---|---|---|---|
| | | | | | |

Sample Appearance/Odor: _____

*Sample Information:*

Sample ID: _____

Sample Date: _____

Sample Time: _____

Analytical Profile: _____

**Photo Log:**

Property Owner consented to photograph of well, treatment systems, and sampling point? _____

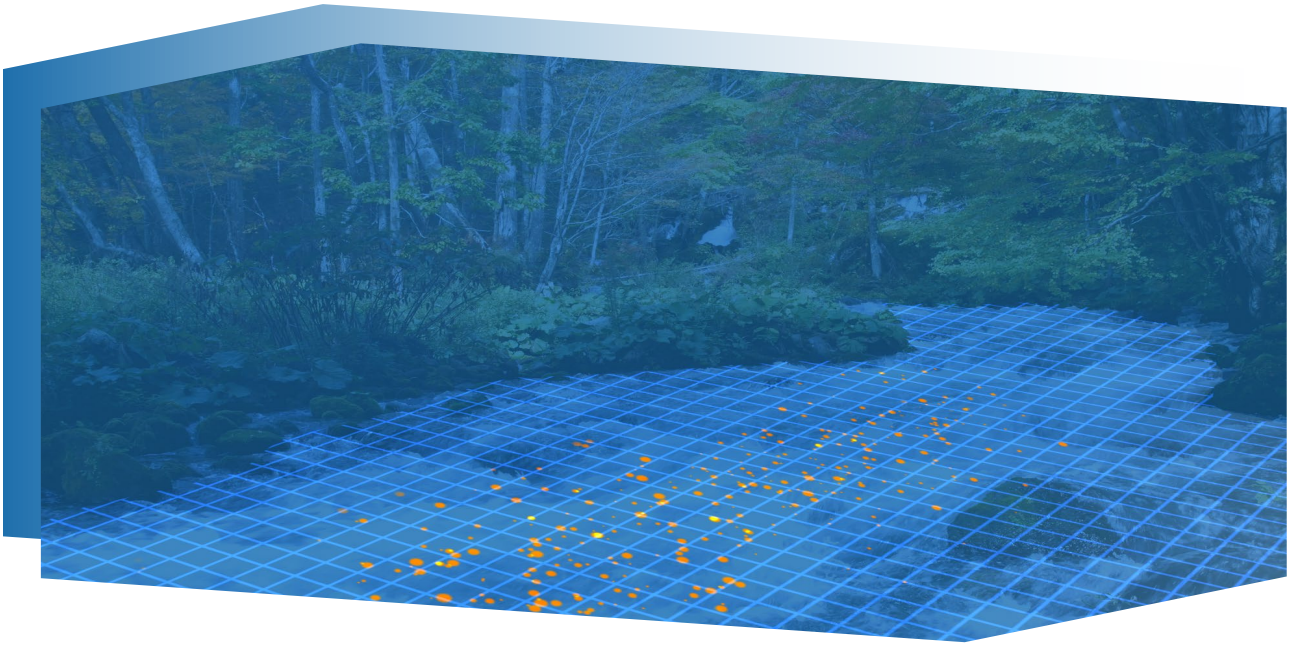
| *{photo description}* | *{photo description}* |
|---|---|
| | |
| *{photo description}* | *{photo description}* |
| | |
| *{photo description}* | *{photo description}* |
| | |

# ATTACHMENT C

## Site Specific Health and Safety Plan

# GSI ENVIRONMENTAL INC.

## Environmental, Health & Safety Program Manual for Field Operations / (Injury & Illness Prevention Program)



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www.gsienv.com

*Revised: 11 September 2023*

# GSI ENVIRONMENTAL INC.

## ENVIRONMENTAL, HEALTH & SAFETY PROGRAM MANUAL FOR FIELD OPERATIONS / INJURY & ILLNESS PREVENTION PROGRAM

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### Abbreviations and Acronyms

| | |
|---|---|
| ACGIH | American Conference of Government Industrial Hygienists |
| APF | Assigned Protection Factor |
| BEI | Biological Exposure Index |
| CERCLA | Comprehensive Environmental Response, Compensation and Liability Act |
| CPR | Cardiopulmonary Resuscitation |
| dB | Decibel |
| EMR | Experience Modified Rate |
| GHS | Globally Harmonized System |
| HASP | Health and Safety Program (or Plan) |
| HAZCOM | Hazard Communication |
| HAZWOPER | Hazard Waste Operations and Emergency Response |
| HSC | Health and Safety Coordinator |
| HSA | Health and Safety Administrator |
| Hz | Hertz |
| IDLH | Immediately Dangerous to Life or Health |
| IDW | Investigation-Derived Waste |
| IIPP | Injury & Illness Prevention Program |
| JSA | Job Safety Analysis |
| SDS | Safety Data Sheet |
| MTSA | Marine Transportation Safety Act |
| NAICS | North American Industry Classification System |
| OSHA | Occupational Health and Safety Act (or Administration) |
| NAPL | Non-aqueous phase liquid; DNAPL = Dense NAPL, LNAPL = Light NAPL |
| PEL | Permissible Exposure Limit |
| PPE | Personal Protective Equipment |
| PLHCP | Physician or Licensed Health Care Professional |
| RCRA | Resource Conservation and Recovery Act |
| REL | Recommended Exposure Limit |
| SIC | Standard Industrial Code |
| SDS | Safety Data Sheet |
| SS-HASP | Site-Specific Health and Safety Plan |
| SSO | Site Safety Officer |
| STEL | Short-Term Exposure Limit |
| TLV | Threshold Limit Value |
| TWA | Time- Weighted Average |
| TSA | Transportation Safety Administration |
| TWIC | Transportation Worker Identification Credential |
| USACE | United States Army Corps of Engineers |
| USEPA | United States Environmental Protection Agency |

# GSI ENVIRONMENTAL INC.

## ENVIRONMENTAL, HEALTH & SAFETY PROGRAM MANUAL FOR FIELD OPERATIONS / INJURY & ILLNESS PREVENTION PROGRAM

## 1.0 GSI HEALTH AND SAFETY POLICY

### 1.1 Purpose, Scope, and Applicability

***Purpose***

GSI Environmental Inc. (GSI) is committed to providing a safe and healthy work environment for all of its employees, and to ensuring that our safety performance and environmental compliance meets or exceeds applicable regulations and our clients' expectations. Accordingly, GSI has developed this Environmental, Health and Safety (EHS) Program Manual for Field Operations (the "EHS Program Manual") in order to i) promote safety awareness and safe working practices; ii) establish procedures for safe implementation of field activities; iii) address safety-related concerns; iv) prevent accidents, injuries, and occupational illness; v) ensure compliance with EHS regulations applicable to field activities. As such, this EHS Program Manual also comprises GSI's Illness and Injury Prevention Program (IIPP).

***Scope***

This EHS Program Manual / IIPP provide standard practices and procedures relating to EHS matters for fieldwork on jobsites owned and operated by GSI's clients and others. H&S issues and procedures applicable to non-fieldwork, in the office and warehouse environment, including, but not limited to, fire safety and emergency building evacuation procedures, and GSI business travel, are addressed in the Employee Procedures Handbook.

This EHS Program Manual has been designed to comply with applicable Federal and state standards which relate to our core business activities in the field of environmental consulting and engineering (SIC 8744 / NAICS 541620). These include, but are not limited to, the Occupational Safety and Health Act (OSHA), promulgated in Chapter 29 of the Code of Federal Regulations (29 CFR), and the California OSHA (Cal/OSHA) standards promulgated in Title 8, Chapter 3.2. Specifically addressed are requirements of i) the Hazardous Waste Operations and Emergency Response (HAZWOPER) standard (§1910.120), and the specific requirement for a written health and safety program (§1910.120(b)); ii) Subpart I, Personal Protective Equipment (PPE; §1910.132–1910.138), including Respiratory Protection (§1910.134); and iii) the Hazard Communication Standard (HAZCOM; §1910.1200). Other standards (e.g., USACE EM-385) are addressed, as applicable.

In addition to the main body of this EHS Program Manual, supplemental sections governing certain program areas including Electrical / Hazardous Energy Isolation ("Lock-out/Tag-out"), and Confined Space Procedures (non-permit-required confined spaces only), are included as appendices to this EHS Program Manual. Updates and supplemental sections will be prepared and distributed, as needed, and incorporated in Appendix A to this EHS Program Manual. Program areas which are applicable to all employees engaged in office work, business travel and other non-field work activities, such as the HAZCOM program, motor vehicle safety and substance abuse prevention, are covered in the Employee Procedures Handbook.

***Applicability***

Applicable elements of this EHS Program Manual / IIP apply to all GSI employees performing or directing field work or related tasks ("applicable employees") at all field sites located on the facilities and properties where GSI performs work on behalf of its clients, whether owned by the

client or by a third party. The principles and safe work practices described in this program also apply to contractors and subcontractors working under our direction. GSI employees supervising the work of contractors and subcontractors are responsible for communicating the requirements of this program to contract personnel and for ensuring their conformance with all applicable safety requirements. (For convenience herein, the terms “GSI employees” and “employees” include professional services contractors, (i.e., individuals who are under direct contract to GSI and who may be performing in roles functionally similar to those of regular GSI employees).

This EHS Program Manual is designed to accompany, and to be used in conjunction with site-specific / project-specific Health and Safety Plans (SS-HASPs; §1910.120(b)). Each site may have specific rules, practices, or other requirements which may not be specified in this EHS Program Manual, but which must also be adhered to, as applicable. As allowed by OSHA, the company-wide Health and Safety Program document may be used to specify standard operating procedures, which need not be duplicated in the SS-HASP. ***This EHS Program Manual / IIPP and the SS-HASP must both be on-site and readily available to all workers engaged in project field work, including GSI employees and subcontractors, at all times when fieldwork is being performed.***

## 1.2 Employer Commitment and Employee Responsibilities and Expectations

***Employer Commitment.*** GSI Management is committed to providing our employees with the resources and support needed to conduct their work in a safe manner and environment. This includes, but is not limited to, i) providing training and personal protective equipment appropriate to the work; ii) being receptive to and addressing employee concerns relating to workplace health and safety; and iii) communicating and contracting with clients in a manner that promotes safe work.

***Mandatory Conformance.*** Conformance with all elements of the GSI Environmental, Health and Safety Program is mandatory. All employees are required to certify in writing their understanding of the program and acknowledge that conformance with the program is a condition of their employment. Each employee’s demonstrated attitude and efforts toward safe work is evaluated as part of their annual performance review. All GSI employees are expected to take primary responsibility for their own safety, to use sound judgment, and to make the safe performance of their jobs their first priority. This includes taking all reasonably practicable measures necessary to ensure the safety of not just themselves, but their co-workers and others in the work environment, including, when necessary, implementing the ***Stop Work Provision***, described in Section 2.4. In addition, employees are required to comply with all applicable environmental regulations in the performance of their work. Failure to follow written safety and environmental rules, procedures, guidelines or verbal instructions from authorized supervisory personnel, or participation in unsafe practices in the workplace may result in disciplinary action, possibly including termination of employment depending on the severity of the violation.

***Employee Input.*** GSI welcomes input from employees with suggestions for improving health and safety practices based on their personal experiences. New ideas and/or descriptions of incidents, responses, and insights into incident prevention should be sent to the Company Health and Safety Administrator. These will be posted in a folder titled “Lessons Learned” at \\HOUSTON-DC\Jobs\0 General Office\--1 HEALTH AND SAFETY PROGRAM\Lessons Learned, and incorporated into future EHS Program Manual revisions, as appropriate.

## 1.3 Program Distribution and Revision

The most current version of this EHS Program Manual is available to all GSI employees on the network job server at \\HOUSTON-DC\Jobs\0 General Office\--1 HEALTH AND SAFETY

PROGRAM. The GSI Health and Safety Administrator (HSA) is responsible for ensuring that the most recent version of the EHS Program Manual and any interim updates are available on the server and for notifying employees of any revisions or updates.

A hard-copy of the EHS Program Manual is provided to all new employees who will be directly or indirectly involved in field activities upon commencement of their employment. An orientation to the Program is conducted by the HSA, co-HSA, or authorized designee (e.g., local Health and Safety Coordinator, HSC) prior to the employee participating in any field work. Each applicable employee must read, understand, and agree in writing to abide by all aspects of the GSI Health and Safety Program.

This EHS Program Manual will be updated or augmented on an on-going basis, as necessary, to account for i) expansion of the services provided; ii) changes in applicable regulations; and iii) the evolving needs of our clients. Periodically, major revisions to the EHS Program Manual will be distributed to all applicable GSI employees. Updates or minor revisions which occur between major revisions will be temporarily incorporated in Appendix A, and all employees will be notified of such updates via email. These updates will subsequently be incorporated, as appropriate, into the EHS Program Manual during the next major revision.

# 2.0 ORGANIZATIONAL STRUCTURE

## 2.1 GSI Company Health and Safety Administrator and Other Key Personnel

The GSI Environmental, Health and Safety Program, including this EHS Program Manual, is administered by the GSI Company Health and Safety Administrator (HSA) and Co-Administrator (Co-HSA). The HSA and Co-HSA are supported by a Health and Safety Coordinator (HSC) designated for each GSI office. In addition, a GSI Principal in each office has been designated to provide oversight and back-up support in an emergency or as otherwise needed. Support for scheduling of medical surveillance physicals and other matters is provided by Administrative staff in each office. Contact information for these key personnel is provided below.

| GSI Health and Safety Program Contacts | | |
|---|---|---|
| **Location** | **Phone Number(s)** | **E-mail Address** |
| **Corporate and Houston, TX Office Contacts** | **713.522.6300** | |
| Danielle M. Kingham, Health and Safety Administrator and Houston H&S Coordinator | X 185 / cell: 713.775.0481 | dbkingham@gsi-net.com |
| Shawn M. Paquette, V.P., Authoring Principal for H&S | X 137 / cell: 713.775.7326 | smpaquette@gsi-net.com |
| Nissa Bravo-Carnley, General Administration | X 100 / 832.646.0663 | nbcarnley@gsi-net.com |
| **Austin, TX Office Contacts** | **512.346.4474** | |
| Steve Richardson, V.P., Authorizing Principal for H&S | X 223 / cell: 919.452.3942 | sdrichardson@gsi-net.com |
| Michael L. Schofield, Austin H&S Coordinator | X 220 / cell: 512.673.8961 | mlschofield@gsi-net.com |
| Sarah Hansen, General Administration | X 202 / cell: 512.294.7509 | sehansen@gsi-net.com |
| **Irvine, CA Office Contacts** | **949.679.1070** | |
| Tim F. Wood, V.P., Authorizing Principal for H&S | X 351 / cell: 949.283.5696 | tfwood@gsi-net.com |
| Tiam Novin , Irvine H&S Coordinator | X 349 / cell: 949.412.6217 | tnovin@gsi-net.com |
| Denise A. Carter, Scheduling for Physicals | X 301 | dacarter@gsi-net.com |
| **Emeryville, CA Office Contacts** | **510.463.8484** | |
| Susan Gallardo, V.P., Authorizing Principal for H&S | X 507 / cell: 510.520.2363 | smgallardo@gsi-net.com |
| Jennifer P. Duffield, Emeryville H&S Coordinator | X 504 / cell: 510.821.8925 | jpduffield@gsi-net.com |
| **Lakewood, CO Office Contacts** | | |
| Jeff D. Gamlin, Authorizing Principal for H&S<br>Chase W. Holton, Lakewood, H&S Coordinator | cell: 720.726.0807<br>cell: 480.435.1887 | jdgamlin@gsi-net.com<br>cwholton@gsi-net.com |

## 2.2 Roles and Responsibilities of Key Personnel

Responsibilities of the HSA and Co-HSA include i) preparation, distribution, and updating of the GSI EHS Program Manual; ii) coordination of health and safety training and medical surveillance / medical monitoring; iii) review of SS-HASPs; iv) investigation of on-the-job accidents, injuries, occupational illnesses or other incidents; and v) maintenance of health and safety related records and files, including training records, results of physical examinations, and OSHA 300 logs, vi) reviewing EHS requirements and performance on contracts and subcontracts, and vii) recommending disciplinary action in the event of violations of H&S rules.

H&S Coordinators in each branch office assist and support these activities at the local level, as appropriate to their individual levels of knowledge and experience and serve as an initial point of contact on EHS-related matters for individuals in each office. As examples, they may be primarily responsible for preparation of office-specific health and safety plans, review of SS-HASPs for projects involving familiar work activities and potential hazards, or may be the first point of contact in the event of a safety concern brought by an individual or an on-the job incident.

In the event of an on-the-job injury, the HSA has the primary responsibility for making a determination of whether the injury is recordable under OSHA, maintaining the OSHA 300 log, and filing the OSHA Form 101 - Supplemental Record of Occupational Injury or Illness. The HSA will typically also be the primary point of contact with a client's H&S personnel in the event of an incident on a client facility and serves as the liaison to the client for any incident or accident investigation on the client's site. When necessary, the HAS is also responsible for completing the state Employers First Report of Injury or Illness form.

***Texas:*** <http://www.tdi.texas.gov/forms/dwc/dwc001rpt.pdf>
***California:*** <https://www.dir.ca.gov/DOSH/DoshReg/Form5020.pdf>
see policy for other states

## 2.3 Project-Specific Site Safety Officers

Project-specific Site Safety Officers (SSO) will be designated for GSI projects involving field activities. On each project, the SSO will be designated by the PTL, and subject to the approval of the HSA. The SSO must be a qualified person, with knowledge, experience, and training commensurate with the responsibilities for the particular site and project. At a minimum, the 40-hour OSHA HAZWOPER training and a current 8-hour HAZWOPER refresher is required. In most cases, especially when performing field supervision other GSI staff and subcontractors, the 8-hour Supervisor Training, as specified by 29 CFR 1910.120, is also required of the SSO.

The SSO is responsible for i) communicating project health and safety requirements to project personnel, including subcontractors; ii) conducting project safety meetings; iii) when appropriate, verifying the safety training credentials (e.g., OSHA training certificates) and protocols (e.g., standard operating procedures, SOPs) of subcontract personnel; iv) ensuring compliance with the SS-HASP by project personnel on-site, including but not limited to proper use of PPE; v) conducting inspection of the work-site each day to identify hazards and mitigation measures before work commences and as work is on-going, vi) completing the Daily Site Safety Record and related documentation; and vii) communicating safety-related concerns to the client's designated safety representative and to the GSI PTL, project principal and has, as appropriate.

## 2.4 Employee Responsibilities

All GSI employees are expected to be actively involved in safe work performance. They are expected to take primary responsibility for their own health and safety, and to take all appropriate measures to ensure the safety of their fellow employees, subcontract personnel, and the people working around them. Compliance with all elements of the GSI EHS program and project-/site-specific HASPs is mandatory. Beyond that, employees are encouraged to seek additional information whenever appropriate and to provide recommendations for the improvement of our safety performance. In the event that a potentially unsafe condition or action is observed, it is the employee's responsibility to bring that condition to the attention of the appropriate person. It may be necessary at times to remind a co-worker or subcontractor to use the proper procedures or PPE, to suggest a safer way to perform a task to a PTL, or to intervene with a co-worker or other individual to prevent a potentially unsafe act.

All project-related safety concerns and/or accidents are to be reported immediately to the designated SSO. Significant concerns should also be brought to the attention of the GSI HSA or Co-HSA, either directly by the employee or through the SSO or HSC. Reportable safety concerns include, but are not limited to i) unsafe physical conditions at the host facility; ii) unsafe work practices; and iii) "near misses" (i.e., incidents in which, although no accident or injury may have occurred, unsafe conditions or actions resulted in a narrowly averted accident or injury). Non-project safety concerns and/or accidents (e.g., automobile accidents or safety concerns in

the GSI office or warehouse) are to be reported directly to the GSI HSA. Incident investigation policies and procedures are detailed in Section 3.5 of this EHS Program Manual.

***Stop-Work Provision.*** **All GSI employees are authorized, and expected, to intervene to the extent reasonably practicable in the event of an unsafe condition or action, whether caused by another GSI employee, a subcontractor, third-party contractor, by-stander or client representative.** This includes stopping any GSI-directed work, if in the judgment of the employee this is necessary to prevent an accident or injury. Employees who do so in good faith will have management's support and will not face disciplinary action for stopping the work. In the event of such an occurrence, the employee must immediately notify GSI management and seek further guidance. Employees who willingly or negligently allow or enable a recognizable and preventable unsafe action that could foreseeably result in an injury or safety violation may be subject to disciplinary action, possibly including termination of their employment.

## 2.5 Safety Performance Review

GSI employees are evaluated on safety awareness and performance during their annual performance reviews. Employees with a demonstrated awareness of safety and a history of safe work performance will be recognized. Poor safety awareness and performance may be grounds for disciplinary action, possibly including termination for serious or repeated violations of safety policies and procedures.

## 2.6 Subcontractor Qualification

All subcontractors performing site work for GSI must be prequalified based on safety performance history by the GSI HSA and a current contract must be in place before they can be engaged on a project. The PTL has the primary responsibility of ensuring that the subcontract agreement is current before site work commences, for alerting GSI contract management in the event a renewal is needed and ensuring the subcontractor's representative is apprised on the host or client safety requirements. When applicable, the PTL must also confirm with the contractor and the host facility that the contractor has been approved for work on the facility (i.e., is not currently "red-tagged" by the clients H&S process).

Prior to execution of a subcontract agreement, the subcontractor must complete Exhibit A of the standard GSI Subcontract Agreement "Subcontractor's Safety Program and Performance History" and provide their OSHA 300 logs and Workers Compensation Experienced Modified Rate (EMR) as evidence of safe work performance. Safety performance history must be updated annually by submittal of Exhibit A.1, the OSHA 300 log for the most recently completed year, and EMR documentation.

In order to perform site work for GSI, the subcontractor must have a documented Health and Safety Program that meets the requirements of the host facility. In general, the following are minimum performance requirements:

i) The OSHA / Bureau of Labor Statistics Recordable Injury Frequency and Lost Work Day Injury Rates (for companies with 10 or more employees) must be equal to or less than the average rate for the applicable industry; and

ii) The Workers' Compensation Experience Modification Rate (EMR) should be less than or equal to 1.0.

More stringent requirements may apply, depending on the requirements of the host facility. Subcontractors will be included in tailgate safety meetings, job safety analysis or hazard assessments, and/or on-the-job safety inspections. Any variance requires the approval of the HSA. (Minor exceedences of a 1.0 EMR may be accepted at the discretion of the HSA, but it should be noted that some GSI clients will not allow any subcontractors with an EMR >1.0 on-

site.) During the contract period or before renewal, the subcontractor must provide annual updated safety information in accordance with GSI Subcontract Exhibit A.1. Post-job safety performance reviews will be conducted, as needed.

## 2.7 Coordination of GSI EHS Program Manual with Site-Specific HASPs

As specified in 29 CFR 1910.120, site-specific health and safety plans (SS-HASPs) must be developed for hazardous waste site operations as defined in that standard. These include, but are not limited to site investigations and cleanup operations at sites involving hazardous wastes or hazardous substances, governed by federal program areas (e.g., Resource Conservation and Recovery Act (RCRA);, Comprehensive Environmental Response, Compensation and Liability Act, (CERCLA); and the Clean Water Act (CWA), as well as programs administered, and orders issued, by state, county and municipal authorities. SS-HASPs must be available on-site at all times while work is being performed. Required elements and other information concerning SS-HASPs are provided in Section 3.0 of this EHS Program Manual.

As stated in §1910.120, the SS-HASPs do not need to repeat all general information and standard procedures provided in the company's more general H&S program and protocols. Accordingly, GSI has developed a standard form for developing SS-HASPs which references this EHS Program Manual (see Appendix C). When this form is used, it is also required that a copy of this EHS Program Manual is also located on-site and readily-available to site workers.

## 2.8 Employee Orientation to, and Periodic Review of, GSI EHS Program Manual

All GSI employees who perform or direct field work are required abide by this EHS Program Manual and all other GSI safety rules and procedures. Accordingly, all new employees are provided with a copy of this EHS Program Manual and instructed to read it thoroughly in advance of a formal orientation with the HSA, Co-HSA, local HSC or other person designated by the HSA. During the orientation the employee has the opportunity to ask any questions or raise any concerns, which will be addressed to the best of the ability of the person conducting the orientation. The employee will then sign an acknowledgment stating that they have i) read and understood the EHS Program Manual, ii) attended an orientation at which they were given the opportunity to ask questions, and iii) agree to abide by the GSI EHS Program as a condition of their employment with GSI.

Employees are encouraged to raise additional questions or concerns when and as they arise. They are also strongly encouraged to review this EHS Program Manual in its entirety on at least an annual basis (e.g., in advance of their annual OSHA refresher course) and to refer to specific sections more frequently, as needed. GSI welcomes suggestions and recommendations from employees at any time for updates to this EHS Program Manual and improvements to our EHS program based on their personal experiences.

# 3.0 SITE-SPECIFIC HEALTH AND SAFETY PLAN

This section outlines the applicability and requirements for a SS-HASP. A SS-HASP is developed based upon a careful analysis of the project scope and the site conditions that are likely to be encountered as determined from available site investigation reports and other relevant information. ***The PTL is responsible for preparing the SS-HASP and for designating the SSO. The SS-HASP must be reviewed and approved by the HSA or Co-HSA, or by the local office HSC, providing that person has adequate experience with the specific tasks and potential hazards applicable to the project. The SS-HASP will be signed by the HSA, Co-HSA, or HSC, as applicable, as well as the plan preparer(s) (e.g., the PTL and/or SSO), prior to mobilization.*** On a project-by–project basis, completion of a Job Safety Analysis (JSA) worksheet may also be required. Forms for a SS-HASP and JSA are provided in Appendix C.

## 3.1 Applicability and Scope

A SS-HASP shall be prepared for i) any project which requires the use of heavy equipment, such as drill rigs and excavators; ii) projects which require the collection of samples of soil, water, or other media containing potentially harmful concentrations of hazardous materials; and/or iii) projects on which site conditions pose the potential for a significant risk to human health or safety.

A SS-HASP may not be required for projects where site conditions and scope of work do not present a specific hazard, such as a site inspection or reconnaissance; however, in such cases, the client's standard safe working practices and relevant elements of this EHS Program Manual shall be observed at all times. GSI personnel are required to enter only those areas of the site where they are specifically authorized to enter an engage only in activities for which they are specifically authorized. If there is any question as to whether a SS-HASP is required, the PTL should consult with the GSI HSA or Co-HSA.

It is the responsibility of the PTL to ensure the SS-HASP is prepared and provided to the HSA, Co-HSA or local HSC for review prior to mobilization. The plan may be prepared by a designee of the PTL (e.g., a project engineer or scientist), but the preparer must be properly qualified by experience and training (including, but not limited to, completion of the 8-hour OSHA Supervisor Training). In the development of SS-HASPs for projects involving less familiar tasks or potential hazards, employees are encouraged to seek guidance from more experienced personnel. All SS-HASPs are subject to review and approval by the GSI HSA or Co-HSA, or assuming an adequate level of experience on the particular scope of work, by the local HS Coordinator. Review and approval by the client or host facility H&S representative may also be required; it is the PTL's responsibility to ascertaining if this requirement is applicable. Specialized subcontractor activities, such a well drilling should also incorporate the subcontractor's health and safety protocol, which may be included as an attachment to the GSI SS-HASP or provided on-site by the subcontractor.

Prior to project start-up, the project scope of work and available site data shall be evaluated to determine the specific requirements for a SS-HASP. As allowed under OSHA regulations (29 CFR 1910.120), the SS-HASP *"need not repeat the employer's standard operating procedures."* Accordingly, GSI has developed a SS-HASP form (see Appendix C to this EHS Program Manual), which may be used in conjunction with this general EHS Program Manual. The general GSI EHS Program Manual may be referred to for specific procedures for monitoring, selection and use of PPE, personnel training, and other required elements of the SS-HASP. When used in this manner, a copy of this EHS Program Manual must also be on-site with the SS-HASP and available to all site workers.

The health and safety representative for the host facility should be contacted as soon as feasible in the process of developing a SS-HASP to determine client and host facility requirements. As applicable, a copy of the client or host facility HASP, contractor health and safety guidelines, or equivalent must be obtained and evaluated in order to incorporate all relevant portions of the host facility HASP into the GSI SS-HASP. Client health and safety requirements may also be included in the contract with the client, and these may be included in Appendix G to this EHS Program Manual. Applicable provisions of the client's contractor safety rules may be incorporated by inclusion of the original client document(s), such as a safety manual or applicable sections of the client contract, as an attachment to the GSI SS-HASP. Alternatively, these may be incorporated by reference, but if incorporated by reference, a copy of the relevant client document must be readily available to project personnel on-site at all times work is performed. Review of the GSI SS-HASP by the host facility representative may be required or conducted at the discretion of the host facility project/safety manager or authorized representative. In addition, some clients may require review of the SS-HASP by a Certified Industrial Hygienist (CIH) or Certified Safety Professional (CSP). GSI has resources available for this purpose (see Appendix E to this EHS Program Manual). Accordingly, the schedule for SS-HASP preparation must account for this review.

In addition, subcontractor activities, including specialized work such as well drilling or excavation, should also incorporate the subcontractor's own H&S procedures. This can most efficiently be done by ensuring the subcontractor has its own H&S manual on-site. The PTL is responsible for ensuring that the subcontractor is aware of, and compliant with, client or host facility H&S requirements, including but not limited to drug testing, training and orientations, and entry and work permits.

Prior to commencement of work, the SSO or other person designated by the PTL, will conduct an orientation to the SS-HASP or "kick-off" safety meeting for the project field team (including subcontractors). All site personnel must sign the coversheet to the SS-HASP certifying their understanding of the project health and safety requirements and their agreement to abide by the SS-HASP prior to starting work. Daily "tailgate" safety meetings will be held with all project field team members to re-emphasize project objectives and any health and safety concerns. Orientation sessions are also conducted when new personnel join the project field team and when site conditions or project tasks change.

## 3.2 Site Evaluation and Job Safety Analysis (JSA)

On a project-specific basis, completion of a JSA worksheet may be required in addition to or as a part of the SS-HASP. A go-by JSA form is provided in Appendix C. In essence a JSA consists of identifying and evaluating the basic job steps and potential hazards and recommending or specifying safe job procedures to eliminate or effectively control anticipated health and safety hazards. Available information regarding the presence, use, storage, and/or disposal of hazardous materials shall be compiled and reviewed. The scope of work shall be reviewed to identify specific tasks which may pose the risk of injury or chemical exposure to project personnel. Hazard mitigation measures such as engineering controls and work program adaptations should be identified and implemented whenever feasible. A site reconnaissance shall be performed prior to the commencement of field activities by the designated project SSO or other qualified person, as needed, to provide information on current site conditions. Critical elements of the site reconnaissance may include:

i) Location and size of the site, topography, vegetation, structures, accessibility, manufacturing, or other operations or processes which could affect the safe implementation of the work;

ii) Suspected presence of immediate danger to life or health (IDLH) conditions;

iii) Identification of potential hazards, including physical, chemical, and biological hazards; and

iv) Location, phone numbers, and maps to the nearest urgent care and emergency medical facilities.

The initial site evaluation must include an assessment of the possible presence of Highly Hazardous Chemicals at quantities above applicable Threshold Quantities identified in 29 CFR §1910.119 (see Appendix F to this EHS Program Manual) and the following steps implemented:

1) Review existing site documentation and or contact the client health and safety representative to determine which, if any, hazardous materials are known or expected to be present and assess probable concentrations in environmental media to the extent feasible.
2) Obtain Safety Data Sheets (SDSs) and other appropriate information for identified hazardous materials, either from the facility or an on-line source.
3) Identify and arrange for any specific training which may be required for work in and around the unit or area, including procedures in the event of an accidental release of hazardous materials.
4) Determine whether respirator use may be required and verify that personnel are adequately trained, have current medical monitoring certification as needed (Physician or Licensed Health Care Provider, or PLHCP, written opinion), and are properly equipped.

## 3.3 Elements of the Site-Specific Health and Safety Program

The SS-HASP shall include the following elements; however, the specific organization of the plan may vary:

1) ***Project Description:*** An introductory section shall provide a summary of the project objectives, tasks, location, and generalized project schedule.
2) ***Site Description:*** The description shall include a physical description of the site and the identification of potential physical, chemical, and biological hazards. If feasible, a site map should be included.
3) ***Emergency Response Plan:*** The Emergency Response Plan section identifies personnel roles; lines of authority and training; plan for coordination with outside parties (emergency contact information); personnel sign-in / sign-out procedures; emergency procedures (recognition and prevention, alarm signals, excavation routes, location of assembly areas, decontamination, medical treatment, and first-aid); and reporting, including follow-up critique.
4) ***Project Organization, Personnel, and Training:*** This section identifies key project personnel, training requirements, and other qualifications for site workers, and whether a person trained and certified in first-aid and CPR must be on-site. This section also identifies the roles and responsibilities of management for controlling operations at the site during an emergency response.
5) ***Potential Hazards and Hazard Control Measures:*** This section identifies potential hazards, including physical and chemical hazards, and measures to mitigate and avoid hazards, including engineering controls, utility clearance, mowing or vegetation clearing, traffic control and traffic safety measures, and safe work practices.
6) ***Potential Chemical Exposures:*** This section specifies the contaminants expected to be present in environmental media at the site. For contaminants of concern expected to be present above risk levels, the entry routes, exposure limits, and expected concentrations in environmental media (soil and water), based on available site data, should be

specified. Standard exposure concentration limits are identified below. SDSs for these chemicals should be attached as well. See also Section 7.0 for additional information concerning respiratory protection.

| Abbreviation | Limit Concentration | Source |
|---|---|---|
| BEI | Biological Exposure Indices | ACGIH |
| IDLH | Immediate Danger to Life and Health | NIOSH |
| PEL | Permissible Exposure Limit | OSHA |
| REL | Recommended Exposure Limit | NIOSH |
| STEL | Short-Term Exposure Limit | NIOSH |
| TLV | Threshold Limit Value | ACGIH |

7) ***Site Control:*** This section specifies measures to be taken to prevent unauthorized personnel from entering exclusion zones or otherwise creating risk of exposure to job-site hazards.
8) ***Air Quality Monitoring:*** This section specifies monitoring instrumentation, measurement methods, location and frequency to prevent exposure to air-borne contaminants, if applicable.
9) ***Personal Protective Equipment (PPE):*** This section specifies basic PPE requirements and conditions for PPE upgrades from standard "Level D" (i.e., hard hat, safety glasses, body covering, safety shoes), including action levels and specifications for use of respiratory protection.
10) ***Decontamination:*** Procedures for decontamination of PPE and equipment are specified. Where the possibility of a spill of hazardous materials exists, a list of the equipment to be present on-site and the procedures for responding to a spill will be specified in this section of the SS-HASP. In addition, any specifications for handling or disposing of investigation-derived wastes (IDWs) will be specified in this section of the SS-HASP.
11) ***Safety Plan Distribution and Compliance:*** GSI requires its employees and subcontractors to read, understand, and certify in writing their agreement to comply with all of the rules and regulations contained within the SS-HASP. Periodic inspection of work sites will be conducted by the HSA or designee to ensure compliance.

## 3.4 Documentation of Site Health and Safety Activities

Health and safety activities and related matters are documented daily for all GSI field projects using the Daily Site Safety Record form provided in Appendix C of this EHS Program Manual. The SSO is responsible for ensuring that the Daily Site Safety Record is completed in real-time each day of the field program. The record should document the i) names and affiliations of on-site GSI or subcontractor personnel; ii) hours of arrival and departure; iii) topic of "tailgate" safety meetings; and/or other safety-related discussions, iv) activities performed, v) PPE used, vi) air monitoring records, and vii) use of respirators, including hours of respirator use and cartridge change-out schedule by each individual. Records must also be kept of any incidents (including accidents, injuries, first-aids, near-misses, safety-related concerns raised by project personnel or client representatives, or non-compliance with safety protocols); encounters with regulatory personnel, by-standers, or other non-project personnel; and any other safety-related matters. In addition, if performed, records of air monitoring and respirator use must be retained beyond the normal record retention period for the project file; accordingly, copies of these pages must be provided separately to the HSE or designee for inclusion in a separate file.

It is critical that the information on the Daily Site Safety Record is recorded in real-time as the day progresses, not from memory after the fact. It is also critical that any accidents, injuries, or other incidents or concerns be brought to the immediate attention of the appropriate personnel, as specified on the SS-HASP (e.g., GSI HSA or PTL, or client representative).

Daily Site Safety Records are retained in the project file. In addition, to facilitate record retention requirements, in the event that i) air monitoring is performed, ii) respirators are used, and/or iii) any safety-related incident occurs (including first-aids and near-misses, as well as any more serious incidents), the Daily Site-Safety Record for that day should be scanned and emailed to the HSA and local HSC no later than the end of the week in which it occurred.

## 3.5 Site Health and Safety Incident Reporting

In the event that an accident, injury (including first-aid incidents), chemical exposure, or a “near-miss event occurs, a report and or investigation will be required. The nature and scope of the report or investigation will depend upon the severity of the incident. The SSO must contact at a minimum, one of the following personnel as soon as feasible: the PTL, the project principal, the local HS Coordinator and or the HSA or Co-HSA.

The SSO must be prepared to provide the following basic information: What happened? When and where did the incident occur? What task(s) was (were) being performed at the time? What were the relevant conditions (weather, terrain, etc.)? Who was involved? Who, if anyone, was injured or otherwise affected and how severely? What was the immediate response? What follow up measures are on-going or needed? What other factors may have led to the incident? This initial report may be followed as appropriate by a more detailed investigation as to the root cause (i.e., how and why did the incident occur) and what measures have been or should be implemented to prevent recurrence. In addition, the client may have their own incident investigation procedures that must be followed.

# 4.0 GENERAL HEALTH AND SAFETY PROCEDURES

## 4.1 General Practices

All GSI employees and subcontractors are expected to work in a manner to protect the environment and the health and safety of themselves and those around them. Specific procedures will be detailed in SS-HASPs prepared for each project. However, the following guidelines apply to all projects at all locations.

### *4.1.1 Orientation*

All new employees who will be performing or directing field work (including preparation of workplans) will be provided an orientation to this EHS Program Manual / IIPP prior to any on-site project work. An orientation will also be given for the SS-HASP for each project to familiarize employees of any site-specific risks or protocols (i.e., site access limitation, waste disposal, operational activities, emergency response). All employees performing field work shall also have completed the 40-hour OSHA HAZWOPER training specified in 29 CFR§1910.120, and a current refresher, as applicable, prior to field assignments involving possible exposure to hazardous wastes or substances. New employees will spend a *minimum* of three (3) days working in the field under the direct supervision of an experienced GSI employee and will be overseen in the performance of new tasks for a longer period, as needed to demonstrate competence.

### *4.1.2 Host Facility Requirements*

It is of the utmost importance that all GSI personnel and subcontract personnel under GSI supervision conduct themselves and perform all work in a safe manner and in conformance with all host facility requirements. Health and safety requirements of host facilities at which GSI projects are being conducted must be strictly observed. GSI personnel must be familiar with the emergency response and evacuation procedures of the host facility. These may be presented in an orientation conducted at the site, local contractor safety council, or in a contractor safety manual. In some cases, these requirements may differ from GSI standard health and safety requirements. In such cases, the more protective standard will apply. Many facilities or project areas may include the production, use, or storage of chemicals in ways that may risk exposure (i.e., multi-employer workplaces). As such, SS-HASPs for these project facilities will require more detailed development of the HAZCOM Program, including but not limited to the acquisition of SDSs for facility-specific chemicals and precautionary measures taken to avoid or limit work in potentially higher-risk exposure areas, as well as emergency response and evacuation procedures. GSI personnel and subcontractors are explicitly prohibited from operating any process equipment (e.g., opening or closing valves, etc.) unless specifically authorized by an authorized client representative. An observed chemical release involving process equipment or similar occurrences must be reported immediately to the host facility representative.

### *4.1.3 Environmental Compliance*

GSI employees are required to observe and abide by all applicable federal, state, and local environmental regulations and our clients' requirements regarding protection of the environment prior to and during all phases of project execution. This includes, but is not limited to:

i) proper management of IDWs (from site investigations or remedial activities, such as trash, scrap material, contaminated PPE, soil cuttings, purged groundwater, and contaminated equipment);

ii) preventing spills and discharges; and

iii) properly responding to accidental releases.

All regulated materials must be managed in a manner appropriate to the material and site, as specified in the project workplan or client's procedures. Prior to the start of any job that will result in the generation, storage or disposal of IDWs, their probable waste classification, and means of determining or verifying classification, should be identified in advance to the extent feasible, especially if the material either will be, or could reasonably be expected to be, a characteristic or listed hazardous waste.

Spill containment kits, including sorbent materials, containers, and handling equipment (e.g., shovels) should be available on-site for projects involving potential for release of regulated chemicals or liquid wastes. On projects where groundwater containing hazardous constituents or hazardous waste is being managed, the CERCLA-reportable quantities of the specific substances should be specified in the workplan and an attempt made to quantify the volume of released material, if a release occurs (assuming that this can be done safely).

In the event of an accidental spill, project–specific response actions (including containment or abatement by qualified personnel only) and reporting must be followed. Unless otherwise directed, a spill should be reported as soon as possible to the SSO, who will then report to the designated client or host facility contact and GSI HSA. GSI provides awareness-level training only as part of the OSHA HAZWOPER training on spill response for employees engaged in field activity. GSI personnel should not attempt to abate an active chemical or hazardous material release if they have not received appropriate training (i.e., first responder level training) or if doing so puts them at risk of harmful exposure.

### *4.1.4 House-Keeping and Inspection*

All work areas should be kept neat and free of debris which may pose a trip hazard or otherwise interfere with the safe performance of the work. Procedures to address project waste (e.g., trash, scrap materials, or drilling waste) should be evaluated and solutions to minimize for disposal handling developed prior to beginning work. Procedures for proper waste handling and disposal will be reviewed with field employees before beginning work.

Smoking is not allowed in the work area and oral tobacco use may also be prohibited on some sites. A designated smoking area will be identified and/or set-up, and all cigarette butts must be completely extinguished. (Remember to respect our clients'/hosts' properties and do not litter the ground with cigarette butts or allow our subcontractors to do so either.)

The work site shall be inspected at the beginning of each work day by the SSO or designee to ensure the area is free of potential hazards, including but not limited to, slip/trip hazards, potential falling objects, and/or chemical exposure. The work site should also be inspected at the end of each day and prepared for the following day's activities to the extent feasible. At a minimum, no potentially unsafe condition (e.g., an open excavation) will be left without proper barricading, signage, lighting and/or other appropriate precaution. Site inspections are documented on the Daily Site Safety Record form.

At the termination of the project, the site should be left free of debris or surplus materials, and all project generated waste properly stored or disposed of in accordance with applicable federal, state, local, and/or client-specific requirements (or properly staged for transport and disposal in accordance with client instructions). Universal waste, such as batteries should be segregated from other project general waste for separate disposal, and where possible, opportunities for recycling should be identified. Containerized IDWs shall be labeled as to the contents and date, and an inventory prepared to facilitate proper management.

### *4.1.5 Emergency Response*

Emergency response procedures, including reporting, will typically be specified by host facilities and must be followed, including site-specific procedures for notifying emergency response

personnel when an emergency is detected. If emergency response procedures are not specified by the host facility, a plan will be developed and included in the SS-HASP. Prior to beginning any project work, orientation on project-specific emergency response and evacuation procedures is required for GSI employees and subcontract personnel.

In general, GSI employees are not trained as emergency first responders or fire fighters and should not attempt to perform emergency shut-down, active chemical spill abatement, or fire-fighting in cases involving a significant risk of injury or chemical exposure. As part of 40-hour HAZWOPER training, GSI employees receive sufficient "awareness level" training, such that if they are the first person on the scene of an emergency incident, they have sufficient training to recognize the emergency as such and can summon fully-trained responders and not attempt control/response activities in which they themselves are not trained.

On many facilities, the occurrence of a fire, chemical release or other emergency will be signaled by a site-specific alarm, such as a horn or whistle. The site-specific orientation provided by the host facility may specify the codes for emergencies in various areas and designate an assembly point. This information should be incorporated into the SS-HASP. Unless otherwise directed by the host facility, in the event of a fire or chemical release to the air, all powered equipment, including vehicles, should be shut down and the keys left in the vehicle. The PTL or SSO should account for all project personnel on-site. The wind direction relative to the release should be noted and, if it is safe to do so, personnel should move upwind and/or cross-wind to a designated assembly area. Response to emergencies in GSI's offices is addressed the GSI Procedures Handbook.

### 4.1.6 Vehicle Safety

Safe vehicle operation, on and off the job, is expected of all GSI employees. GSI's Motor Vehicle Safety and Defensive Driving Program is presented in the GSI Procedures Handbook. GSI employees who are required to operate motor vehicles as part of their employment must maintain a current, valid driver's license, and consent to annual monitoring of their driving records by GSI. Employees with unsafe driving records may be prohibited from operating a vehicle on a GSI project. Seat belt use is mandatory for all drivers and passengers in all company owned and rented vehicles, and in personal vehicles when on company business. Cell phone use, including texting and non-hands free phone use, while driving GSI vehicles is prohibited. Hands-free phone use in personal vehicles while on company business should be limited to conditions in which use does not create a safety risk due to distracted driving. Note that certain GSI clients prohibit drivers to engage in any type of cell phone use while driving when working on their sites or while working on their projects at other locations.

### 4.1.7 Buddy System

GSI employees will employ the "buddy system" during field operations. Typically, two or more employees will be assigned to field tasks, or a GSI employee may be accompanied by subcontract personnel or a client contact. Plant and unit sign-in and sign-out procedures will be observed, and in some cases, radio contact with a plant control room may be required and may substitute for the physical presence of a "buddy." Some low-risk tasks, such as measurement of water levels or routine inspections in high visibility areas, may be safely performed by an individual working alone. This determination will be made by the PTL or SSO. However, the SS-HASP should specify that person check-in by phone or radio periodically (e.g., every hour) to confirm that all is well, and specify what measures will be taken in the event that an employee fails to check in and contact is lost.

### 4.1.8 Site Security

At sites which are not secured by the client's security system (e.g., fenced and patrolled), a site security plan should be developed as needed to prevent theft of, or vandalism to, equipment or

supplies and to ensure the personal safety and security of GSI employees and subcontractors. Site security measures may include temporary fencing, temporary secure storage, such as a locked cargo container, and or surveillance by a private security firm.

### 4.1.9 Fire Protection

GSI employees must observe all host-facility requirements regarding hot-work permits and restrictions on the use of spark-producing equipment such as gasoline-powered engines (e.g., generators). Gasoline for use in pumps or other powered equipment must be transported in designated, labeled cans with self-venting, spring-activated lids and flame arresters.

Fire extinguishers are carried on all GSI field vehicles, including rental trucks, and should be placed in an accessible area close to spark-producing equipment. GSI personnel shall receive fire extinguisher education to become familiar with the general principles of fire extinguisher use and the hazards involved with incipient stage firefighting. GSI personnel are not required to use fire extinguishers or otherwise engage in fire control measures as part of their job description. Field personnel may receive hands-on training in the appropriate use of portable fire extinguishers, including initial training and annual refreshers, on a strictly voluntary basis. In the event of a fire, only employees that have received this specific training may attempt to extinguish the blaze, and only if the individual determines that attempting to extinguish the blaze does not put them at risk.

At the GSI warehouse, flammable liquids must be stored in the appropriate fire-resistant cabinet, which must be closed at all times when not in use. Fire extinguishers are available in the GSI office and warehouse facilities in clearly marked locations. Portable fire extinguishers are subjected to monthly visual inspections and an annual maintenance check. Inspections are conducted by a designated GSI employee and records are maintained with the H&S Administrator, as further discussed in the Employee Procedures Handbook.

Smoking is not permitted in any GSI facility, including the offices or warehouse, in GSI vehicles, including rental vehicles, or on job sites, except in designated smoking areas. All host-facility restrictions on possession of smoking materials, matches, or lighters must be observed.

### 4.1.10 Electrical Storm Safety

This section deals specifically with safety issues related to lightning, high wind and high water. Weather-related health and safety relating to heat and cold exposure is discussed in Section 4.2.

GSI employees shall follow safety procedures associated with field work during inclement weather, specifically in the occurrence of electrical storms. It is generally accepted that the distance from the work site to the location of lightning strike can be approximated by a count of the time elapsed between observing the lightning and hearing the thunderclap. As a general rule of thumb, lighting will be located one mile away for every five seconds counted between seeing the lightning and hearing the clap. For example, a 15 seconds count would indicate that lightning occurred approximately 3 miles from the work site.

A “30-30” lighting safety recommendation indicates that if lighting is observed and the time to corresponding thunderclap is less than 30 seconds (i.e. lighting is within 6 miles of the work site), personnel should seek shelter from the storm. It is recommended that a fully enclosed building with proper electrical wiring and plumbing be used as a shelter. However, if such a structure is not available, personnel should shelter in field vehicles with rolled up windows. The field crew should remain in the shelter for at least 30 minutes after hearing the last thunderclap.

It is also necessary to be mindful of the hazards associated with high winds and high water during storm events. Precautions should be taken to avoid being hit by falling branches, wind-blown objects and the like. Downed power lines must be avoided. Never drive into a flooded

road. It is frequently not possible to tell how deep the water is, particularly in the dark. Water flowing across the road adds to the danger of your vehicle being swept downstream. If you encounter high water on the road in front of you: “Turn around, do not drown.”

During field work it will be the responsibility of the SSO and other GSI personnel to monitor the weather conditions for indications of approaching inclement weather. It will be the responsibility of the SSO to implement the lightning storm safety procedures. The lighting safety procedures are detailed below.

1) Monitor for weather conditions. Darkening skies and increased wind speed may be indicative of developing thunderstorms.
2) If thunder is heard, the SSO and field personnel should observe the weather conditions to determine the direction of the storm and the occurrence of lightning.
    i) If lightning is observed, a count of the time between the sighting of the lightning and the thunderclap will be conducted.
        - If the elapsed time between the lighting and thunderclap is greater than 30 seconds the field work will proceed with the SSO and other personnel monitoring the weather conditions.
        - If the elapsed time between the lightning and thunder clap is less than 30 seconds, the SSO will instruct the field personnel to seek shelter in either an on-site building or field vehicles if no adequate on-site structures (i.e. enclosed building with electrical wiring and plumbing) are available.
3) Personnel will remain sheltered for at least 30 minutes from the time of the last rumble of thunder in the area.
    i) Work may resume when neither lightning nor thunder have been observed/heard for 30 consecutive minutes.
4) If the lightning safety procedure for drilling subcontractors differs from GSI’s policies, it is the responsibility of the SSO to ensure that the more stringent procedures are followed. The mast of the drill rig should be lowered in the event a thunderclap follows lightning by less than 30 seconds.
5) In the event that lighting storms persist for an extended period of time or create conditions that are deemed unsafe for continuing field work, the SSO shall contact the PTL or HSA to determine the best course of action.
6) If field personnel are struck by lightning the following steps should be taken:
    i) Call 9-1-1 and communicate the emergency.
    ii) Assess the situation and consider moving the victim to a safer location, if one is available.
    iii) Check if the victim is breathing and has a heartbeat (pulse may be checked in the carotid artery).
    iv) A Cardiopulmonary Resuscitation (CPR)-certified GSI employee who is willing to administer first-aid should do so until emergency responders arrive.

### *4.1.11 Personal Protective Equipment (PPE) and Respiratory Protective Equipment (RPE)*

GSI’s PPE and Respiratory Protective Equipment (RPE) Programs are detailed in Sections 6.0 and 7.0, respectively, of this EHS Program Manual. GSI’s Hearing Conservation Program is in Section 8.0. GSI, at its own expense, provides employees with all necessary PPE, including standard Level D gear and respirators, as needed, and provides training for its proper use and maintenance through the 40-hour OSHA course and annual refresher class. GSI employees are

responsible for properly using and maintaining their GSI-issued PPE and for arranging for replacement when needed.

On most projects, the minimum required Level D PPE for both GSI and GSI subcontractor personnel will include the following: hard hat, safety glasses with side-shields, sturdy shoes or boots, long pants, and shirt with sleeves. Steel-toe safety boots or shoes should always be worn on projects such as drilling jobs, and or in environments with the potential for foot injuries due to impact or compression, but are not necessarily required for activities such as site surveys or reconnaissance, groundwater sampling, etc. Additional PPE required for specific tasks or locations will be specified in SS-HASPs, and may include various types of gloves, safety splash-guard goggles, hearing protection, chemical-protective clothing, fire-retardant clothing, or respiratory-protective equipment. As applicable, safety gear must meet American National Standards Institute (ANSI) or other standards (e.g., ANSI Z87-2 for safety glasses, ANSI Z89.1 for hard hats, ASTM F2431-05 for protective footwear, etc.).

PPE must be inspected prior to each use by the user. In addition, the SSO or designee shall periodically inspect the PPE in use by the work crew and ensure that the proper PPE is in use, properly worn, and in good working order. PPE use is documented on the Daily Site Safety Record.

### *4.1.12 First-Aid*

Most GSI jobs are conducted at locations where emergency medical services are readily available, either via a 9-1-1 service or from the client's on-site emergency response personnel. The SS-HASP shall identify the availability and location of on-site and/or off-site facilities or services. If such services are not available, other arrangements shall be specified in the SS-HASP.

GSI personnel are not required to perform first-aid as part of their job description. However, GSI periodically provides, at its expense, basic first-aid training, including CPR, and blood-borne pathogens safety training through the American Red Cross or other qualified organization to interested employees on a voluntary basis. Certificates of First-Aid and Blood-borne Pathogens Safety Training are retained in the files of the HSA. Certificates are good for two years and refresher training is required to maintain certification.

In the event that a project location precludes a timely response by emergency responders, due to distance, terrain, or other conditions, the field team should, if feasible, include a person with a valid certification in basic First-Aid and Blood-borne Pathogens Safety Training and who confirms their willingness to perform first-aid, if needed. Identification of the certified person and documentation of certification shall be included in the SS-HASP. Project personnel will be requested to sign a waiver releasing the designated first-aid provider from any liability related to administration of first-aid. In the absence of trained and certified personnel, GSI personnel may administer first-aid on a "good Samaritan" basis but should also contact qualified responders.

First-aid kits equipped for responding to minor injuries, such as cuts and scratches, are carried on GSI field vehicles and first-aid supplies are available in the office and warehouse spaces. Additional kits are available for use in rental vehicles. A first-aid kit should be included as part of the standard field supplies on the GSI field equipment checklist form. First-aid supplies shall be easily accessible and stored in a weather proof container.

The basic required contents of the first-aid kit are specified on a list kept inside the kit (see also Appendix C), and the kit should be routinely inspected and resupplied to ensure it is complete. The local HSC for each GSI office is responsible for inspecting the first-aid kit(s) at their respective office or delegating this task to an appropriate person (e.g., field technician). Office kits shall be inspected at least every 2 weeks. The inspector will initial and date the list following each inspection. Field kits shall be inspected prior to each field mobilization and at least weekly

for continuing operations by the SSO. Inspections should be documented on the Daily Site Safety Record.

GSI's work does not typically include work with strong acids or caustics; however, where the eyes or body of personnel may be exposed to injurious corrosive materials, suitable facilities shall be provided within the work area. On host facilities, such as chemical plants, where exposure to such materials is a potential hazard and safety showers and eyewash stations are present, the SSO shall identify the location(s) of the nearest safety shower(s), communicate this information to applicable personnel, and note the location(s) on the SS-HASP and/or Daily Site Safety Record. If exposure to such corrosive materials is identified as a potential hazard and safety showers or other appropriate facilities are not present, the SS-HASP shall identify an appropriate hazard mitigation measure, such as the use of a portable eye-wash station and or potable water source with a hose.

### *4.1.13 Back Safety and Safe Lifting*

Back injuries are considered by OSHA to be the nation's foremost workplace safety problem. Attempting to lift an object that is too heavy or lifting and carrying loads improperly can lead to injury, disability, and or chronic pain. Serious injury can also result from slipping or tripping while carrying loads. Employees are expected to use good judgment and request assistance in lifting or moving an object that is heavier or bulkier than the person can safely lift.

Before lifting an object, first assess the situation and only lift the object if you are certain that you can do so safely. If the object is obviously too heavy to lift safely, do not attempt to do so. If you are uncertain whether the object is too heavy, try lifting one corner to size up the load. Also assess whether the object is too bulky or irregular in shape or weight distribution to lift and carry safely and ensure that you will be able to see the path in front of you while carrying the load. Unless you are certain that you can safely lift and carry the object, get assistance or use a mechanical device, such as a hand-truck, dolly, or push cart. ***Do not use a forklift unless you have been properly trained and certified.***

Assess the distance and condition of the path over which the object is to be carried. Determine whether the path can be shortened (e.g., by moving a vehicle into which the load is to be placed closer to the load) and ensure that the path is free of obstacles and provides for firm, slip-free footing. Only after you have determined that you can safely lift the object *and* carry it safely to the destination should you proceed. To lift the load:

1) Start by putting your feet close to the object and get a firm footing, with your body centered over your feet;
2) Squat down bending at the knees, back straight or slightly arched;
3) Grasp the load with both hands and pull toward you;
4) Smoothly lift straight up with your legs, not your back; and
5) Keep your head up, looking forward, and do not twist your body while lifting.

As you carry the load, keep your back straight or slightly arched, walk slowly, and use your feet to change directions rather than twisting your body. Setting the load down should be the reverse of lifting:

1) Position yourself where you want to place the load;
2) Squat down letting your legs, not your back, do the work; and
3) Release your grasp only when the load is safely placed on the receiving surface ensuring that fingers are not caught between the load and the surface.

### 4.1.14 Tool Inspection and Use

GSI provides tools for projects, including hand tools, electrically-powered tools, and other powered equipment with moving parts, such as cement mixers, gasoline-powered generators, and pumps. All tools, including those provided and used by GSI subcontractors, must be inspected prior to use by a qualified person and properly maintained in a safe condition. Tools which are not in proper repair pose a hazard and should not be used. Such tools shall either be identified as unsafe by tagging or locking the controls to render them inoperable or shall be physically removed from the place of operation. Tools in need of repair shall be taken to the GSI warehouse or office and designated for repair or disposal.

Electrical tools must be either double–insulated or grounded. Power tools and extension cords which have had the grounding plug removed, or which have damaged insulation exposing the electrical wires, must not be used. Electrical tools designed to accommodate guards must have guards in place to protect against accidental contact with moving parts, such as saw-blades, belts, drive chains, fly wheels, and pulleys. Guards shall be in place and operable at all times while the tool is in use. The guard may not be manipulated in such a way that will compromise its integrity or the protection in which is intended. Guarding shall meet the requirements set forth in American National Standards Institute (ANSI) B15.1.

Eye protection must always be worn when using cutting, drilling, chipping, or other tools, which could result in discharge of small particles to the air. Eye protection must always be worn when using hand or power tools (see Section 6.0 of this EHS Program Manual) and hearing protection must also be worn if the power tool generates a noise level in excess of 85 decibels (dB; see Section 8.0). Employees that may i) use hand and power tools, ii) be exposed to the hazard of falling, flying, and abrasive objects, or iii) be exposed to harmful dust, fumes, mists vapors, or gases or splashing liquids, shall be provided with the particular PPE necessary to protect them from the hazard.

Hot-work permits must be obtained as required by the host facility for operation of sparking equipment in designated areas. GSI has an Energy Isolation Lock-out/Tag-Out Program, presented in Appendix B to this EHS Program Manual. Lock-out/Tag-out training will be required for personnel engaged in applicable projects.

### 4.1.15 Chainsaw Safety

Operating a chain saw is potentially hazardous and only experienced personnel are permitted to operate chainsaws on GSI projects. Potential injuries can be minimized by using proper personal protective equipment and safe operating procedures.

***Before Starting a Chain Saw***

1) Chain saws must be equipped with a protective device that minimizes chain saw kickback.
2) Check controls, chain tension, and all bolts and handles to ensure that they are functioning properly and that they are adjusted according to the manufacturer's instructions.
3) Make sure that the chain is sharp, and the lubrication reservoir is full.
4) Proper personal protective equipment must be worn when operating the saw, which includes hand, foot, leg, eye, face, hearing and head protection. Do not wear loose-fitting clothing.
5) Inspect the area where the cutting will be performed. Clear away potential trip hazards. Set up an exclusion zone as needed.

***Fueling the Saw***

1) Use approved containers for transporting fuel to the saw.
2) Dispense fuel at least 10 feet away from any sources of ignition when performing construction activities. No smoking during fueling.
3) Use a funnel or a flexible hose when pouring fuel into the saw.

4) Never attempt to fuel a running or hot saw. Allow at least two minutes after shutting off a hot saw before refueling.

***Starting the Saw***

1) Start the saw on the ground or on another firm support. Drop starting is never allowed.
2) Start the saw at least 10 feet from the fueling area, with the chain's brake engaged.

***Operating the Saw***

1) Pay attention to your surroundings, ensure that no person is in close proximity to the saw or a potential falling tree or branch.
2) Clear away dirt, debris, small tree limbs and rocks from the saw's chain path. Look for nails, spikes or other metal in the tree before cutting.
3) Shut off the saw or engage its chain brake when carrying the saw on rough or uneven terrain.
4) Keep both hands on the saw's handles and maintain secure footing while operating the saw.
5) Position your feet so that the saw is oriented between your legs and maintain a firm stance.
6) Be careful that the trunk or tree limbs will not bind against the saw. Cut a wedge-shaped notch on the side of the tree in the direction you intend it to fall, then cut from the opposite side at a slight downward angle to intercept the notch.
7) Watch for branches under tension, they may spring out when cut.
8) Be cautious of saw kick-back. To avoid kick-back, do not saw with the tip. If equipped, keep tip guard in place.

For additional information consult OSHA “Quick Card, Chain Saw Safety”

### *4.1.16 Traffic Safety*

When working along roadways, in parking lots, or other areas with potential hazards from vehicle traffic, appropriate precautions must be taken to prevent vehicle-pedestrian accidents. In some cases, such as working on public streets, a formal traffic control plan may be required and must be prepared for review and approval by Department of Transportation (DOT) or other authorities. When drilling or other operations on public roadways is required, the SSO must determine if a DOT-approved traffic control plan is required. At a minimum, when working in traffic areas, cones and/or barricades with appropriate signage and high-visibility vests should be worn. A flagman may also be required. Hours of operation may be restricted. Lighting should be employed if work is to be conducted during before dawn or after dusk.

### *4.1.17 Ladder Safety*

Portable ladders shall have non-conductive side rails. Ladder rungs, cleats, and steps shall be parallel, level, and uniformly spaced when the ladder is in position for use. Ladder safety includes but is not limited to:

i) not standing on the top two rungs of a step ladder;
ii) facing the ladder when ascending or descending;
iii) having at least three points of contact to the ladder; and
iv) not carrying objects that could cause injury in the event of a fall.

Ladders shall not be loaded beyond the maximum intended load for which they were built or beyond the manufacturer's rated capacity. Shoes with steel shanks should be worn to prevent foot fatigue or injury to the arch.

Ladders shall be used only for the purpose for which they were designed. Always ensure that extension ladders have three points of contact (i.e., both feet on firm ground and a secure point at the top) and that step ladders have all four feet firmly on the ground. Never use a ladder in a

horizontal position or as scaffolding, and do not place ladders on top of boxes, barrels, crates, etc. Ladders shall be inspected by a competent person for visible defects on a periodic basis and after any occurrence that could affect their safe use. Extension ladder side rails shall extend at least 3 feet (0.9 m) above the upper landing surface and shall be tied off or otherwise secured at the top to prevent slippage. When ladders are not able to be extended to the required height, then the ladder shall be secured at its top to a rigid support that will not deflect or shift. Ladders shall be used at an angle such that the horizontal distance from the top support to the foot of the ladder is approximately one-quarter of the working length of the ladder; For example, if the height from the foot of the ladder to the top support (e.g., a wall) is 8 feet, then the distance on the ground from the foot of the ladder to the point on the ground directly below the top support (e.g., the base of the wall) should be approximately 2 feet).

Portable and fixed ladders with structural defects, such as, but not limited to, broken or missing rungs, cleats, or steps, broken or split rails, corroded components, or other faulty or defective components, shall either be immediately marked in a manner that readily identifies them as defective, or be tagged with "Do Not Use" or similar language, and shall be withdrawn from service until repaired.

GSI's work does not entail the construction of scaffolding, work on scaffolding or work requiring rigging or the use of fall protection. In the even such work should arise, personnel must receive appropriate training

### *4.1.18 Flora and Fauna Hazards*

Flora and fauna hazards at job sites may include poisonous plants, venomous wildlife and insects, and vector-borne diseases. All employees are prohibited from touching, harassing, moving, or tampering with hazardous flora and fauna. In case of an accidental exposure or encounter, examples of flora and fauna hazards, along with typical signs or symptoms of contact and appropriate response actions, are provided in Appendix E to this EHS Program Manual. Additional information may be found at the following NIOSH website: https://www.cdc.gov/niosh/topics/outdoor/.

### *4.1.19 Altitude Sickness Awareness*

Altitude sickness occurs when you cannot get enough oxygen from the air at higher altitudes. Air is "thinner" at higher altitudes, so when you go too high too fast, your body cannot get as much oxygen as it needs. This causes symptoms such as headaches, loss of appetite, and trouble sleeping. It happens most often when people who are not used to high altitudes go quickly from lower altitudes to 8,000 ft (2,438 m) or higher. The effective amount of oxygen that is expected to be found at different altitudes is provided below:

| Altitude (feet) | Altitude (meters) | Effective Oxygen % | Altitude Category | Example |
|---|---|---|---|---|
| 0 | 0 | 20.9 | Low | Boston, MA |
| 1000 | 305 | 20.1 | Low | |
| 2000 | 610 | 19.4 | Low | |
| 3000 | 914 | 18.6 | Medium | |
| 4000 | 1219 | 17.9 | Medium | |
| 5000 | 1524 | 17.3 | Medium | Boulder, CO |
| 6000 | 1829 | 16.6 | Medium | Mt. Washington, NH |
| 7000 | 2134 | 16.0 | Medium | |
| 8000 | 2438 | 15.4 | High | Aspen, CO |
| 9000 | 2743 | 14.8 | High | |
| 10000 | 3048 | 14.3 | High | |
| 11000 | 3353 | 13.7 | High | |
| 12000 | 3658 | 13.2 | High | |
| 13000 | 3962 | 12.7 | Very High | |
| 14000 | 4267 | 12.3 | Very High | Pikes Peak |
| 15000 | 4572 | 11.8 | Very High | |
| 16000 | 4877 | 11.4 | Very High | Mont Blanc |
| 17000 | 5182 | 11.0 | Very High | |
| 18000 | 5486 | 10.5 | Extreme | |
| 19000 | 5791 | 10.1 | Extreme | Kilimanjaro |
| 20000 | 6096 | 9.7 | Extreme | Denali (McKinley) |
| 21000 | 6401 | 9.4 | Extreme | LIMIT OF THE MAG-20 |
| 22000 | 6706 | 9.0 | Extreme | |
| 23000 | 7010 | 8.7 | Extreme | Aconcagua |
| 24000 | 7315 | 8.4 | Extreme | |
| 25000 | 7620 | 8.1 | Extreme | |
| 26000 | 7925 | 7.8 | Ultra | |
| 27000 | 8230 | 7.5 | Ultra | |
| 28000 | 8534 | 7.2 | Ultra | K2 |
| 29000 | 8839 | 6.9 | Ultra | Everest |

Mild altitude sickness is common. There are no specific factors, such as age, sex, or physical condition, that correlate with susceptibility to altitude sickness. If you have not been to high

altitudes before, it is important to be cautious. If you have been at higher altitudes before with no problem, you can probably return to that altitude without problems as long as you are properly acclimatized.

The symptoms of altitude sickness include:

i) headaches, which are usually throbbing and worsen at night and in the morning when you wake up;
ii) loss of appetite;
iii) feeling sick to your stomach or vomiting;
iv) feeling weak and tired;
v) waking up during the night and not sleeping well; and/or
vi) feeling dizzy.

Prevention of altitude illnesses falls into two categories: proper acclimatization and preventive medications. Given time, your body can adapt to the decrease oxygen levels at a specific altitude. This process is known as acclimatization. Below are a few basic guidelines for proper acclimatization:

1) If possible, do not go to higher altitudes. If you do, do not over-exert yourself or move higher for the first 24 hours.
2) If you go above 10,000 feet (3,048 meters), only increase your altitude by 1,000 feet (305 meters) per day and for every 3,000 feet (915 meters) of elevation gained, take a rest day.
3) If you begin to show symptoms of moderate altitude illness, do not go higher until symptoms decrease.
4) Stay properly hydrated (at least 3-4 quarts per day); urine output should be copious and clear.
5) Avoid tobacco and alcohol, which may further decrease the respiratory drive during sleep resulting in a worsening of the symptoms.
6) Eat a high carbohydrate diet (more than 70% of your calories from carbohydrates).
7) Keep in mind that different people will acclimatize at different rates. Make sure all of your party is properly acclimatized before going higher.

Lastly, if approved and prescribed by a medical doctor, preventive medications may be taken to help alleviate symptoms associated with altitude sickness.

### *4.1.20 Prohibited Items and Restricted Activities*

GSI policy prohibits the possession and or use of illegal drugs, alcohol, and other controlled substances in the workplace, including GSI's facilities and our clients' facilities, and in vehicles owned or rented by GSI. GSI employees may not consume alcoholic beverages during their lunch hour, or during any other break, if they will subsequently be going to a job-site or operating a company vehicle or other equipment. GSI's substance abuse policy and program are presented in the GSI Employee Policy Manual.

In addition, GSI prohibits the possession and/or use of firearms or other weapons, fireworks or explosives, or other items which could be used as such, in the workplace, including GSI's and our client's facilities. Knives used for soil core inspection should not have a sharpened blade capable of inadvertently cutting the skin. Some facilities prohibit the use of knives of any kind. When working on a client's facility, GSI employees must also comply with our client's policies and procedures, which may include prohibitions on such activities as: smoking, carrying smoking materials (i.e., cigarettes, matches, and/or lighters), oral tobacco use, carrying or use

of cellular phones equipped with a camera, radio playing, card playing, and/or reading of newspapers or magazines.

Work-place violence or harassment, including fighting and/or the making of explicit or implicit threats against any person, is absolutely prohibited and will be grounds for immediate dismissal.

## 4.2 Heat Stress and Cold Exposure

This section deals specifically with worker exposure to heat and cold. Other weather-related hazards associated with lightning, high winds, heavy rains, and high water are discussed in Section 4.1.10.

### *4.2.1 Heat Stress and Heat Strain Prevention*

***Overview.*** Heat stress can be a major hazard during much of the year in southern climates, such as in Texas and southern California, where GSI maintains offices, and in tropical locales where GSI employees frequently work. As the ambient temperature approaches the normal core temperature of the human body (98.6°F), it becomes increasingly difficult for the body to dissipate excess heat, which can result in an increase in core temperature. This is exacerbated by increased humidity which results in less evaporation of perspiration and lower cooling capacity.

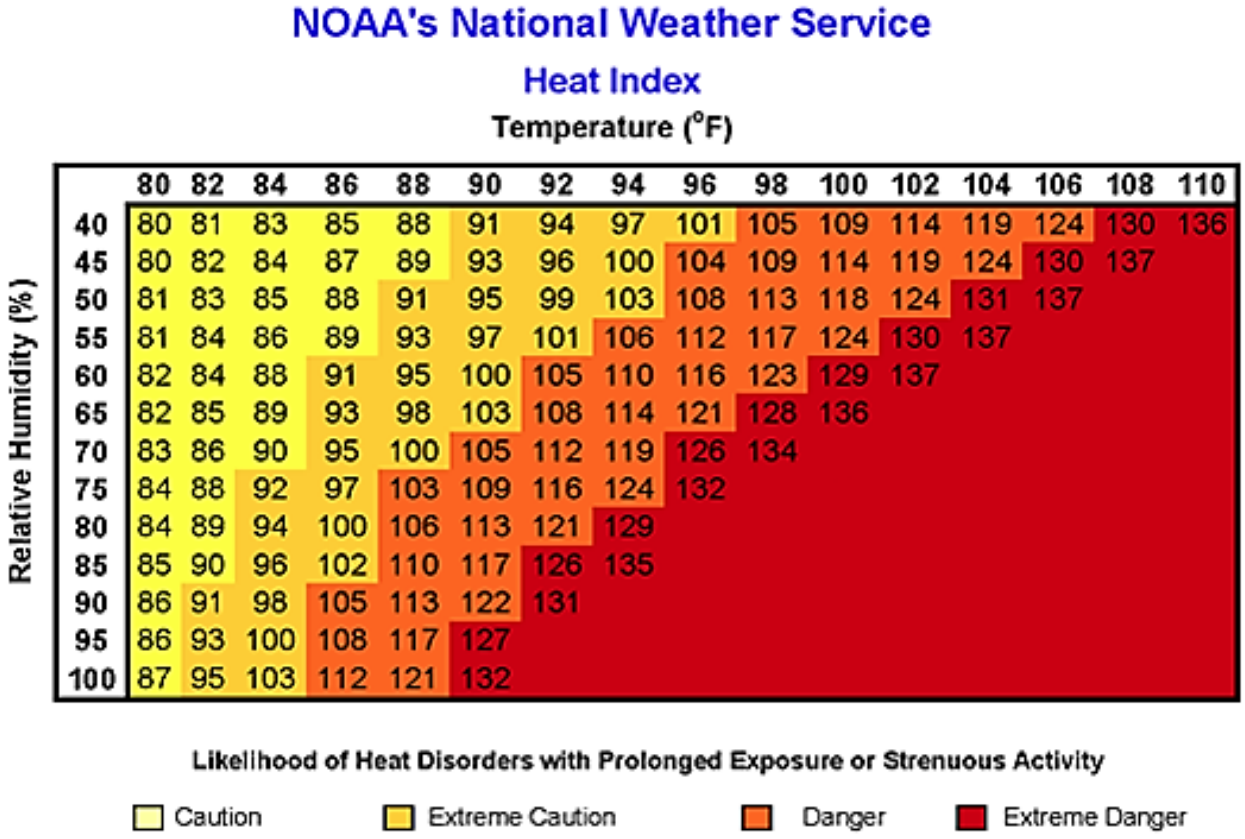
Impermeable PPE that protects workers from chemical hazards can further limit dissipation of body heat. Use of PPE may also increase the energy expenditure to perform a given task, further elevating body temperature. Depending on ambient conditions (air temperature, relative humidity, presence or absence of shade or breeze), the physical condition of the individual, level of exertion and use of PPE, the effects of heat stress can occur very rapidly (within as little as 15 minutes). Further, excessive sun exposure to uncovered skin can contribute to skin damage (e.g., sunburn) and long-term excessive exposure can contribute to the risk of skin cancer.

While the term “heat stress” has been commonly applied to all types of heat disorders, from heat rash to heat stroke, the Centers for Disease Control (CDC, 2016) defines heat stress as “the net heat load to which a worker is exposed from the combined contributions of metabolic heat, environmental factors and clothing worn which results in an increase in heat storage in the body.” CDC defines the adverse effects of heat stress as heat strain, “the physiological response to the heat load (external or internal) experienced by a person, in which the body attempts to increase heat loss to the environment in order to maintain a stable body temperature.” Forms of heat strain include heat rash, heat cramps, heat syncope, heat exhaustion and heat stroke, which are discussed at the end of this section.

***Key to Heat Strain Prevention.*** Heat Strain can be prevented by three key elements: water, rest and shade. Proper hydration, before, during and after field work, is critical; OSHA recommends four cups of cool water per hour. In addition, periodic rest breaks of at least a few minutes every hour or two gives the body a chance to release heat. Rest is more effective in a shaded place out of the direct sun. If shade is not naturally present at the site, pop-up shade tents can be used to shade the break area and in some cases the work area as well. If no breeze is blowing, a fan can help move the air and increase the cooling effect. The effects of direct sun exposure can be mitigated by light-weight, light colored (reflective) clothing covering the arms and neck as well as the entire body, should be worn and use of sunblock on exposed skin areas is encouraged.

***NOAA/NWS Heat Index and OSHA Risk Levels.*** The National Oceanic and Atmospheric Administration / National Weather Service (NOAA/NWS) developed the “Heat Index” which combines temperature and relative humidity into a single value (given in °F) to indicate the “apparent temperature” or “how hot the weather will feel.” In high humidity, perspiration does not evaporate as readily as in drier weather, and therefore the body’s ability to cool itself is

diminished, the weather feels hotter than would be indicated by ambient temperature alone, and the potential for heat strain increases. The following graph combines temperature and relative humidity to derive Heat Index value.




OSHA notes that “Heat Index values were devised for shady, light wind conditions, and exposure to full sunshine can increase heat index values by up to 15°F.” OSHA identifies the following Risk Levels for given values of the heat index and recommends increasing protective measures to be implemented at each level. Protective measures recommended by OSHA for the various risk levels are provided in Appendix F. The following paragraphs provide an overview of protective measures.

| Heat Index | Risk Level | Protective Measures |
|---|---|---|
| < 91° F | Lower (Caution) | Basic heat safety and planning |
| 91° to 103° F | Moderate | Implement precautions and heighten awareness |
| 103° to 115° F | High | Additional precautions to protect workers |
| > 115° F | Very High to Extreme | Aggressive measures (e.g., reschedule non-essential work) |

***Heat Strain Prevention Measures.*** **All heat strain disorders are preventable and preventing heat strain, in oneself and one’s co-workers, is the responsibility of each employee.** Heat strain disorders, including heat rash, heat cramps, heat syncope, heat exhaustion and heat stroke, and their symptoms and treatment, are described below. All heat disorders are caused by loss of fluids and the body's inability to cool itself***.*** A site safety plan will provide protocols or guidelines for prevention of heat disorders, and all employees are expected to observe their co-workers for signs of heat stress. Ultimately though, it is the responsibility of each employee to recognize their own personal heat tolerance and limits for working in hot

weather and to not put themselves at risk of a heat-related injury or illness. The *Stop Work Provision* described in Section 2.4 applies to unsafe conditions resulting from excess heat. The following measures should be taken by all workers:

***Acclimatization*.** The body needs time to acclimate to the surrounding environment when temperatures rise suddenly. Workers risk heat strain by not moderating heat stress exposure when a heat wave strikes or when the employee's body hasn't yet adjusted to the change in season. Consider regularly spending time outside as the weather warms up in spring and summer (e.g., by taking walks at lunch time) to gradually get used to the heat. When forecasted or actual conditions result in sudden exposure to heat to which employees are not accustomed, additional precautions (e.g., more frequent rest periods) may be necessary.

***Access to Water.*** Pre-hydrate before going into the field. Water or water-electrolyte drinks are preferable to caffeinated beverages or soft drinks. Consider refraining from alcohol the night before field work. Drink frequently in moderate volumes fluids while in the field. Numerous small drinks (e.g., 4 cups in an hour) at a tepid temperature are better than rapid, large volume intakes of iced drinks. The SSO will ensure employees have access to cool, potable drinking water. In hot weather, water will be provided in sufficient quantity at the beginning of the work shift to provide one quart per employee per hour for drinking for the entire shift. If, during the day, quantities have been reduced to unacceptable levels, one employee should be tasked with going for more water at GSI's expense. An inadequate supply of drinking water may require temporary suspension of work until water can be obtained.

Water will be kept as close as possible to the worksite (given the working conditions and layout of the worksite), to encourage the frequent drinking of water. Employees should periodically remind one another to stay hydrated. As an option, personal hydration devices may be used, providing suitable precautions are taken to prevent oral contact with chemical residues on gloves during sampling activities.

***Access to Shade.*** Employees shall be allowed to take rest breaks in a shaded area as needed. California regulations have specific requirements for providing shade for workers, which are good guidance for working in heat in other locations. Specifically, California regulations require shade to be present on the worksite when the temperature exceeds 80 degrees Fahrenheit. Below 80 degrees Fahrenheit, if shade is not already present on site, shade must be provided when requested by an employee. "Shade" means blockage of direct sunlight and accommodate at least 25 percent of the employees on the shift at any time.

Employees working indoors near operating machinery that can generate high temperatures and/or humidity, regardless of whether the location is considered a confined space, also require access to shade or another area of the building that is well ventilated and allows the body to cool. The interior of a vehicle may be used to provide shade provided that the vehicle is air-conditioned. In situations where it is not safe or feasible to provide shade, a note will be made of these unsafe or unfeasible conditions, and of the steps taken to provide alternative cooling measures but with equivalent protection as shade.

***Rest Periods and Breaks.*** In warm and hot weather, employees should take breaks throughout the day for at least a few minutes every hour or two as needed to prevent excess heat stress exposure. Breaks may be more frequent and or of longer duration during the hottest part of the day. Resting in the shade without wearing PPE and with clothing loosened, if possible, will help the body release excess heat and maintain a stable core temperature. Splashing the face and arms with cool water or placing cool wet towels against the skin can aid the cooling process. If shade is inadequate and an air-conditioned environment (whether building or vehicle) is available, take advantage. As you rest, take note of how you feel, your breathing, heart rate, etc.

and if you feel abnormal, let the SSO know and prolong the rest period accordingly. When you are ready to go back to work, proceed at a moderate pace.

***Summary of Heat Strain Prevention Measures.*** All heat disorders are caused by loss of fluids and the body's inability to cool itself. ***Heat stress is controllable and heat strain is preventable.*** The following measures should be taken by all workers:

1) Maintain a general level of good health and physical fitness.
2) Pre-hydrate before going into the field. Water or water-electrolyte drinks are preferable to caffeinated beverages or soft drinks. Consider refraining from alcohol the night before field work.
3) Consume numerous small drinks at a tepid temperature, rather than rapid, large volume intakes of iced drinks.
4) Be familiar with and aware of warning signs such as fatigue, dizziness, faintness or light-headedness, and disorientation. Report the on-set of symptoms to the SSO immediately.
5) Do not overexert and rest at least a few minutes every hour or two, or more frequently in warmer weather.
6) Monitor co-workers for signs of heat stress; be observant of indicators such as altered complexion, clumsiness or stumbling, or apparent disorientation; and bring their occurrence to the attention of the individual and the SSO if symptoms appear.
7) Use the buddy system and maintain contact and communication, in person or by cellphone or text messaging.

In addition, the SSO and PTL should take the following measures to the extent feasible:

1) Plan the job (and prepare the SS-HASP) to prevent excess heat exposure; when practical, schedule tasks to take advantage of available shade (e.g., work on the west side of a structure in the AM and on the east side in the PM).
2) Monitor weather reports for heat alerts.
3) Try to schedule work so that the most strenuous tasks are not performed during the hottest part of the day.
4) Devise a work schedule that provides sufficient time for re-hydration, rest, and heat dissipation, and ensure that workers comply.
5) Provide sunblock to protect workers from excessive sun exposure.
6) Ensure an adequate supply of drinking water is provided.
7) Provide a shaded rest area and consider use of fans.
8) Monitor workers for signs of heat stress or exhaustion and intervene if they appear to be over-exerting.
9) During periods of extreme heat, evaluate whether fieldwork schedules can be adjusted to reduce potential for harmful heat exposure.

***Heat-Related Disorders.*** The major varieties of heat-related disorders and their related symptoms and appropriate treatments are listed below in order of increasing severity, along with recommended treatments. Again, it must be stressed that heat-related disorders can be prevented by maintaining good physical conditioning, acclimating to warmer weather by spending time outdoors as the season changes from spring to summer, maintaining proper hydration and electrolyte levels, pre-hydrating before field activities, refraining from alcoholic beverages on nights before field work and from excessive caffeine during the workday, and periodically resting in a shaded area. In addition, adaptive work practices and simple engineering controls can help prevent heat related disorders.

***Heat Rash.*** Heat rash, also known as prickly heat, is a skin irritation caused by excessive sweating during hot, humid weather when sweat ducts (pores) become blocked. Personal protective equipment can increase the likelihood of developing heat rash. Heat rash looks like a red cluster of pimples or small blisters and is more likely to occur on the neck and upper chest, in the groin, under the breasts, and in elbow creases. Workers experiencing heat rash should keep the affected area dry and remove PPE during breaks. Dusting powder may be used to increase comfort. Heat rash normally clears on its own, but if condition persists or worsens seek medical treatment.

***Heat Cramps.*** Heat cramps are painful muscle spasms, typically in the extremities, back, and abdomen due to water/sodium imbalance. Heat cramps are readily alleviated by oral intake of drinking water and electrolytes or in severe cases by intravenous administration of salt solution.

***Heat Syncope.*** Heat-induced fainting (collapse or unconsciousness) episode or dizziness that usually occurs with prolonged standing or sudden rising from a sitting or lying position. No increase in body temperature or cessation of sweating is characteristic. Factors that may contribute to heat syncope include dehydration and lack of acclimatization. Symptoms of heat syncope include light-headedness, dizziness, and fainting. Workers with heat syncope should sit or lie down in a cool place when they begin to feel symptoms and slowly drink water, clear juice, or a sports beverage.

***Heat Exhaustion.*** Heat exhaustion occurs as a result of the circulatory system being unable to meet the demand of cooling the body and providing oxygen and nutrition to muscles and organs. Heat exhaustion is characterized by “elevation of core body temperature above 100.4° F and abnormal performance of one or more organ systems without injury to the central nervous system. Heat exhaustion may signal impending heat stroke,” (CDC, 2106). Fainting may result. Unless the individual has another illness, such as heart disease, they will usually recover promptly if removed to a cool place and permitted to lie down for a time. External symptoms of Heat Exhaustion may include:

i) Cool, moist, pale or flushed skin;
ii) Heavy sweating;
iii) Headaches, dizziness, lightheadedness or fainting;
iv) Weakness and moist skin;
v) Mood changes such as irritability or confusion; and/or
vi) Upset stomach or vomiting.

Get the person to a comfortable position in a cooler place. Remove or loosen clothing and apply cool, wet cloths (towels or sheets) to the entire body. If the person is conscious, give half glass of non-alcoholic, caffeine-free liquid every 15 minutes - drink slowly. Monitor carefully for changes in condition.

***Heat Stroke.*** Heat stroke is the most serious heat related illness. It occurs when the body is unable to cool itself, and the body temperature rises to critical levels. Tissue damage and death are possible. CDC defines heat stroke as “an acute medical emergency caused by exposure to heat from an excessive rise in body temperature 106°F and failure of the temperature-regulating mechanism. Injury occurs to the central nervous system characterized by a sudden and sustained loss of consciousness preceded by vertigo, nausea, headache, cerebral dysfunction, bizarre behavior, and excessive body temperature.” External symptoms of Heat Stroke may include:

i) Dry, hot skin with no to little sweating;
ii) Mental confusion or loss of consciousness;

iii) Seizures or convulsions;
iv) Cardiovascular collapse; and/or
v) Elevated body temperature in excess of 104°F.

***Heat stroke is a life-threatening illness and the individual requires professional emergency medical treatment as soon as possible. At the first sign of possible heat stroke call 9-1-1.*** Until medical help arrives, take emergency measures to quickly reduce body temperature to avoid brain damage. While waiting for the ambulance, move the worker to a cool, shaded area; remove protective clothing, gloves, shoes, and socks; loosen clothing; lay victim flat on their back; and attempt to give conscious victim water. If the victim is semiconscious or unconscious, do not attempt to give water as it may be aspirated into the lungs causing a serious health problem. Soak the individual's clothing with cold water and fan vigorously to assist cooling. Apply wrapped ice bags to the arm pits, the groin area, and around the neck because these are large blood-flow areas capable of transferring large amounts of body heat to reduce the core temperature. Elevate legs about 12 inches to protect against possible shock condition. If a heat-induced seizure occurs, clear the area around the victim to prevent any further injury. Prompt first-aid can prevent permanent injury to the brain and other vital organs.

### *4.2.2 Cold Exposure*

Cold injuries (including frostbite and hypothermia) and impaired ability to work are two dangers caused by extremely cold conditions. Warning signals include reduced coordination, drowsiness, impaired judgment, fatigue, and numbing of toes and fingers. Exposure to cold can be greatly exacerbated by wet conditions, even at above-freezing temperatures. Cold exposure can be prevented by appropriate clothing for cold weather work, providing warm shelter at the work site, and monitoring each worker's physical condition. In potentially wet conditions, having a change of dry clothing is recommended. For projects where significant outdoor fieldwork in cold weather is anticipated, the SS-HASP should address any appropriate additional measures to prevent harmful exposure.

## 4.3 Confined Space and Excavation Safety

### *4.3.1 Confined Space*

GSI's activities do not involve entry of personnel into permit-required confined spaces, such as tanks, vessels, excavations, etc. Limited work is done in non-permit required confined spaces (e.g., crawl spaces in residences for vapor intrusion sampling), but it must first be verified that the space does not require an entry permit. Therefore, it is critical for employees performing such work to understand the defining characteristics of both types of confined space. In the event that a specific future project requires entry into a permit-required confined space, assigned personnel will receive proper training prior to project start-up (see Section 5.7).

To avoid possible hazards associated with inadvertent confined space entry, GSI employees must obey all posted restrictions on entry to confined spaces. ***GSI employees are expected to know the four defining characteristics of a confined space and a permit-required confined space.*** The four defining features of a *confined space* include:

i) the space is ***not meant for continuous occupation*** by workers;
ii) the space has ***limited or restricted openings*** for entry or exit;
iii) the space has ***poor natural ventilation***; and
iv) the size, shape, or use of the space ***may injure workers entering*** it.

Additionally, confined spaces are classified as *"Permit Required" whenever one or more of the following four characteristics apply:*

i) the ***atmosphere can become immediately dangerous to life and health (IDLH)***;
ii) there is ***potential for engulfment***;
iii) its ***size or shape can trap or asphyxiate***; or
iv) any ***other serious recognized safety hazard*** is present.

*Excavations or trenches deeper than 4 feet should not be entered for any purpose unless all of the following conditions are met.*

i) the excavation walls are properly shored or are sloped at a 1:1 slope (45 degrees) or less, and there is no danger of collapse or engulfment;
ii) a suitable means of egress such as a ramp, stairs, or ladder is located so as to require no more than 25 feet of lateral travel to reach it; and
iii) adequate vapor testing prior to entry demonstrates a hazardous atmosphere is not present.

GSI has developed a procedure for non-permit required confined spaces, specifically for use in sampling of crawl spaces or similar areas for vapor intrusion sampling (see Appendix D). Personnel engaged in these projects will receive confined-space awareness training. The procedure is based on first ensuring and documenting that the space does not meet the definition of a permit-required confined space. Confined spaces determined to meet the definition of an permit-required confined space must not be entered unless additionally-required training has been completed and an appropriate procedure has been developed, including assignment of trained personnel to the four required roles: i) entrant, ii) attendant / observer ("hole watch"), iii) supervisor, iv) rescue team.

### *4.3.2 Excavation Safety*

For site investigation and remediation projects trenches or other excavations may be needed and these must be installed or performed by a subcontractor with sufficient qualifications, training and experience. Excavations must be a safe distance from any building foundations or other potentially vulnerable structure. Before any excavation, underground utilities must be identified, and proper precautions taken to prevent damage.

GSI employees and subcontract personnel must not enter excavations unless proper precautions have been taken. Occupied excavations deeper than five (5) feet are regulated by OSHA (20 CFE §1926.650 - 1926.652) and may be classified as permit-required confined spaces. GSI employees must not be enter unprotected excavations *deeper than four (4) feet* unless additional training has been conducted and the project SS-HASP has been prepared with meets all OSHA requirements (proper sloping or shoring of the walls, adequate egress, safe atmosphere tested regularly, etc.) and reviewed by a Competent Person. Vehicles, heavy equipment (e.g., drill rigs), excavation spoils and heavy loads should be kept away from the edge of the trenches. For information purposes, an OSHA Fact Sheet on Trenching and Excavation Safety is included in Appendix F.

## 4.4 Drilling, Excavation, and Other Heavy Equipment Operations

### *4.4.1 General Considerations for Heavy Equipment Operations*

GSI routinely utilizes subcontract services to provide equipment and operators for soil probing, well drilling, excavation, equipment hoisting, and other activities during site investigation and remedial construction activities. For these types of projects, GSI uses only qualified subcontractors with documented safe work practices, properly trained personnel, and a history of safe operations based on our subcontractor prequalification process. It is the responsibility of the PTL to verify that the subcontractor selected for a GSI project has a current subcontract agreement in place with GSI and that GSI has received a current subcontract Exhibit A.1 (Safety Update, see Appendix C) with their most recent OSHA 300 log and workers compensation experience modified rate (EMR) documentation.

While it is required and expected that subcontract personnel will have proper knowledge and training in the safe operation of their equipment, GSI personnel must also be alert at all times to the potential hazards associated with these types of operations and have an obligation to prevent unsafe acts by our subcontractors. In addition, on some sites, heavy equipment operations unrelated to GSI's work may be ongoing in the immediate vicinity. It is equally important to remain alert to potential hazards associated with those operations.

Drill rigs and other heavy equipment must be in good condition to be operated safely in accordance with the manufacturer's or their employer's safety manual, as applicable. The GSI SSO should confirm that the subcontract operator has inspected the equipment to ensure it is in safe and operable condition, and document this on the Daily Site Safety Record. In addition, GSI personnel should note any obvious deficiencies (e.g., leaking hydraulic hoses, frayed hoisting cables, absence of back-up beeper, etc.) and ensure that these are corrected before starting operations.

Areas in which heavy equipment operations are taking place should be accessible only to authorized personnel. Barricades or caution tape should be used, as needed, to exclude unauthorized personnel from the work area. All vehicles or mechanical equipment that may have all or part of its structure (e.g., drilling mast) in the vicinity of energized overhead lines should maintain an operating distance of at least 20 feet of clearance with distance increased by 4 inches for every 10 kV over 50kV, or greater if specified in the contractors procedures. Drill rig masts should be lowered as soon as weather indications conducive to lightning strikes develop (see Section 4.1.10)

When working in the vicinity of heavy equipment operations, personnel should always be mindful that the operator may have limited peripheral vision and may be unaware of the presence of people in close proximity. Therefore, it is up to people working in the vicinity of the equipment to maintain a safe distance and to make visual contact with the operator before entering the operating area of the equipment.

### *4.4.2 Underground and Overhead Utilities Clearance*

Prior to any operations involving drilling, subsurface probing, or excavation, drilling or digging locations must be cleared for underground utilities. For most refineries, chemical plants and other major industrial facilities, this is generally done through the host facility. For sites on or near public rights-of-way, power lines, or pipeline easements, clearance is obtained through local or state organizations, such as the Texas 811 System by calling 811 or accessing the Portal at https://txgc.texas811.org/geocall/portal/. ***In most states, utility clearance prior to drilling or excavation is required by law. Failure to properly pre-clear drilling or excavation locations may lead to serious injury or property damage and will be subject to disciplinary action, possibly including termination of employment.***

Drilling or excavation locations should be clearly marked on the ground with stakes and/or paint, and a street address with nearest cross-street(s) must be provided at least 48 hours in advance of any drilling or excavation. If possible, a detailed explanation of the color-coding system used to represent the various underground utilities should be included in the SS-HASP. Below are the color designations typically used by the underground utilities surveyors in Texas and California (note other states may differ):

**WHITE** – PROPOSED EXCAVATION

**PINK** – TEMPORARY SURVEY MARKINGS

**RED** – ELECTRIC POWER LINES, CABLES, CONDUIT AND LIGHTING CABLES

**YELLOW** – GAS, OIL, STEAM, PETROLEUM OR GASEOUS MATERIALS

**ORANGE** – COMMUNICATION, ALARM OR SIGNAL LINES, CABLES OR CONDUIT

**BLUE** – POTABLE WATER

**PURPLE** – RECLAIMED WATER, IRRIGATION AND SLURRY LINES

**GREEN** – SEWERS AND DRAIN LINES

On plants, if feasible, the site should be inspected in the presence of the site representative. In areas of a large amount of subsurface utilities or long developmental history, a representative of the public works department of the municipality in which the work is being conducted should be contacted directly prior to work. If the exact location of underground utilities is still unknown prior to commencement of drilling activities, a private utility locator can be hired to locate subsurface lines, pipes, and/or tanks. Utility locating techniques include probing with a tile probe, ground penetrating radar (GPR), electromagnetic surveys, and use of an air knife and vacuum truck (a.k.a. “pot-holing”) to clear the upper soil column prior to drilling.

The location of overhead power lines should also be noted relative to drilling or excavation locations.

### *4.4.3 Drill Rig Operational Safety*

During drilling, the drill rig should be positioned to allow for adequate work room and the area should be kept free of trip and slip hazards. The drilling mast should maintain an operating distance of at least 20 feet of clearance from energized overhead lines, with distance increased by 4 inches for every 10 kV over 50kV, or greater if specified in the contractor’s procedures. Whenever feasible, the rig should be positioned so that any vapors emanating from the borehole or from the cuttings pile or mud pit are blown away from the crew. The geologist’s logging table should be situated to face the driller so that operations can be clearly viewed; communication is easily facilitated; and is out of the potential path of falling drill rods.

Care must be taken to avoid the catching of loose clothing in moving parts, and to keep hands free of pinch points. Proper PPE, including hard hat, safety glasses, gloves, hearing protection and safety shoes with steel-toe protection, must be worn while the rig is in operation. In the event site work must occur in a high traffic area or roadway, include a traffic control plan in the SS-HASP. This plan may include, but is not limited to, additional PPE requirements (e.g., high visibility vests), the timeline for high-risk traffic patterns, and the traffic control requirements to

create a safe perimeter around the work zone. The SSO is responsible for ensuring that the drill crew has proper PPE, and that it is changed out when needed (e.g., torn Tyvek coveralls are not acceptable).

In the event that it becomes necessary to free a stuck cable from the upper portion of the drill rig mast, the mast should be lowered rather than climbed, if feasible. If it is necessary to climb the mast to make a repair, a harness should be used for fall prevention. In the event of lightning, operations should be suspended, and the mast should be lowered. Additional safety-related procedures to be considered when operating during inclement weather are included in Section 4.1.10.

Acrylic core tubes used for soil sampling can be difficult to handle while cutting open. Attempting to cut the tubes with a standard utility knife while holding the core with one hand can pose a significant risk of serious laceration. Cutting tools specially designed for the tubes are available and should always be used. The tube should be placed in a cradle or jig to hold it steady. When cutting, never pull the cutting tool toward yourself.

### *4.4.4 Forklift Operations*

GSI periodically rents forklifts for movement of drummed IDWs, palletized well construction materials, or other heavy items. Only personnel who have been trained and certified in forklift operations in accordance with §1910.178(l) are permitted to operate forklifts. All forklift equipment must be inspected before use to ensure proper function. Subcontract personnel operating forklifts must present their certification to the GSI SSO for inspection prior to use, and this should be documented on the Daily Site Safety Record or SS-HASP.

## 4.5 Chemical Hazards

Hazardous chemicals, including organic and inorganic substances, may be present at GSI work sites as process–related chemicals, managed or uncontrolled wastes, or as residues or contaminants in environmental media. Exposure to elevated levels of hazardous substances can result in injury or illness. Potential routes of entry into the body include i) inhalation, ii) ingestion, iii) absorption through the skin or eyes, and/or iv) injection into the bloodstream via a cut, puncture, or other wound. The SS-HASP must identify known chemical hazards and specify precautions to be taken to prevent exposure to unsafe levels of hazardous chemicals.

The SS-HASP must i) identify the specific hazardous chemicals known or suspected to be present at the site, and ii) identify their harmful properties, exposure routes, and applicable exposure limits. The mode of occurrence in the environment (e.g., adsorbed onto soil and/or dissolved or as free-phase in groundwater) and their known or expected concentrations based on existing site data, if available, should also be described. As detailed in the HAZCOM Program (see GSI Procedures Handbook), Safety Data Sheets (SDSs) should be obtained for the primary constituents of concern (COCs) and attached to the SS-HASP. SDSs may be found at on-line sources or may be available from the client. SDSs should be reviewed to ensure an understanding of the nature of the hazard associated with each COC, including applicable exposure pathways, permissible exposure limits, and air monitoring procedures, and to identify hazard avoidance measures, including appropriate monitoring and proper selection and use of PPE. Additional information on selection and use of PPE is provided in Section 6.0 of this EHS Program Manual.

## 4.6 Sampling Natural Gas Wells and Related Facilities

Projects for the upstream oil and gas industry frequently require measurement of methane, oxygen, and hydrogen sulfide ($H_2S$) concentrations to detect leaks at or within the working area immediately surrounding a natural gas wellhead and associated equipment. Water well systems

that have been contaminated by migration of methane into an aquifer can also result in methane accumulations in residential structures, especially basements. For these conditions, the primary work hazards include i) explosion or fire risks associated with methane levels that exceed the lower explosive limit (LEL), ii) asphyxiation risks due to decreasing oxygen levels below 19.5%, and iii) health risks due to measurable concentrations of $H_2S$. Procedures to monitor for and mitigate these hazards are provided below.

### *4.6.1 Methane and $H_2S$ Exposure Mitigation*

***Monitoring of Methane and Oxygen.*** Methane is classified as a simple asphyxiant in oxygen-deficient environments ($O_2$ < 19.5% e.g., confined spaces and other enclosed, poorly ventilated areas). Therefore, oxygen and methane levels should be measured prior to entry and subsequently monitored to ensure that oxygen levels are between 19.5% and 23% and that methane concentrations are below the LEL. Because methane is denser than air, it can accumulate in low areas, such as basements. Methane does not have an OSHA PEL or other health-based exposure limit and it is not detectable with a photo-ionization detector (PID) so alternative instrumentation must be used. Most commonly a combination $O_2$-LEL meter is used, frequently coupled with additional gas detectors such as for $H_2S$.

Methane is a flammable gas with a LEL of 5% (50,000 ppm). Any source of ignition, including an electrical spark from a light switch, can trigger an explosion in an atmosphere at or above the LEL. As a conservative measure, GSI personnel or contractors may not enter or work in an atmosphere with a methane concentration above 10% of the LEL (i.e., 0.5% methane in air by volume or 5,000 ppm of methane). And, site conditions and planned activities should keep the risk of either hazard low.

To ensure safe working conditions at natural gas wells, the following procedures should be followed:

1) Upon arrival at the site, field personnel should ensure that:
   i) the area where sampling or monitoring is to be conducted is well ventilated (i.e., open air movement); and
   ii) no sources of ignition (e.g., vehicles, generators) are in the immediate area of the wellhead (i.e., within 35 feet) until after the sampling area is checked for natural gas levels.
2) Immediately and continuously monitor oxygen and methane levels using a multi-gas meter to ensure that oxygen levels are between 19.5% and 23% and that methane concentrations are below 10% of the LEL (i.e., 5,000 ppm of methane) in the work area. These measurements should be recorded every 15 minutes.

If oxygen levels should fall below 19.5% or if methane levels should exceed 10% of the LEL in the work area (i.e., 5,000 ppm of methane), all powered equipment should be immediately shut down or removed from the work area, all work should be discontinued, and all personnel should immediately vacate the well vicinity. Therefore, if a potential source of ignition is observed near the wellhead (e.g., a well switch or starter box), field personnel should stand by the well switch or starter box during the sampling process, and be ready to de-energize the well electrical equipment, if needed. Field personnel should then confirm that the area is well ventilated, including opening windows or doors or moving vehicles to allow maximum air movement. However, energized fans and associated power equipment must not be used in the presence of elevated methane conditions.

If after 30 minutes, methane and oxygen concentrations return to acceptable ranges in order to continue work, then personnel may return to the site. If work continues, methane and oxygen

concentrations should be measured continuously and are subject to the same response actions should oxygen levels fall below 19.5% or methane concentrations exceed 10% of the LEL.

***Monitoring of Hydrogen Sulfide.*** Hydrogen sulfide ($H_2S$) presents both a toxicity and fire risk, as it is an asphyxiant that can lead to adverse physical effects at concentrations above the NIOSH recommended exposure limit (REL) for 10-minutes of 10 ppm, and permanent physical injury or death at concentrations above the IDLH concentration of 100 ppm, and is an explosive hazard with a LEL of 4% (40,000 ppm). $H_2S$ exhibits a distinct rotten egg odor at lower concentrations but is undetectable by odor at higher concentrations.

To ensure safe working conditions, the following procedures must be followed:

1) Continuously monitor $H_2S$ levels to ensure that $H_2S$ concentrations remain below 50% of the NIOSH REL of 10 ppm (i.e., below 5 ppm). These measurements should be recorded approximately every 15 minutes. Due to the low threshold of monitoring for the toxicity of $H_2S$, concentrations of the gas will not be allowed to approach levels that would pose a fire risk.
2) If $H_2S$ levels should exceed 50% of the REL (i.e., 5 ppm) in the work area at any time, work should be discontinued immediately, and measures will be taken to ventilate the work area until the measured breathing zone concentration is below 50% of the REL. If the toxicity of $H_2S$ is the only factor affecting the air quality (i.e., methane concentrations do not also exceed 10% of the LEL), then energized fans and associated power equipment may be used as engineering controls to mitigate $H_2S$ concentrations. When work continues, $H_2S$ concentrations should be measured continuously and are subject to the same response actions should concentrations exceed 50% of the REL.

### *4.6.2 Fire and Explosion Hazard Mitigation*

No sparking equipment or similar ignition source should be within a 35-foot radius of the wellheads, or within any enclosed structures surrounding a wellhead (e.g., well houses, basements). Field personnel will work on the upwind side of the wellhead during sampling operations to the extent feasible, or in the absence of adequate natural ventilation, set up a fan at the perimeter of the sampling area to help dissipate any vapors.

Fire extinguishers must be present on-site, and no smoking is permitted in the work area or general vicinity of the wellheads.

## 4.7 Reporting of Safety Concerns and Incident/Accident Investigation

### *4.7.1 General Reporting Requirements*

GSI employees are required to report all on-the-job and/or work-related injuries or illnesses, and other occurrences such as traffic accidents, chemical exposures, and other safety-related incidents to the appropriate person as soon as feasible after occurrence. All incidents must be reported, no matter how minor, including first-aid and near-miss incidents. When incidents occur on a project, they must be recorded on the Daily Site Safety Record. Incident reports are to be retained on file by GSI for a period of 30 years following the incident.

In addition to more serious injuries and accidents (e.g., those determined to be “OSHA–recordable” incidents), reportable safety concerns include, but are not limited to, unsafe physical conditions at the host facility, observed unsafe work practices by GSI or subcontract personnel, minor injuries requiring first-aid, and “near misses” (i.e., incidents in which, although no accident, injury or property damage may have occurred, an unsafe condition or action resulted in a narrowly averted accident or injury). In addition to injuries, accidents or illnesses, employees should also report any observed potentially unsafe conditions or activities. All employees are encouraged to provide recommendations for the upgrade of safety practices.

Records of safety incidents and concerns will be maintained on file by the GSI HSA and communicated in the form of "lessons learned" to GSI employees.

Project-related safety concerns and/or accidents are to be reported immediately to the designated SSO or acting designee, who will in turn, report them to the designated client representative, and GSI HSA and PTL, as specified in the SS-HASP without fear of reprisal and may be anonymously reported if needed. Non-project related safety concerns and/or accidents (e.g., automobile accidents or safety concerns in the GSI office or warehouse) are to be reported directly to the GSI HSA, and should be documented by a memorandum to file or other appropriate form (see Section 4.7.3) as soon as feasible following the incident.

It is important to note that medical treatment for on-the-job / workplace injuries is covered by workers compensation, while treatment for non-work-related injuries would be covered by the employee's personal or company supplied health care benefit. Therefore, failure to report a work-related injury in a timely manner could result in treatment not being covered. For example, if an employee were to get a cut on the job and not report it, and it subsequently became infected requiring treatment, there is the possibility that the workers compensation insurance provider could dispute that the injury is work-related and deny coverage, and the employee's health care provider could dispute the claim based on it being work-related.

### *4.7.2 OSHA-Recordable Incidents and Workers Compensation Injuries*

The HSA is responsible for maintaining the OSHA 300 logs and for completing the Employers' First Report of Injury or Illness for Workers Compensation. Assistance will be provided as needed from the HSC for each office. The HSA has ultimate responsibility for determining whether an injury is an OSHA-recordable incident.

An injury or illness is determined to be recordable if it results in any of the following: i) a fatality; ii) days away from work at the direction of a health care provider (after the day of the incident itself); iii) restricted work or transfer to another job; iv) medical treatment beyond first-aid; or v) loss of consciousness. An injury or illness is also recordable if it involves a significant injury or illness diagnosed by a physician or other licensed health care professional, even if it does not result in the other conditions listed above. Injuries and illnesses meeting the criteria for recordable incidents will be recorded on the OSHA 300 Log, in accordance with the instructions included on the OSHA 300 form. OSHA Form 101 - Supplemental Report of Occupational Injury or Illness will also be completed for all recordable incidents. As required by law, the OSHA 300 log for the most recently completed year is posted in a visible location at the GSI office from February 1 to April 30 of the following year. OSHA 300 logs and Form 101 are kept on file by the HSA for a minimum of 5 years, as required by law.

The HSA is also responsible for completing the Employers' First Report of Injury or Illness for Workers Compensation. In Texas, the law requires that DWC Form-001 be completed and filed with GSI's Workers Compensation Insurance Carrier, and a copy delivered to the employee or employee's representative no later than the eighth day following either i) receipt of notice of occupational disease, or ii) the employee's first day of absence from work due to injury or death.

In California, Cal-OSHA requires employers *"to report within five days of knowledge every occupational injury or illness which results in lost time beyond the date of the incident OR requires medical treatment beyond first aid. … In addition, every serious injury illness, or death must be reported immediately by telephone or telegraph to the nearest office of the California Division of Occupational, Safety and Health."*

### *4.7.3 Accident Investigation and Reporting*

All accidents, injuries, or other serious safety-related incidents will be investigated by the GSI HSA or their designee, and will include participation by participants, witnesses, and other

personnel, as appropriate. If an incident occurs on a host facility, the investigation will be conducted in accordance with the requirements of the host facility as well as with GSI practice. Incident/accident reports will be based on interviews with all persons directly or indirectly involved in the incident and with all eye-witnesses, if any. The report will include a description of events, an analysis of the immediate and root causes of the incident, and recommended action items for prevention of recurrence or similar occurrences.

If you are involved in, or witness to, a safety incident: i) remain calm; ii) take appropriate measures to mitigate any continuing danger of further injury, provided that doing so will not cause injury to yourself or others; iii) take notice of pertinent facts (time, ambient conditions, what happened, people involved, etc.); and iv) at your earliest opportunity following the incident, contact the GSI HSA. If other people are involved, record their names and contact information. As soon as feasible, prepare notes to aid the incident investigation. A clear and concise report should present all of the pertinent facts and include an analysis of the root and proximal cause and identify any measures taken to mitigate the incident and measure that may be implemented in the future to prevent recurrence

Copies of the reports will be kept on file at GSI offices for a period of 30 years following the incident and will be made available to the host facility owner, if requested.

# 5.0 HEALTH AND SAFETY TRAINING PROGRAM

It is GSI policy that all personnel who either directly engage in or supervise field work, including, but not limited to, environmental site investigations and remediation, are required to complete OSHA HAZWOPER training and maintain current certification under 29 CFR §1910.120. In addition, all GSI employees performing field work are required to read this EHS Program Manual, attend an orientation session by the GSI HSA, HSC or other designated person, and upon completion, sign an acknowledgment, agreeing to abide by the EHS Program Manual as a condition of their employment.

Employees who do not directly perform field work but do supervise field projects are required to be equivalently trained. Additional training, including training provided through local or regional contractor safety councils or other site-specific, task-specific, or client–specified training (e.g., the United States Army Corps of Engineers EM-385 training for certain DOD work), will be provided on an as-needed basis. All required training is performed on "company time" and is provided at no expense to the employee. In addition to receiving training, employees are expected to demonstrate and utilize their experience knowledge and competence in health and safety matters during the performance of their work.

## 5.1 OSHA "HAZWOPER" Safety Training

### *5.1.1 Scope of OSHA Training*

All GSI field personnel whose jobs require field work on sites with potential exposure to hazardous chemicals are required to complete an initial 40-hour training course on safety and health for HAZWOPER, and an annual 8-hour refresher course, as required by 29 CFR 1910.120 ("the OSHA standard"). Training certificates must include the employee name, dates of training, certification subject, and signature of the instructor. Key elements of the course include, but are not limited to:

i) Regulatory framework;
ii) Hazard identification, mitigation, and emergency response;
iii) Air quality monitoring techniques;
iv) Proper selection, use, and maintenance of PPE, including respiratory protection (see Sections 6.0 and 7.0 of this EHS Program Manual); and
v) Decontamination procedures.

All field personnel who perform work in a supervisory role, including, but not limited to, directing the activities of subcontract personnel and preparing SS-HASPs, will also complete the 8-hour supervisor's training as specified by the OSHA standard. Typically, Supervisor training will be conducted for employees that GSI feels are ready to supervise others in the field, which will be based on each employee's level of experience and competence. Generally, this includes employees with at least one year of experience in field work whether with GSI or a prior employer. Supervisor training is geared in part towards developing effective SS-HASPs, including hazard identification and mitigation, selection and use of PPE, and establishing air quality monitoring parameters and action level criteria for use of respiratory protection. It also is a prerequisite for GSI employees to serve as an SSO.

GSI requires that its subcontractors whose tasks involve potential exposure to hazardous materials also receive the 40-hour training and 8-hour annual refresher courses, as applicable. Some GSI clients require presentation of certificates documenting training before allowing personnel on-site to commence work. It is the responsibility of the SSO or other person preparing the SS-HASP to be aware of any such requirements, and to communicate them to the subcontractor prior to mobilization to the site in order to avoid project delays.

Following 40-hour training, field workers shall receive a minimum of 24 hours (three days) of on-the-job field training under the direct supervision of an experienced, qualified supervisor, as required by OSHA regulation (29 CFR 1910.120(e)(3)(i)). Additional training and/or on-site supervision shall be provided, as needed, to achieve demonstrated competence for the scope of work to be performed, at the discretion of GSI management or as specified in the SS-HASPs. GSI PTLs and principals are responsible for ensuring that personnel selected for project work, and the specific tasks, have demonstrated adequate training, experience and competence before they are assigned to work without direct on-site supervision.

### *5.1.2 OSHA Trainer Qualifications*

OSHA training shall be performed by personnel qualified to instruct employees about the subject matter that is being presented in training. Such trainers shall have satisfactorily completed a training program for teaching the subjects they are expected to teach, or they shall have the academic credentials and instructional experience necessary for teaching the subjects. Instructors shall demonstrate competent instructional skills and knowledge of the applicable subject matter. GSI's preferred provider and alternates are specified in Appendix E.

## 5.2 Hazard Communication "HAZCOM" Program

GSI's HAZCOM program is presented in in the GSI Procedures Handbook. All GSI employees are oriented to the HAZCOM program upon employment. Refresher classes are conducted annually for all employees, typically in conjunction with the in-house OSHA HAZWOPER Refresher class.

As a summary, the four key elements of the HAZCOM Program are summarized below.

1) ***Hazard Classification:*** The criterion for classification of chemicals and mixtures based on health, physical, and other types of hazards as defined by the Globally Harmonized System (GHS). Prior to performing any field activities which may include exposure to or use of potentially harmful chemicals, the hazard classification will be identified and detailed in the SS-HASP and communicated to all project personnel as part of the safety orientation.
2) ***Safety Data Sheets (SDSs):*** Required for all hazardous materials used in the GSI warehouse or field. The person purchasing or authorizing the purchase of any chemical has the responsibility to obtain an SDS from the manufacturer or vendor of the chemical and to provide it to the GSI HSA or Co-HSA.

   To the extent feasible, SDSs shall be obtained for hazardous materials which may be present in the soil, groundwater, or other media at particular sites where drilling, sampling, or excavating shall occur. These SDSs shall be included as attachments to SS-HASPs and shall be on file at the project field office, where applicable.

   When feasible, the primary source for the SDSs should be the host facility owner for chemicals manufactured or used at the project site. Secondary sources include a variety of internet sites. The SDS should be reviewed by the SSO prior to inclusion in a SS-HASP to verify that all required sections are present.

   The GSI local HSCs are responsible for maintaining: i) an inventory of all chemicals used in the office, shop, or field, and ii) a file of all respective SDSs at their respective office or shop locations. For example, the Houston HSC has responsibility for the SDS files at the GSI Houston office and warehouse. These must be readily available at each location for the use of employees handling the materials.
3) ***Labeling:*** Chemical manufacturers and importers are required to provide standardized labels that include a harmonized signal word, pictogram, and hazard statement for each hazard class and category. Hazardous materials used by GSI shall be properly labeled,

handled, and stored in accordance with the manufacturer's instructions. Flammable materials shall be kept in a closed metal cabinet equipped with the required label clearly indicating its contents.

4) ***Information and Training:*** GSI will provide orientation and training for new employees on the GSI HAZCOM Program. Annual refresher training will be typically provided in conjunction with the annual 8-hour OSHA refresher training.

## 5.3 Safety Meetings

Company-wide safety meetings for all available field personnel to review this EHS Program Manual are held at least annually and following major updates to the EHS Program Manual. Typically, annual meetings are held in conjunction with the OSHA HAZWOPER Refresher training, which is generally conducted annually in-house by GSI's preferred providers. More frequent company-wide meetings are conducted to address specific topics at periodic staff meetings (e.g., PTL and Tech Staff meetings). In addition, memoranda or emails will be periodically sent to all staff to call attention to specific safety concerns, procedures, and lessons learned. The HSA and HSCs meet as a group at least annually (in person or via teleconference) to identify any issues relating to H&S and discuss possible modifications to standard procedures or the need for updates to this EHS Program Manual or other elements of the EHS Program.

Project safety orientation meetings for GSI employees and subcontractors shall be conducted prior to project start-up, with follow-up sessions upon changes to project personnel, tasks, and/or site conditions. Informal "tailgate" safety meetings shall be held daily. Safety meeting attendance and topics will be documented on appropriate safety forms. Job specific and non-routine hazards are discussed during these sessions.

## 5.4 Energy Isolation (Lock-Out/Tag-Out) Program

GSI has developed an Energy Isolation (Lock-out/Tag-out) program to prevent the accidental exposure to hazardous energy. This program is included as Appendix B to this EHS Program Manual. Host facilities may have additional requirements that will be incorporated as needed into SS-HASPs. Use of lock-out and tag-out procedures is typically applicable only to groundwater pump and treat or other remediation systems installed, operated, and/or maintained by GSI. Detailed training in lock-out/tag-out procedures will be provided to all employees engaged in tasks requiring energy isolation, and lock-out devices will be assigned to them. All employees are required to be familiar with and abide by general lock-out/tag-out principles and procedures as described in Appendix B.

## 5.5 Site-Specific Training

Most GSI projects will require site-specific training, which may be supplied on-site directly by the site owner/operator, or through a designated local safety council such as the Houston Area Safety Council (HASC). Many sites will also require general worker safety training and certification as offered by the local safety council. Entry onto safety council member facilities typically requires the "Basic Plus" course on general safe-work practices, and site-specific training. The SS-HASP is responsible to identify the training needed for site entry and for the performance of any specialized tasks, and to ensure that GSI and subcontract personnel receive the required training prior to arrival at the site. GSI project team leaders are responsible for coordinating with the site owner or designated representative to ensure that all personnel (including subcontractors) receive any required site-specific training provided at the facility. Each applicable GSI employee is responsible for maintaining current certification by the applicable local safety council, by keeping track of expiration dates and scheduling the training with assistance from the local HSC as needed.

## 5.6 Transportation Worker Identification Credential (TWIC) Program

The Transportation Security Administration (TSA), in coordination with the United States Coast Guard, developed the Transportation Worker Identification Credential (TWIC) Program in response to the Maritime Transportation Security Act of 2002 (MTSA). MTSA requires a biometric identification credential for individuals who require unescorted access to secure areas of maritime facilities and vessels. Before issuing a TWIC, TSA must conduct a security threat assessment on the TWIC applicant. An applicant who, as a result of the assessment, is determined to not pose a security threat, will be issued a TWIC card. Possession of a TWIC card does not guarantee access to secure areas because the owner/operator controls which individuals are granted unescorted access to the facility or vessel. Rather, TWIC is a secure, verified credential that can be used in conjunction with the owner/operator's risk-based security program that is required in security regulations issued by the Coast Guard. It is the responsibility of the PTL to know whether a TWIC card is required for entry onto a site and ensuring that the project is staffed with properly credentialed personnel.

## 5.7 Confined Space Awareness Training

GSI's activities do not routinely involve entry of personnel into confined spaces such as tanks, vessels, excavations, etc. GSI employees and subcontractors are prohibited from confined space entry unless properly trained and authorized. On most facilities, permit-required confined spaces are posted. However, employees must be familiar with the general characteristics of such spaces in order to recognize the potential hazards (see Section 4.3).

Appendix D provides a procedure for spaces such as basements and crawlspaces that may need to be entered (e.g., for sampling during vapor intrusion investigations) and which may be classified as non-permit-required confined spaces. The procedure is designed to first confirm that the space is not a permit-required space. ***The non-permit-required confined space entry procedure in Appendix D may not be used if the space meets the definition of a permit-required confined space.***

In the event that a specific project requires entry into a permit-required confined space by GSI personnel, the assigned personnel will receive proper training prior to project start-up. Training in accordance with OSHA requirements will be provided through a qualified organization, such as a contractor safety council.

## 5.8 Hydrogen Sulfide ($H_2S$) Safety Training

As discussed in Section 4.6.1, certain projects may require familiarity with $H_2S$ as a potential site contaminant or as an occupational hazard of working in active petrochemical facilities. Training on the health and safety procedures related to $H_2S$ are specified in ANSI standard Z390.1-2017. All employees identified to work on applicable projects will participate in a $H_2S$ Safety Training course compliant with the scope elements defined in ANSI Z390.1-2017 on an annual basis. All certifications of employees who have completed the course will be maintained by GSI for a minimum of 3 years.

## 5.9 DOT Hazardous Materials Shipping (Dangerous Goods)

Employees responsible for shipping supplies, equipment, and samples related to hazardous waste site investigation and remediation may be required to meet the DOT's regulations for shipping hazardous materials or dangerous goods. Regulatory training requirements may be met by completing a certified on-line course.

## 5.10 Fire Extinguisher and First-Aid Training

Training in the use of fire extinguishers and in first-aid (including CPR training) is provided by qualified instructors to interested employees on a strictly voluntary basis. GSI employees, even

those who have received this training, are not required to use a fire extinguisher, or otherwise fight a fire, or administer first-aid as part of their job description.

## 5.11 EM-385 Training

Certain projects for the United States Department of Defense (DOD) may require training on the health and safety procedures specified in Engineering Manual EM-385, developed by the U.S. Army Corps of Engineers. Two levels of training are available, including a 16-hour and a40-hour course, available on-line. The PTL is responsible for identifying the training required for DOD site under this program.

## 5.12 Other Specialized Training

Additional training may be required and will be supplied for personnel involved in certain other activities, as required by specific projects. Examples include training for scaffold safety and fork-lift operation. Training in accordance with OSHA requirements will be provided through a qualified organization such as local contractor safety councils.

# 6.0 PERSONAL PROTECTIVE EQUIPMENT (PPE) PROGRAM

## 6.1 Scope, Application and Overview

GSI's Personal Protective Equipment (PPE) Program is designed to meet the applicable requirements of 29 CFR Subpart I, specifically §1910.132 - §1910.136, and §1910.95 (Occupational Noise Exposure). All GSI personnel who perform or supervise field work are required to comply with the requirements of this section of the EHS Program Manual and are encouraged to become familiar with these OSHA standards. GSI personnel are also responsible for ensuring compliance with applicable PPE requirements by subcontract personnel working under their supervision.

GSI issues appropriate Personal Protective Equipment (PPE) at no cost to all field personnel, as needed for safe performance of their jobs. Standard "Level D" PPE (see below) is required for all field projects. Level D PPE will be augmented by additional PPE (including chemical-protective gloves and body covering) or upgraded to Level C (air-purifying respirators) or Level B (supplied air) to reduce potential chemical exposure, as needed. However, engineering and/or work practice controls should always be considered first to reduce disadvantages associated with unnecessary use of respirators (e.g., increased physical stress and impacted communications). Use of PPE and respirators is subject to a physician's or licensed health care professional's (PLHCP) written opinion regarding fitness of the employee (see Section 7.0 of this EHS Program Manual).

## 6.2 PPE Selection and Use

### *6.2.1 General*

The project SSO is responsible for specifying the required PPE in the SS-HASP. PPE will be specified based on a project-specific hazard assessment to determine whether conditions necessitating the use of PPE are likely to be present, with appropriate reference to relevant, available supporting documentation (e.g., site assessment reports or other documents). Selection of PPE shall be based on the i) tasks to be performed; ii) chemicals potentially present on-site and their compatibility with the PPE; and iii) potential for worker exposure to the hazards identified during the site evaluation phase of the work program. PPE requirements must always meet or exceed the host facility's minimum requirements.

GSI will provide all necessary PPE to its employees at GSI's expense. In general, field tasks require a minimum of Level D protection which shall consist of the following:

i) Body covering, including long pants, shirt with sleeves;
ii) Safety shoes or boots;
iii) Hard hat (ANSI Z89.1-2014); and
iv) Safety glasses with side shields (ANSI Z87.1-2015).

GSI provides employees with gloves, hardhats, safety glasses, chemical-splash and/or vented goggles, face shields, safety shoes, boots and/or disposable shoe covers, flame retardant clothing (FRC) and disposable chemical protective suits (e.g., Tyvek) as appropriate to the work assignment. Employees are responsible for inspecting and maintaining in good condition their PPE and for requesting replacement equipment when needed. Protective clothing shall be cleaned and laundered at least weekly (when used). Clothing shall also be properly disposed and repaired or replaced as necessary.

Many sites require the use of flame-retardant clothing (FRC) for entry onto the facility in general or in certain areas of the facility. Steel-toed shoes or boots are required for any projects with the potential for heavy objects being dropped on feet (e.g., drilling jobs), but sturdy leather work

shoes without steel toes may be acceptable for projects with no such identified hazard such as routine site surveys and groundwater sampling, unless required by the host facility. Hard hats must always be worn in designated hard hat areas and in other areas or activities with potential for falling objects around heavy equipment or other overhead hazards, or other areas specified by the facility. Many sites require that standard eye protection also include chemical splash goggles. Hearing protection must be worn in high-noise areas and in proximity to any high-noise level equipment, including but not limited to drilling rigs, excavation equipment, gasoline-powered pumps and generators. Protective gloves are to be worn when handling abrasive or sharp materials or chemical substances.

Basic Level D PPE will be augmented (e.g., with chemical protective gloves and or coveralls, etc.), as appropriate to job or site conditions. Upgrades to Levels C (air-purifying respirators) and B (supplied air) will be determined based on actual or expected atmospheric conditions in accordance with site-specific information. The following guidelines should be observed (see Sections 6.2.2 through 6.2.7 of this EHS Program Manual).

### 6.2.2 Respiratory Protection

The GSI Respiratory Protection Program is designed to meet the requirements of 29 CFR ¶1910.134 and is presented in Section 7.0 of this EHS Program Manual.

### 6.2.3 Hand and Body Covering

If specified in the SS-HASP, disposable, chemical-resistant coveralls made of Tyvek or other equivalent material (e.g., CPF4) should be worn during tasks involving potential contact with contaminated soils or other materials (e.g., soil sampling). Poly-coat Tyvek or equivalent should be specified when there is a potential for splashing with free-phase chemical liquids or water with elevated concentrations of dissolved hazardous constituents (e.g., during well development). Other special equipment, such as rubber aprons or slickers should be worn whenever acids or other corrosive or caustic materials are in use (e.g., during well re-development). Flame-retardant clothing (FRC; Nomex or equivalent) must be worn as required by host facilities.

Employees are required to wear gloves when hands are exposed to physical hazards posing the potential for cuts, abrasions, lacerations, thermal burns, or punctures, or for chemical hazards such as chemical absorption by the skin, or chemical burns. The compatibility of the glove material with the potential chemical or other hazard must be confirmed when preparing the SS-HASP. Gloves shall be selected for resistance to the anticipated chemical hazards. When NAPL and or unfamiliar contaminants are expected to be present, consult a chemical compatibility guide such as the Wiley “Quick Selection Guide to Chemical Protective Clothing.” At a minimum, nitrile or vinyl surgical-type glove should always be worn when there is a low potential exposure to chemicals and when dexterity is required (e.g., during soil core logging). When the potential for chemical exposure is greater, gloves of neoprene or other chemical-resistant material should be worn over the surgical gloves (inner gloves). Coverall cuffs shall be taped to gloves and boots, as appropriate to prevent skin exposure to hazardous liquids, when present.

### 6.2.4 Head Protection

Hard hats meeting ANSI Z89.1-2014 standards must be worn in areas where vertical clearance is limited, when there is potential for falling objects or other impacts, and during all operations involving heavy equipment. Hard hats, including internal supports, must be inspected prior to each use and replaced annually, as recommended by the manufacturer, or following an incident of significant impact. Additional information may be found in 29 CFR §1910.135.

### 6.2.5 Eye and Face Protection

Safety glasses with side shields meeting ANSI Z87.1-2015 standards should be augmented with chemical protective goggles on sites where there is potential for chemical exposure. Face shields are required during operations with potential for splashing or spraying of chemicals or contaminated water, such as well acidification or pressure washing of contaminated equipment, and during operations involving the use of grinders or similar equipment. Additional information may be found in 29 CFR §1910.133.

### 6.2.6 Hearing Protection

GSI's Hearing Conservation Program is presented in Section 8.0 of this EHS Program Manual, and additional information may be found in 29 CFR §1910.95.

### 6.2.7 Foot Protection

Sturdy, closed-toe work shoes or boots are required on all worksites. Steel-toed work shoes or boots are required whenever there is potential for injury due to dropped or falling objects. Leather boots are acceptable if no significant potential exists for a chemical contamination or corrosion hazard. When there is potential for exposure to liquid chemicals or non-aqueous phase liquids, boots made of rubber, PVC, or other chemical resistant material are required. Rubber boot covers may be worn over leather boots to prevent chemical exposure. Foot ware with safety shanks should be worn if the project entails the use of ladders. Additional information may be found at 29 CFR §1910.136.

## 6.3 Inspection, Decontamination, Maintenance, and Storage

PPE including gloves, hard hats, safety glasses, vented goggles, safety shoes, and/or disposable shoe covers shall be inspected by the employee using it. Employees are responsible for ensuring that the PPE issued to them is in proper working order or for requesting replacement equipment in the event of damage or defect. Non-disposable PPE (e.g. respirators, hard hats, etc.) will be inspected by the employee prior to each use, and will be properly decontaminated, stored, and maintained. Inspection before each use will be documented on the Daily Site Safety Record. Respirators must be inspected, and an inspection form completed as discussed in Section 7.4. GSI will provide replacement equipment as needed, but it is the responsibility of the employee to inspect the equipment and to request replacement, as needed.

Personal protective equipment, including PPE for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained in a sanitary and reliable condition. Barriers shall be provided and used wherever it is necessary by reason of hazards associated with processes or the environment, such as chemical or radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation, or physical contact.

If applicable, reusable protective clothing shall be cleaned and laundered at least weekly and shall be properly disposed, repaired, or replaced, as necessary, based on inspection by the user.

## 6.3 PPE Training

PPE training is provided to all GSI personnel performing and supervising field work. Training is generally provided as part of the OSHA HAZWOPER 40-hour training (and annual refresher) and/or by contractor safety councils. Proper training includes, at a minimum: i) when use of PPE is necessary; ii) what PPE is necessary for specific hazards; iii) proper selection of PPE, including material compatibility with specific COCs; iv) how to properly don, doff, adjust, and

wear PPE; v) the limitations of PPE; and vi) the proper care, maintenance, useful life, and disposal of PPE.

Re-training of the employee is required when the i) workplace changes, making the earlier training obsolete; ii) type of PPE changes; or iii) employee demonstrates lack of use, improper use, or insufficient skill or understanding. Fitting, including proper donning, doffing, cleaning, and maintenance practices must be observed. **Defective or damaged PPE shall not be used.** Training in the use of respiratory protective equipment is conducted in conjunction with OSHA training, as discussed in Section 7.4.3 of this EHS Program Manual.

# 7.0 RESPIRATORY PROTECTION PROGRAM

## 7.1 Scope, Application and Overview

The respiratory system offers a significant potential entry point to the body for organic and inorganic toxic substances via inhalation of dust, fumes, vapors, and mists. In addition, the presence of air contaminants can result in an oxygen-deficient IDLH condition (Immediately Dangerous to Life and Health). GSI does not perform work in entry permit required confined spaces or other IDLH atmospheres. However, GSI does work on projects where airborne chemical concentrations associated with contaminated soil and or water may exceed safe occupational exposure levels, including the following:

i) Permissible Exposure Levels (PELs, promulgated by OSHA);
ii) Threshold Limit Values (TLVs, established by ACGIH);
iii) Biological Exposure Indices (BEIs, ACGIH); or
iv) Other Time-Weighted Average (TWA) concentrations.

While engineering and work practice controls to prevent potential exposure should be given preference whenever feasible, levels above these threshold values may at times require the use of air-purifying respirators ("Level C" PPE) or supplied air ("Level B" PPE). In addition, atmospheric concentrations of chemicals associated with plant process could at times exceed such limits on client facilities due to unexpected releases. In addition, respirator use may be required during the time period necessary to install or implement engineering and work practice controls, where such controls are insufficient to reliable reduce exposure concentrations to acceptable levels, or in emergency situations.

To prevent injury or disease of the respiratory system or asphyxiation, GSI has implemented a respiratory protection program which incorporates medical surveillance, air quality monitoring, engineering control measures, and use of respiratory protective equipment. GSI's Respiratory Protection Program is designed to meet the requirements of 29 CFR 1910.134. Air-purifying respirators are provided at no cost to the employee, as required by the regulation. Employees who may be required to use respirators receive training on respirator use, maintenance, and limitations through initial OSHA training and annual refreshers. In the event supplied-air is required, equipment will be obtained from an approved supplier and additional training, as needed will be provided.

Medical surveillance will be conducted, in accordance with the OSHA standard, to ensure personnel are fit to use a respirator. GSI's Medical Surveillance Program is described in Section 9.0. Annual quantitative fit tests, or, in select situations, qualitative fit tests, will be conducted for the selected respirator make and model. Records of training and fit tests will be maintained by the GSI HSA. To track and maintain the respiratory program for each project, the Daily Site Safety Record includes a record of air monitoring measurements and respirator use. When air quality monitoring is performed and/or when respiratory protection equipment is used, documentation must be retained for a period longer than GSI's standard project file retention time; therefore, separate copies must be provided to the HSA (Section 10.0 of this EHS Program Manual).

## 7.2 Air Quality Monitoring

Identification and quantification of airborne chemicals is required to ensure worker safety. When airborne concentrations of chemical constituents can reasonably be expected to exceed safe limits and/or are unknown, air quality monitoring is required. The goals of the air monitoring program are to:

i) Determine the level of PPE that is required;
ii) Define areas where engineering or work practice controls and/or respiratory protection is necessary; and
iii) Determine whether exposure potential may indicate the need for medical monitoring.

A description of the instruments and monitoring procedures and the mechanism for using air monitoring information are provided below.

### *7.2.1 Air Monitoring Techniques and Instruments*

Identification and quantification of airborne contaminants is achieved by using direct reading instruments or chemical detection methods. Depending on the nature of the site, these tools are either used alone or in combination. Four primary air monitoring devices are described below. Others may be specified by SS-HASPs on an as-needed basis.

***Photo Ionization Detector (PID)***

A photo-ionization detector (PID) device is the most commonly used instrument for direct measurement of total organic vapors in air, and action levels specified in SS-HASPs for requiring respiratory protection are tied to measurements from this instrument. Additional specifics regarding PIDs include:

i) ***Hazard Monitored:*** Total organic gases and vapors.
ii) ***Information Provided:*** On-site detection and quantification of organic gases and vapors.
iii) ***Primary Use:*** Continuous or periodic on-site air monitoring for total airborne volatile organics. Indicates if action level is exceeded, necessitating an upgrade in PPE, or a modification of work procedures.
iv) ***Detection Method (for PIDs):*** Gases and vapors are ionized by a light source, producing a current proportional to the number of carbon atoms present.
v) ***Limitations:*** Does not identify specific organic compounds. Does not detect inorganic gases or vapors, methane, or organic compounds with an ionization potential (IP) greater than the limits of the ionizing light source. The standard lamp is 10.6 electron volts (eV). Depending on the chemical to be monitored it may be necessary to specify an 11.7 eV lamp; however, these are more expensive and deteriorate rapidly, even when not in use.
vi) ***Care and Maintenance:*** Requires charged battery and daily calibration check.

***Dräger / Draeger Colorimetric Tubes***

Dräger or “Draeger” tubes may be used to determine the presence or absence of specific chemicals in a vapor mixture (e.g., whether vapors from a gasoline source contain significant levels of benzene); whereas, a PID can only measure the total volatile organic concentration. Additional specifics regarding Draeger tubes include:

i) ***Hazard Monitored:*** Specific organic gases and vapors.
ii) ***Information Provided:*** On-site and rapid identification, and rough quantification of specific gases and vapors.

iii) ***Primary Use:*** Identification and limited quantification of specific organic constituents in air to augment total organic vapor measurement (e.g., by a PID).

iv) ***Detection Method:*** Chemical reaction in indicator tube, producing a stain whose length is proportional to the COC's concentration.

v) ***Limitations:*** Relatively low precision and accuracy; detection limits may be higher than TLVs; some interferences can cause misleading results.

vi) ***Care and Maintenance:*** Requires fresh indictor tubes.

***Chemical Exposure Personal Monitor Badges***

Personal monitor badges will most commonly be used to assess potential exposure due to general ambient conditions over time; most typically on remedial construction projects of longer duration. Additional specifics regarding personal monitor badges include:

i) ***Hazard Monitored:*** Specific organic gases and vapors.

ii) ***Information Provided:*** Average concentrations of specific gases and vapors over an extended period of time.

iii) ***Primary Use:*** Monitors average exposure of worker over an extended work period (days or weeks).

iv) ***Detection Method:*** If exposure occurs, chemical is adsorbed onto badge. Time-weighted average concentration of the chemical is determined by laboratory analysis of chemical mass and knowledge of total exposure duration.

v) ***Limitations:*** Relatively low precision and accuracy; extended time period before results are available limits use to relatively long-term exposure evaluation.

vi) ***Care and Maintenance:*** Requires fresh indicator badges, proper badge handling and chain-of-custody procedures.

***Oxygen Meters and Multi-Gas Detectors***

The “normal” oxygen content in dry air near sea level is 20.9%. OSHA considers atmospheres with <19.5% as oxygen-deficient, and those with >23% are considered oxygen-enriched. Oxygen meters are used to test for potentially oxygen–deficient or enriched atmospheres and are often combined with additional detectors to test for the presence of toxic and combustible gases including methane, $H_2S$ and carbon monoxide (CO) among others, and for monitoring potentially explosive conditions (lower and upper explosive limits, LEL and UEL). Selection of the instrument will depend on the specific conditions expected on the project and planned activities. In each case, the instrument must be intrinsically safe (i.e., constructed such that it will not cause an explosion if used in a hazardous atmosphere). The user must carefully review the operations manual for the specific instrument and be aware of its limitations, including the potential for interferences causing false positives or false negatives.

### *7.2.2 Guidelines for Developing Action Levels and Utilizing Air Monitoring Data*

In preparing a SS-HASP, the potential for exposure to airborne contaminants is addressed by specifying a monitoring program and determining action levels for use of respiratory protection. Air monitoring for volatile organic compounds (VOCs) is generally conducted using the PID in the workers’ breathing zone either in response to a noticeable odor or during certain activities with anticipated potential risk of exposure. Depending on the project setting, monitoring on the perimeter of the work zone may also be required. Wherever the monitoring occurs, the instrument must be given sufficient time for the potential contaminant to be pumped into the detector. This may take several seconds or longer, and generally, a period of 30 to 60 seconds should be allowed for the reading to stabilize. Monitoring information is compared against designated action levels specified in the SS-HASP, which are derived from health-based

exposure limits, to determine the level of PPE that is required. If action levels are exceeded, a PPE upgrade, possibly including respirator use may be required, unless the vapor exposure can be reduced by implementation of an engineering control or modifying work practices. Use of engineering and work practice controls is always preferable to use of respiratory equipment, but may not always be practical, and it may be necessary to use respirators until the control is in-place and monitoring has confirmed its effectiveness.

Action levels are developed in the SS-HASP based on the following considerations:

i) Anticipated or suspected gases and vapors at the site;
ii) Concentrations of hazardous substances expected in environmental media (e.g., soil or water samples);
iii) Relative concentration and volatility of components in chemical mixtures;
iv) Toxicity characteristics of the gases and vapors of concern;
v) Warning properties (e.g., odor threshold levels) of the gases and vapors of concern; and
vi) Potential exposure of workers during each phase of the work program.

Commonly, site contaminants consist of a mixture of volatile and semivolatile organic chemicals (VOCs and SVOCs); some of which are more toxic and/or more volatile than others. When developing an air monitoring program and determining action levels for use of respiratory protection for a SS-HASP, the available site data (typically soil and/or groundwater tests) should be evaluated to identify the i) chemicals present and assess their relative concentrations, and ii) potential for airborne chemical exposure during the specific tasks to be performed (e.g., drilling of soil borings and monitoring well installation).

In setting an action level, the goal should be to ensure that workers are not exposed to COC concentrations exceeding safe exposure levels without respiratory protection, while at the same time not triggering unnecessary respirator use. Due to the nature of GSI's business and the tasks commonly performed, for some projects or tasks, action levels may be based on PELs, which are based on continuous exposure over the course of a work day. For others, the exposure potential may be more of an episodic, short-term nature (e.g., during the grouting of soil borings), in which case consideration of short-term exposure limits (STELs) or ceiling values may be appropriate. Additional guidance on development of action levels and monitoring plans is provided in conjunction with the OSHA 8-hour Supervisor course and annual refresher classes.

In the absence of site-specific information, a common industry approach is to assume a "worst–case scenario" (i.e., to assume that most or all of the total organic vapor measured consists of the component with the lowest PEL). In certain cases, (e.g., first response to a large volume release of unknown chemicals), this assumption may be prudent and use of air-purifying respirators or even supplied air may be justified until more complete information justifies a down-grade. In such a case, the "action level" for a down-grade of PPE may be the level below which vapor concentrations must decrease in order to down-grape the PPE level (e.g., from B to C or C to D, no respirator).

In other cases (e.g., sampling soil or groundwater contaminated by miscellaneous historical hydrocarbon spills), the "worst-case" assumption (e.g., assuming the measured organic vapor consists entirely of a chemical with a very low PEL, such as vinyl chloride or benzene) could lead to unnecessary respirator use, which poses its own set of risks by potentially increasing physical stress on the workers, especially in hot weather conditions. One approach is to initially use a lower action level and to obtain additional compound-specific information in the early phases of work (e.g., by using Draeger tubes or personal monitoring badges) and then later

revising the action level. Modification of action levels may be appropriate under a number of scenarios, but must be approved by the GSI HSA or qualified designee.

During operations resulting in significant dust generation, particulate matter, including the soil itself and/or heavy metals or other contaminants in the soil, may pose an adverse exposure potential from inhalation or incidental ingestion. Monitoring of particulates with specification of action levels for respirator use may be appropriate, though in many cases engineering controls, such as dust suppression by watering and/or use of particulate filters on respirators, may be more effective and more practical.

The procedures described above provide a general approach which is applicable to common VOCs and other air-borne contaminants encountered in the field. However, a site-specific air monitoring program with action levels based on the available information must be developed for each project based upon the tasks to be performed and the conditions anticipated or encountered at the field location.

### *7.2.3 Documentation of Air Monitoring and Respirator Use and Records Retention*

When air monitoring is conducted, whether or not respirators are used, it must be documented on the Daily Site Safety Records (DSSR). The time and location of readings (e.g., workers' breathing zone, perimeter station, etc.), the work activities being performed (e.g., well purging), and numerical results are recorded on the DSSR. If an action level is exceeded, the action taken (e.g., implementation of an engineering control or use of respirators) is also recorded. DSSRs are placed in the job file, but it is important to note that OSHA requires air monitoring records to be retained for 30 years, which is longer than the standard document retention period for project files. Therefore, to facilitate retention of air monitoring records, a duplicate copy of the Daily Site Safety Record must be provided to the HSA or designee (i.e., the local H&S Coordinator) whenever air monitoring is performed and/or when respirators are used. Completed respirator inspection forms (see Section 7.4.6) will also be retained with the air monitoring and respirator use records.

In addition, to facilitate tracking of respirator use for internal GSI purposes, SSOs conducting field work are required to provide a summary of the respirator use to the HSA or designee when field work is performed. The notification should include the dates and total on-site man-hours for the field team, including GSI employees and subcontractors, and the total hours of respirator use by each individual. The summary should be provided via email by 10:00 AM on the Monday following the week in which field work is performed (i.e., on the same schedule as submittal of weekly time cards).

## 7.3 Engineering and Work Practice Controls

The use of respiratory protective equipment such as air-purifying respirators places stress on the body, especially during physical labor performed in hot weather and while wearing protective clothing. In addition, respirators may make verbal communication more difficult, especially in high noise areas. Therefore, whenever feasible, engineering controls and work practice adjustments should be used to reduce exposure to air-borne contaminants. In some cases, a simple adjustment, such as maintaining a position upwind of the contaminant source may be all that is needed to prevent inhalation of air-borne contaminants. Use of fans should also be considered to move vapors away from the workers' breathing zone. In some cases, plastic sheeting or other coverings may be placed over affected soil or waste to minimize volatilization to the workers' breathing zone. Use of dust suppression methods, such as watering exposed soil, can frequently mitigate potential exposure to particulate matter.

## 7.4 Respiratory Protective Equipment

Use of air-purifying (Level C PPE) or supplied-air respirators (Level B PPE) will be based on air quality monitoring, as specified in the SS-HASP. Respirators meeting applicable ANSI standards shall be provided by GSI and used in accordance with the manufacturer's instructions. Employees will be issued respirators for their exclusive use and will be responsible for keeping them clean and in good working order, and for requesting a replacement for a damaged or lost respirator. The respirators remain the property of GSI and are to be returned to GSI on termination of employment.

### *7.4.1 Fitness for Use of Respirators*

Employees who use a respirator must demonstrate annually that they are fit to wear a respirator by successfully passing pulmonary function and spirometry testing, administered as part of the Medical Monitoring Program (see Section 9.0 below), and obtaining a physician's or licensed health care provider's (PLHCP) written opinion that the employee is fit to wear a respirator. More frequent pulmonary function testing may be required depending on the employee's medical or exposure history. If, based on the pulmonary function test or other factors, the physician's written opinion indicates that the individual is not fit to wear a negative-pressure air-purifying respirator; use of a positive pressure device may be a suitable alternative.

### *7.4.2 Approved Devices*

***Air-Purifying Respirators.*** Air-purifying respirators (Level C PPE) will be based on air quality monitoring as specified in the SS-HASP. Respirators approved by ANSI shall be provided by GSI and used in accordance with the manufacturer's instructions. Air-purifying respirators may not be used in oxygen-deficient or other potentially IDLH environments.

Half-face and/or full-face respirators are issued to all field personnel whose work requires respirator use. Half-face respirators typically have an assigned protection factor (APF) of 10, meaning they should not be used if the contaminant concentration in air is 10 times the PEL of the COC. Full-face respirators typically have an APF of 50. Therefore, if anticipated exposure to COCs at concentrations in air approaching or above 10 times the PEL, a full-face respirator should be used, and in the event that the COC concentration approaches or exceeds 50 times the PEL, supplied air should be specified.

***Action Levels for Respirator Use.*** Theoretically, a respirator might only be needed when the ambient concentration of a specific chemical exceeds its PEL (or other applicable safe level), and a half- or full-face respirator could be used up to a concentration 10 or 50 times the PEL. However, due to a variety of factors including uncertainties in the actual composition of the contaminant mixture and the concentrations of the individual constituents, GSI takes a more conservative approach, and specifies actions for Level C upgrades that are generally less than PELs, and use limitations that well below concentrations corresponding to APFs. At the same time, it is also our policy and practice to not require unnecessary respirator use when it can be safely avoided.

Action Levels are developed on a project-specific basis depending on the expected mixture of contaminants, the work being performed and other site conditions. Because the PID gives only the total concentration of the detectable organic vapors, and not the actual concentration of individual gases or vapors, the process requires professional judgment and the person preparing the SS-HASP should confer with the HSA or HSC (one of whom will ultimately review and approve the SS-HASP). Although OSHA PELs and other TWA concentrations are considered safe to breathe 8 hours/day and 40 hours/week over a period of years, GSI's preference is that exposures above the PEL not occur even for more limited periods. Therefore, for a simple situation with a single airborne contaminant, the Action Level for respirator use will be some fraction of the PEL measured in the breathing zone for a sustained 1-minute interval,

and the use of a half- or full face respirator would be limited to some fraction (e.g., half) of the APF concentration. In a more typical and more complicated situation, where multiple VOCs are present, the Action Level should take into account the relative proportion of each known constituent as determined from available information (e.g., soil and groundwater data), and their relative toxicity and volatility. To the extent such information may not be available or reliable, it will be necessary to "err on the safe side" and set an Action Level that is closer to the lowest PEL for the identified VOCs. (In rare cases where the constituents have not yet been identified, use of supplied-air (Level B) may be required.)

It would not be appropriate, however, to set the Action Level for a project at a gasoline release site corresponding to the PEL for benzene, since benzene typically accounts for only 2 to 3% of the mass of gasoline and so most of the vapors are from constituents other than benzene. Similarly, it would be inappropriate at a tetra- or trichloroethene (PCE or TCE) release site, to specify an Action Level corresponding to the PEL of vinyl chloride on the assumption that it could be present as a degradation by-product since its contribution to the vapor mix would generally be small. In such cases, an Action Level corresponding to between 2 to 10 times the PEL of the VOC with the lowest PEL may be more appropriate. Bearing in mind the exposure assumptions underlying the PEL (i.e., that concentrations at or below the PEL are safe to breathe), such values are still quite conservative.

The upper use limitation for half- and full-face respirators should generally be some fraction (e.g., half) of the APF-based concentration. For example if the Action Level is 5 ppm, the upper use limit for the half- and full face respirators would be 25 and 125 ppm, respectively, not 50 and 250 ppm. Of course, the IDLH, 15-minute Short-Term Exposure Limit (STEL) and Ceiling Values for each VOC must not be exceeded and so should also be taken into account in determining Action Levels and use limitations. In addition, some COCs may be particularly irritating to the eyes even at concentrations for which half-mask respirators are fully protective of the respiratory tract. In such cases full-face piece respirators would be more appropriate. As noted, PEL concentrations are based on repeated exposure over an 8-hour work day. Occasional momentary exposures above these levels do not necessarily represent a health hazard, as long as any applicable STELs or ceiling values are not exceeded.

Appropriate cartridges must be specified, based on the composition of the contaminant mixture. The cartridges must be used in accordance with the manufacturer's instructions, including compliance with the specified service life. Typical service life does not exceed 8 hours from opening of the sealed package and may be shorter in the event of high humidity or elevated contaminant concentration.

***Supplied Air Respirators.*** Use of supplied air (Level B PPE), when performed, will utilize equipment from a supplier meeting all applicable guidelines. The equipment will consist of an approved source of breathing-air, airlines, properly designed face pieces and a 5-minute escape bottle. The equipment will be inspected thoroughly before use by the project SSO or other qualified person, and procedures for use will be reviewed with project personnel prior to project start-up.

At a minimum, supplied air will be certified to conform to Grade D breathing air specifications per ANSI/Compressed Gas Association Commodity Specification for Air G-7.1-1989, (see 29 CFR §1910.134(i)), and will be provided in containers meeting DOT Container Specification Regulations. Air supply pressure must be monitored during use.

### *7.4.3 Training*

Training in the selection, use, and maintenance of PPE is conducted as part of the 40-hour OSHA HAZWOPER training and annual refreshers course, as specified in Section 5.0 above. Initial training may also be provided through contractor safety councils. Additional refresher

sessions will be conducted, as needed, during site-specific orientation sessions and the 8-hour OSHA HAZWOPER refresher course and 8-hour Supervisor course.

### 7.4.4 Fit-Testing

All field employees who use a respirator shall have a passed a quantitative respirator test for the make and model of respirator they will be using within the one year prior to use. Tests will be performed annually by a qualified analyst under applicable OSHA guidelines. These are generally performed at a contractor safety council and may be scheduled in conjunction with the annual safety council refresher. To ensure a proper fit, facial hair in the area of the seal must be shaved. It is each employee's responsibility to ensure they have a current fit-test.

### 7.4.5 Respirator Use

To don the respirator, the straps are loosened and pulled to the front of the mask so that the mask seal is unobstructed. The face piece is then placed against the face and the straps are pulled over the head and into place. The straps are then lightly tightened sequentially from top to bottom, and then, once the respirator is in place, the straps are re-tightened to provide a snug fit to the face without over-tightening to cause discomfort or circulatory constriction.

A seal check is then performed by first placing the hands over the cartridges and inhaling. The mask should contract toward the face and no leakage should be felt along the seal. If a leak is detected, the straps are adjusted and the process is repeated until a good seal is obtained. A hand is then placed over the exhalation vent and the wearer exhales. The mask should be pushed away from the face without breaking the seal. Again, if a leak is detected the straps are adjusted and the test is repeated.

During use, if a leak is detected, the wearer should leave the affected area, remove outer gloves, and make adjustments as needed to obtain a good fit. At the end of the use period, the wearer should leave the affected area, remove outer gloves, and, retaining the inner gloves, remove the respirator by first loosening the straps and pulling them over the head with one hand while holding the face piece with the other.

The respirator shall be used during the time period necessary to install or implement engineering and/or work practice controls, where engineering and work practice controls are insufficient, and during emergencies.

### 7.4.6 Inspection, Decontamination, Maintenance, and Storage

Employees are responsible for ensuring that the PPE issued to them is in proper working order. GSI will provide replacement equipment as needed, but it is the responsibility of the employee to inspect the equipment and request replacement as needed.

Using the Respirator Inspection Checklist (provided in Appendix C), all respirators will be inspected by the employee to ensure good operating condition. Respirator inspections should be completed: i) prior to each use; and ii) at a minimum, annually, following completion of a quantitative respirator fit test for the approved respirator(s). Completed inspection forms should be submitted to the local HSC, who will then forward them to the HSA for filing. Following use, the respirator will be properly decontaminated, stored, and maintained, and the cartridges will be removed and discarded. For proper decontamination, the respirator should be cleaned with a suitable disinfectant cleaner, or with mild detergent and warm water solution, thoroughly rinsed in warm clear water, hand dried with a soft lint-free cloth, placed in a clean protective casing such as a plastic bag, and stored out of the elements.

# 8.0 HEARING CONSERVATION PROGRAM

## 8.1 Overview

The GSI Environmental Inc. (GSI) has established a Hearing conservation Program to protect workers from the hazards of noise on the job. OSHA regulations require that each employer implement a hearing conservation program when workers are exposed to noise levels exceeding 85 decibels (dB). Typically, noise levels exceeding 85 dB are experienced when working with any type of pneumatic chipper or hammer, metal saw, and grinders, as well as drilling rigs and other heavy equipment. See Attachment I for list of some common noise levels.

The company HSA is responsible for the developing a written Hearing Conservation Procedure and providing for the training of all employees in the company. Designated office Health and Safety Coordinators (HSCs) and Site Safety Officers (SSOs) are also responsible for the monitoring and administering this procedure. The topic of hearing conservation is covered during the 40-hour OSHA HAZWOPER course and annual 8-hour refresher.

The OSHA Standard on Occupational Noise Exposure, 29 CFR 1910.95, established the permissible limit of noise as 85 dB(A) (decibels), expressed as an eight-hour (8-hours), time-weighted average, (TWA). This standard allows short-term unprotected noise exposure up to a maximum of 115dB (A), peak sound.

The noise standard requires the identification by personnel monitoring of employees who may be exposed above the 85 dB (A), 8-hour, TWA. Hearing protection is also required for specific activities or using certain types of equipment.

## 8.2 Procedures

GSI has taken a conservative approach to this noise hazard by establishing this program. The following elements establish the program:

i) An Audiometric Testing Program when required;
ii) An Employee Education and Training Program;
iii) Monitoring and Analysis of Workplace Noise Levels;
iv) Providing Suitable Engineering Controls when appropriate;
v) Providing Hearing Protectors when required; and
vi) Maintain required records for the above.

### *8.2.1 Audiometric Testing*

Each new employee whose work exposes them to noise levels above the “OSHA action level” will receive an Audiometric test as part of a pre-screening physical examination to establish a baseline audiogram against which subsequent audiograms can be compared as required by the OSHA Standard. Annually, all employees who are exposed to noise levels exceeding the 85 dB standard will be given a follow-up Audiometric examination to monitor for any significant changes in their hearing ability. Audiometric testing is conducted as part of the medical monitoring program for employees who perform regular field work.

Employees will be formally notified if there is any change in their hearing identified by the testing. The Standard has defined this shift as a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 200, 3,000 and 4,000 Hz in either ear. In determining whether a standard threshold shift has occurred, allowance may be made for the contribution of aging (presbycusis) to the change in hearing level by correcting the annual audiogram according to standard procedures. Such corrections may only be made by a qualified physician.

When audiometric testing is required, each affected employee must not be exposed to any workplace noise for at least 14 hours prior to his/her test. This requirement may be met by wearing hearing protectors which will reduce the employee's exposure to a sound level of 80 dB (A) or below.

Audiometric tests shall be performed by a licensed or certified audiologist, otolaryngologist, or other physician, or by a technician who is certified by the Council of Accreditation in Occupational Hearing Conservation, or who has satisfactorily demonstrated competence in administering audiometric examinations, obtaining valid audiograms, and properly using, maintaining and checking calibration and proper functioning of the audiometers being used. A technician who operates microprocessor audiometer does not need to be certified. A technician who performs audiometric tests must be responsible to an audiologist, otolaryngologist or physician.

An audiologist, otolaryngologist or physician will review problem audiograms and shall determine whether there is a need for further evaluation. The company will provide to the person performing this evaluation the following information:

1) A copy of the 29 CFR 1910.95 Hearing Conservation.
2) The baseline audiogram and most recent audiogram of the employee to be evaluated.
3) Measurement of background sound pressure in the audiometric test room as required in 29 CFR 1910.95 Appendix D.
4) Records of audiometric calibrations as required by 20 CFR 1910.95 Appendix E.
5) If a comparison of the annual audiogram to the baseline audiogram indicates a standard threshold shift as defined by OSHA, the employee will be informed of this fact, in writing, by the company within 21 days of determination.

Unless a physician determines that the standard threshold shift is not work related or aggravated by occupational noise exposure, the company will ensure that the following steps are taken when a standard threshold shift occurs:

1) An employee not using hearing protectors will be fitted with hearing protectors, trained in their use and care, and required to use them.
2) An employee already using hearing protectors shall be refitted and retrained in the use of hearing protectors and provided with hearing protectors offering greater attenuation if necessary.
3) Employees will be referred for a clinical audiological evaluation or an otological examination, as appropriate, if additional testing is necessary or if the company suspects that a medical pathology of the ear is caused or aggravated by the wearing of haring protectors.
4) Employees will be informed of the need for an otological examination if a medical pathology of the ear which is unrelated to the use of hearing protector is suspected.

If subsequent audiometric testing of an employee whose exposure to noise is less than an 8-hour TWA average of 90 decibels indicates that a standard threshold shift is not persistent the company:

i) Will inform the employee of the new audiometric interpretations; and
ii) May stop the required use of hearing protectors for that employee.

### 8.2.2 *Employee Education and Training*

Employees will be trained on the use of personal hearing protection equipment during the 40-hr OSHA course and the OSHA 8-hr refresher. Also each employee must know how to clean and maintain the hearing protection equipment. The training will cover the following:

1) Training will be for all employees who are exposed to noise at or above the 8-hour TWA of 85 dB.
2) The training will be repeated annually for each employee included in the hearing conservation program.

Training will include:

1) The effects of noise on hearing.
2) The purpose of hearing protectors, the advantages, disadvantages, and the attenuation of various types and instruction on selection, fitting, use and care.
3) The purpose of audiometric testing, and an explanation of the test procedures.
4) Access to information and training materials.

## 8.3 Monitoring and Analysis or Workplace Noise Levels

GSI will, as necessary or required, conduct noise level surveys of the workplace. The results of these surveys will be made available to employees upon request.

Any job area or company location found to be in excess of the allowable designated noise levels that cannot be brought into compliance with the noise standard will be designated as an area where hearing protectors are to be worn. When signs are posted employees must wear hearing protection. The signs may read as follows:

***NOTICE: EAR PROTECTION REQUIRED IN THIS AREA***

## 8.4 Engineering controls

Where necessary, GSI will provide engineering controls to reduce noise exposure. Due to the complexity of most job sites, it is difficult, if not impossible to institute effective engineering controls for most noise exposures. Should this be the case, then employees will be required to wear suitable hearing protection.

## 8.5 Hearing Protection

GSI will provide with and require employees to wear hearing protectors if his/her 8-hr TWA is above the 85dB (A). GSI will also make hearing protectors available to all employees exposed to a TWA above 85dB (A) at no cost to the employee. Any employee who may have a significant threshold shift of hearing level will be required to wear hearing protection if they are exposed to noise TWA of 85dB. GSI will provide workers with a choice of at least one type of ear plug and one type of ear muff (ear muffs cannot be used when anything prevents the seal of the ear muffs, such as safety glasses). On some job sites there will be a choice of two different ear plugs. GSI will make a concerted effort to find the right protector for each employee, one that offers the right attenuation, is accepted on the terms of comfort, and is used by the employee.

## 8.6 Responsibilities

***A Client Will:***

1) Determine all sources of noise at or above 85dD.
2) Determine if personnel have 8-hr TWA exposures at or above fifty-percent (50%) of the OSHA allowable.

3) Review noise exposures annually for all job classifications with TWA.
4) Review exposure at or above fifty-percent (50%).
5) Ensure that audiograms are made annually for personnel whose TWA exposures are at or above fifty-percent (50%) of the OSHA allowable.

***Job Site Supervision Will:***

1) Will require hearing protection in all area with noise levels at or above the 85dB(A) and for all tasks which generate such noise level (i.e., grinding, hammering).
2) Ear plugs shall be required in an area and/or on tasks with sound levels exceeding105dB.
3) To alert employees to possible hazardous noise exposures, signs shall be posted in work areas in which the sound levels may exceed 85dB. These signs will be posted by the client.
4) Evaluate the need for engineering and/or administrative controls to reduce the noise levels below the 85 dB and, where feasible, develop a plan to reduce all personnel exposures to less than fifty-percent (50%) of the OSHA allowable.
5) Make hearing protection available and enforce its use by all employees with TWA exposures at or above the fifty-percent (50%) of the OSHA allowable and/or by those who must enter or work in areas where the noise level is 85dB or above.

***Remember:***

The client determines if a unit or work area is classified as a high noise area. After the determination is made, GSI employees will be instructed to wear the appropriate hearing protection.

## 8.7 Record Keeping

All record-keeping for this program will be maintained in the office. Records will include:

i) Audiometric tests;
ii) Noise surveys;
iii) Employee training;
iv) Engineering controls implemented; and
v) Record of purchase of hearing protector.

## 8.8 Work Requiring Hearing Protectors

There are many jobs or types of work that generally produces noise level that intermittently or for short durations exceed the permissible TWA. It is the policy of GSI to require all workers who are engaged in these jobs to wear hearing protectors. The attached list is some of those jobs (see Attachment I).

## 8.9 Hearing Protectors

Employees may choose the type of hearing protection that best suits their particular assignment and personal preference for among those listed below. Each employee required to wear hearing protection is responsible for carrying hearing protection on his/her person. Hearing protection is furnished at no cost to employees.

***Ear Plugs.*** Most ear plugs, when worn properly, have a noise reduction rating (NRR) on the package. Most ear plugs have NRR of about 30.

***Ear Muffs.*** Adjustable muffs can be worn in three positions:

| POSITION | NRR |
|---|---|
| 1. Over the head | 24 (this depends on the NRR of the Ear Muff) |
| 2. Under the chin | 20 |
| 3. Behind the head | 20 |

***Computing the Hearing Protection Level***

To compute the actual hearing protection level under the protector, subtract 7dB(A) from the Noise Reduction Rating (NRR), divide the number by 2, and subtract the remainder form the measured noise level dB (A).

**For example:** NRR of 29 - 7 = 22 dB(A)
22 dB(A) ÷ 2 = 11 dB(A)
Noise level of 95 dB(A) – 11 dB(A) = 84 dB(A)
*Therefore, this device offers a protection level of 11 dB(A).*

The following list represents some work activities and equipment which will require the use of hearing protection:

| Activities and/or Equipment Typically Resulting in High Noise Levels | Estimated Average Noise Level dB(A) |
|---|---|
| Air compressor / Welding machine | 95 |
| Forklift inside a trailer | 98 |
| Abrasive blasting | 100 |
| Electric Disc Grinder | 100 |
| Heavy equipment working | 100 |
| Chain saw | 107 |
| Impact tools | 108 |
| Pneumatic chipping hammer | 110 |

# 9.0 MEDICAL SURVEILLANCE

## 9.1 Medical Surveillance Program

Personnel who do field work and may be required to use a respirator as part of their routine duties are included in GSI's Medical Surveillance Program. OSHA regulations (29 CFR §1910.120(f)(2)) specifically require medical surveillance for employees who (i) are exposed to hazardous substances or health hazards at or above PELs 30 days or more a year; (ii) use a respirator 30 days or more a year; (iii) are injured, become ill, or show symptoms due to possible over-exposure to hazardous substances or health hazards; are members of HAZMAT teams. As a conservative, proactive measure, all personnel who do field work and may need to use a respirator are included in GSI's medical surveillance / medical monitoring program, even if they may not be expected to use respirators 30 or more time in a year. GSI does not employ HAZMAT responders and exposure to airborne concentrations of hazardous chemicals above PELs on a routine basis (e.g., 30 times or more annually) is not a part of the job description of any employee.

Employees in the medical surveillance program undergo pre-assignment and annual physical examinations by a physician or licensed health care provider (PLHCP) to ensure fitness to use PPE and a respirator. Employees whose normal work assignments change such that they no longer do routine field work may be taken out of the medical monitoring program, and they may be reinstated in the program if subsequent assignments include field work with possible respirator use required. On termination of employment with GSI, whether voluntary or involuntary, employees who are in the medical surveillance program at the time their employment terminates, are offered the opportunity for an exit physical examination. The exit physical may be declined by the employee, but the employee is required to sign an acknowledgment that they have been offered the opportunity to have the examination. The costs of all medical surveillance examinations, including pre-assignment, annual, and exit physicals, are paid by GSI.

The contents of the medical exam are in accordance with 29 CFR §1910.120(f)(4) and the PLHCP's professional judgment to make a proper determination as to the fitness of the individual for respirator use. The results of the exam must include a PLHCP Written Opinion as to *"whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from work in hazardous waste operations or emergency response, or from respirator use."* The exam also includes audiometry testing to detect possible occupational hearing loss. The results of medical examinations are provided directly to the HSA by the medical provider.

Unless special circumstances require further review, the HSA reviews only the PLHCP Written Opinion, and otherwise inspects the report only as needed to confirm completeness. The HSA provides a complete copy of the report to the employee. The original examination reports are maintained in a confidential condition in a locked file cabinet in or adjacent to the HSA's office, and may be examined by the employee at any time by request. Upon termination, and employees complete medical file is placed in a sealed envelope labeled with the employee's name and termination date and is retained for thirty (30) years from the employment termination date.

## 9.2 Applicability

The GSI medical surveillance program is designed to help assess and monitor the health and fitness of all employees who work with hazardous substances. The OSHA HAZWOPER Standard (29 CFR §1910.120) requires medical surveillance for: i) employees exposed to hazardous substances at or above PELs 30 days/year or more; ii) employees who use a

respirator 30 days/year or more, as required by §1910.134 (respiratory protection standard); iii) employees who become injured or ill due to overexposure to hazardous substances; and iv) members of HAZMAT Teams.

In practice, most GSI employees do not meet any of these criteria; therefore, medical surveillance is not required by regulation. However, as a conservative measure, GSI employees who perform field work on a regular basis and are likely at some point to use a respirator will be designated for medical surveillance to ensure readiness for respirator use if required. In addition, medical surveillance and certification of fitness to use a respirator is required by some GSI clients for field work on their sites. Therefore, in practice, most new employees who may be required to perform field work will receive either a pre-employment physical exam or one prior to being assigned to field work.

During subsequent years the employee may or may not be included in the medical surveillance program at the discretion of the GSI HSA based on prior and anticipated field assignments. This determination may, in certain cases, be made based on the requirement by specific clients that personnel engaged in certain projects to present a current Physician's Written Opinion concerning fitness to wear a respirator. Therefore, some employees may not be included in medical surveillance for periods of one or more years, but based on a change in the nature of their work assignments, they may re-enter the program for one or more years on an as-needed basis.

In general, the following employees are required to participate in the program:

i) All employees who participate in field work for 30 days/year or greater at sites where hazardous materials are known to be present and where respirator use may be required;
ii) Workers who are exposed to unexpected or emergency releases of hazardous materials above exposure limits or who show signs, symptoms, or illness that may have resulted from exposure to hazardous substances; and
iii) Other employees as designated by the GSI HSA.

Due to changing work assignments (i.e., no regular field work), employees may be permanently or temporarily be taken out of the Medical Monitoring Program, and may be reinstated if work assignments change again (i.e., to include regular field work) at the discretion of the HSA. To assist in making this determination, an employee may be required to provide monthly reports of the number of days of field work, the total number of fieldwork hours, number of field days on which air monitoring was conducted, and number of days on which the employee used a respirator.

## 9.3 Elements of Medical Surveillance

A medical exam will be conducted under the supervision of a licensed physician, without cost to the employee, and without loss of pay. The examination is intended specifically to ascertain whether the employee is: i) at any excess risk for chemical exposure; ii) fit to use PPE in general, with respiratory protective equipment in particular; and iii) assess whether any limitations need to be placed on their use. The physician will conduct specific tests and procedures as necessary to make that determination for each employee. The examination consists of some or all of the following procedures and analytical tests:

i) A medical and work history;
ii) General physical examination;
iii) Blood chemistry;
iv) Urine analysis;
v) Blood temperature and pressure;

vi) Pulmonary function / “Spirometry;”
vii) Chest x-ray;
viii) Vision test; and/or
ix) Hearing test.

Some of the above tests (e.g., chest x-ray) are optional and are performed at the discretion of the examining physician only as needed to determine fitness for respirator use.
GSI will provide the employee with a copy of the results of the examination and any written opinions furnished by the examining physician. Any conditions that may be related to exposure to hazardous substances will be reported immediately to the employee. The physician will not reveal to GSI specific findings, diagnoses, or opinions unrelated to employment, but may recommend that the employee consult his or her personal physician to follow up on a particular finding, in which case GSI will relay that recommendation in conjunction with providing a copy of the exam report. If a condition requiring follow up is occupationally related, GSI will pay for the follow up; however, if the condition is non-occupational (e.g., blood pressure, diabetes, etc.) the follow up is the responsibility of the employee, but may be covered by the employee’s major medical health care plan.

## 9.4 Frequency of Medical Examination

The medical examination will be performed according to the following schedule:

i) Prior to job assignment;
ii) Annually after beginning work, while designated as in the medical surveillance program*;
iii) As deemed necessary by the examining physician;
iv) As soon as possible for employees injured or becoming ill from exposure to hazardous substances during an emergency, or who develop symptoms of overexposure from hazardous substances; and
v) At the termination of employment, if the employee in currently in the Medical Surveillance Program and has not had an examination within the last 6 months. Note that terminated employees are not required to have an “exit physical,” but will be offered the opportunity to have one and are required to sign an acknowledgement that they have been offered the opportunity.

## 9.5 Records of Medical Examination

Records of medical examination, including the Physician’s Written Opinion form, are provided by the examining physician to the HSA under a confidential seal. A copy of the records is provided free to the employee and the original is retained in a locked file located in the HSA’s office. Records of medical examinations will be maintained for a period of 30 years from termination of employment.

It is GSI policy that the contents of employees’ medical records are confidential and are therefore not examined by the HSA or other GSI personnel, unless required by specific circumstances. However, the HSA does review the Physician’s Written Opinion form to determine whether any limitations on work assignments or use of PPE are appropriate. If the review of this document indicates that i) the examining physician has not certified that the employee is fit to wear a respirator, ii) limitations on the use of PPE are recommended, or iii) follow-up examination or re-testing is recommended, the employee is so notified and encouraged to schedule an appropriate follow-up as soon as feasible. Failure by the employee to address such restrictions or limitations on a timely basis could affect the employee’s ability to perform expected fieldwork assignments.

## 9.6 Physician-Directed Work Limitations and Post-Injury or -Illness Return to Work

In the event of an injury or illness, whether occupational or non-occupational, which prevents an employee from performing his or her normal duties, GSI may require the employee to provide written notice from the employee's physician of the condition and any applicable limitations or restrictions on the employee's job activities. Following treatment of, and/or recovery from such injury or illness, GSI may also require the employee to provide certification from their physician that the limitations or restrictions are no longer required, before the employee may resume their normal duties. It may be necessary for the employee to undergo a medical surveillance examination (at GSI's expense) before returning to fieldwork assignments.

## 9.7 Drugs, Alcohol, and Other Prohibited Items

Drug and alcohol testing is not performed as part of the Medical Surveillance Program. The GSI policy regarding substance abuse and its prevention is summarized in a separate document, included as part of the GSI Policy Manual. "Company Policy Regarding Drugs, Alcohol, and Other Prohibited Items," presents the GSI company provides details regarding the administration of the drug abuse prevention program, as well as our policy concerning banned and regulated substances. Testing is performed pre-employment, with cause and/or if required by a client for entry onto a site. Therefore all employees who perform field work are subject to drug screening at the request of a client and must agree to undergo such testing as a condition of their employment.

## 10.0 RECORD KEEPING

GSI employees will be given a copy of their written medical examination report when a copy of such report is received by GSI. In addition, GSI will retain all medical records for 30 years from the termination of the employee. Upon an employee's first entering into employment, and at least annually thereafter, information will be given to current employees of the existence, location, availability and the person responsible for maintaining and providing access to records (i.e., the company HSA) and each employee's rights of access to these records.

OSHA 300 logs and Form 101 will be maintained on file a minimum of 5 years, and posted in accordance with the instructions included on the OSHA 300 form.

OSHA HAZWOPER training records and respirator fit-test records for each employee are maintained by the GSI HSA for a minimum of 5 years following termination of employment.

Daily Site Safety Records and Tailgate Safety Meeting forms must be completed on all field projects and must be placed in the project file. Project safety records will be kept on file for a minimum period of three years following completion of the project. Air monitoring records must be maintained for 30 years. To facilitate records retention, whenever air monitoring is conducted and/or respirators are used, a separate copy of the Daily Site Safety Record documenting the air monitoring and respirator use must be provided to the has or CO-HSA, as detailed in Section 7.2.3 of this EHS Program Manual.

# GSI ENVIRONMENTAL INC.

## SITE-SPECIFIC HEALTH AND SAFETY PLAN for

**Spokane International Airport**

*Short-term Interim Action*

**Spokane, Washington**

*Project Location*

| | | | |
|---|---|---|---|
| GSI Job No.: | 6892 | Revision No.: | 1 |
| Plan Prepared By: | JAR | Date: | 04/03/2026 |
| Plan Reviewed By: | KW | Date: | 04/03/2026 |

Plan Approved:  Date: 04/13/2026

## ACKNOWLEDGEMENT

I, the undersigned, have been provided with a copy of this Site-Specific Health and Safety Plan. I have read the Plan, have attended a project safety orientation session conducted by GSI Environmental Inc. (GSI), and have had the opportunity to ask questions about health and safety issues relating to this project. I understand that it is my responsibility to abide by this Plan, and that physical injury, damage and other harm to myself or others could result from my failure to do so.

## GSI PERSONNEL ONLY

| Name (please print) | Signature | Date |
|---|---|---|
| | | |
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| | | |
| | | |

_____***Non-GSI*** Personnel Present (use next page).

## GSI ENVIRONMENTAL INC.
## SITE-SPECIFIC HEALTH AND SAFETY PLAN
## NON-GSI PERSONNEL ONLY

I, the undersigned, have been provided with a copy of this Site-Specific Health and Safety Plan. I have read the Plan, have attended a project safety orientation session conducted by GSI Environmental Inc. (GSI), and have had the opportunity to ask questions about health and safety issues relating to this project. I understand that it is my responsibility to abide by this Plan, and that physical injury, damage and other harm to myself or others could result from my failure to do so. I also understand that by signing this Site-Specific Health and Safety Plan, GSI is not my supervisor or controlling contractor; and therefore, is not responsible for my health and safety, as my employer is solely responsible for my health and safety.

| Name (please print) | Company | Signature | Date |
|---|---|---|---|
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Note: Non-GSI personnel include, but not limited to, GSI-subcontractors, 3rd party subcontractors, clients, site representatives, and/or regulatory representatives.

# GSI ENVIRONMENTAL INC.
## HEALTH AND SAFETY PLAN

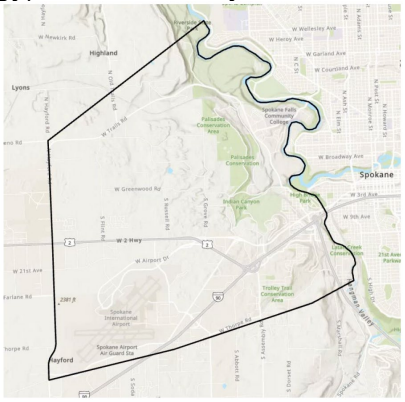
## 1.0 SCOPE AND APPLICATION

This Site-Specific Health and Safety Plan (SS-HASP) has been prepared in accordance with 29 CFR §1910.120, 8 CCR 5192, and is a site-specific supplement to the GSI company Environmental, Health and Safety (EHS) Program Manual for Field Operations (the "EHS Program Manual"), which specifies GSI's general health and safety policies and procedures. This SS-HASP is to be provided to all site workers under the direction of GSI for their review. In addition, this HASP, the GSI EHS Program Manual, and applicable client safety guidelines will remain on-site at all times during the project and will be available to all project personnel upon request from the GSI Site Safety Officer (SSO) or other designated representative.

This HASP specifies health and safety protocol to be followed during implementation of the project work scope by all site personnel under the direction of GSI, including employees and subcontractors. In the event of conflicting standards between this plan or the GSI EHS Program Manual and client health and safety requirements, a more protective standard shall apply. All personnel are required to comply with this HASP and to indicate their agreement to do so by signing the cover page.

## 2.0 PROJECT DESCRIPTION

### *2.1 General Information*

| | |
|---|---|
| Client/Site Owner | Spokane International Airport (SIA) |
| Project Name and General Description | Work to be conducted as part of the Short-term Interim Action (STIA) as described in the Work Plan. |
| Project Location (Physical Address) | Residential and commercial locations with privately owned groundwater supply wells within the targeted sampling area. |
| Detailed Location Information | The general area and maximum extent of activities covered by this HASP are shown in Figure 1 of the Emergency Interim Action Scope of Work and Schedule issued by the Washington State Department of Ecology (Ecology) on 10 February 2026.   Figure 1. Required areal extent of emergency interim actions |
| Start Date/Duration/ Other Schedule Info. | To be determined upon approval of the STIA Work Plan (STIAWP). |

### *2.2 Site Description and Site Plan*

Water supply wells within the required areal extent of emergency interim actions (Figure 1 of the Emergency Interim Action Scope of Work and Schedule issued by Ecology on 10 February 2026) are generally located east and north of SIA in Spokane, Washington extending out towards the Spokane River. Water wells are located within private residential, commercial, and agricultural properties. Samples from residential and commercial wells will be collected as part of the Emergency Short-term Interim Action.

### *2.3 Project Tasks: Outline major tasks, attach detailed workplan and/or operating procedures*

Planned activities:

- Information gathering from residences and businesses for access, agreement to receive point-of-use filters and well sampling.
- Assessment of the well and home treatment system to determine sampling point (at well discharge point prior to any treatment or in-home at the kitchen sink associated with the water supply well).
- Collection of the sample utilizing the currently installed pump at water supply wells, assuming the pump is present and operational to follow the appropriate protocol for the sampling point.

Details are provided in Appendix B Sampling and Analysis / Quality Assurance Project Plan of the STIAWP.

## 3.0 EMERGENCY RESPONSE PROCEDURES

Specify emergency reporting contact. Provide Plant Emergency Response Contact with phone number(s) where applicable. Call 911 for emergencies located elsewhere. **For an injury potentially requiring medical attention, call Axiom Medical at 877-502-9466 at your earliest convenience when safe to do so and following emergency abatement.**

Immediately report all accidents and injuries to:
1) GSI Field Safety Officer: James Roman – (209) 712-8498
2) GSI Project Team Leader: Kenia Whitehead – (564) 999-5192
3) GSI Safety Coordinator: Stephen Sasaki – (559) 286-9677
4) SIA Environmental Compliance: Keylin Huddleston – (509) 481-3489
5) Spokane Police Non-Emergency – (509) 456-2233
If the injury is serious, call 911 immediately.

Describe plant siren/ alarm signals, if applicable, and response

There are no site-wide alarms or signals at private properties.

Location of emergency assembly area(s) and evacuation route

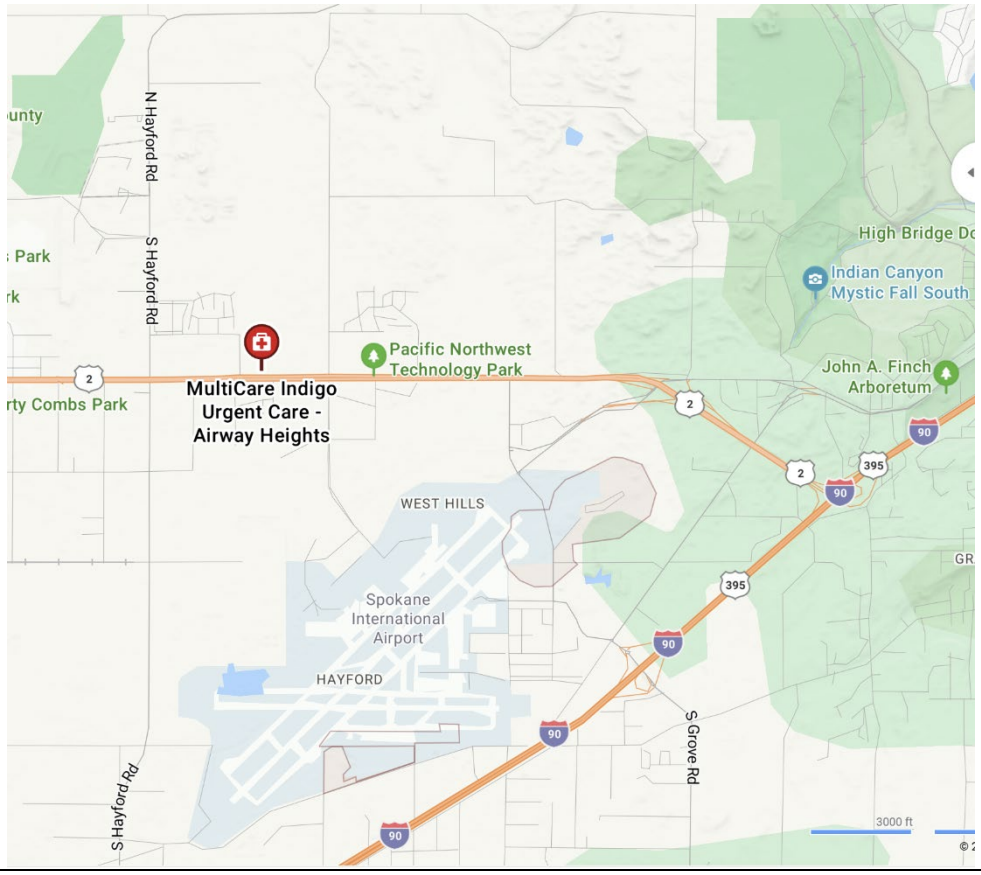
Residential and commercial well sampling locations are spread out across the required areal extent of emergency interim actions (Figure 1 of the Emergency Interim Action Scope of Work and Schedule issued by Ecology on 10 February 2026). In general, the evacuation route will be via the route used to access each private property and sampling point. The MultiCare Indigo Urgent Care - Airway Heights located at 9746 W Sunset Hwy Suite D, Spokane, WA 99224 will serve as the emergency assembly area.

Describe other applicable emergency response measures to be taken (decontamination and/or medical treatment)

Dial 911and inform the operator and provide the location. Only personnel that are certified in First Aid and Bloodborne Pathogens may perform first aid to themselves or colleagues if comfortable doing so on minor injuries (e.g., minor cut/ scrape). Urgent care/emergency room hospital listed below.

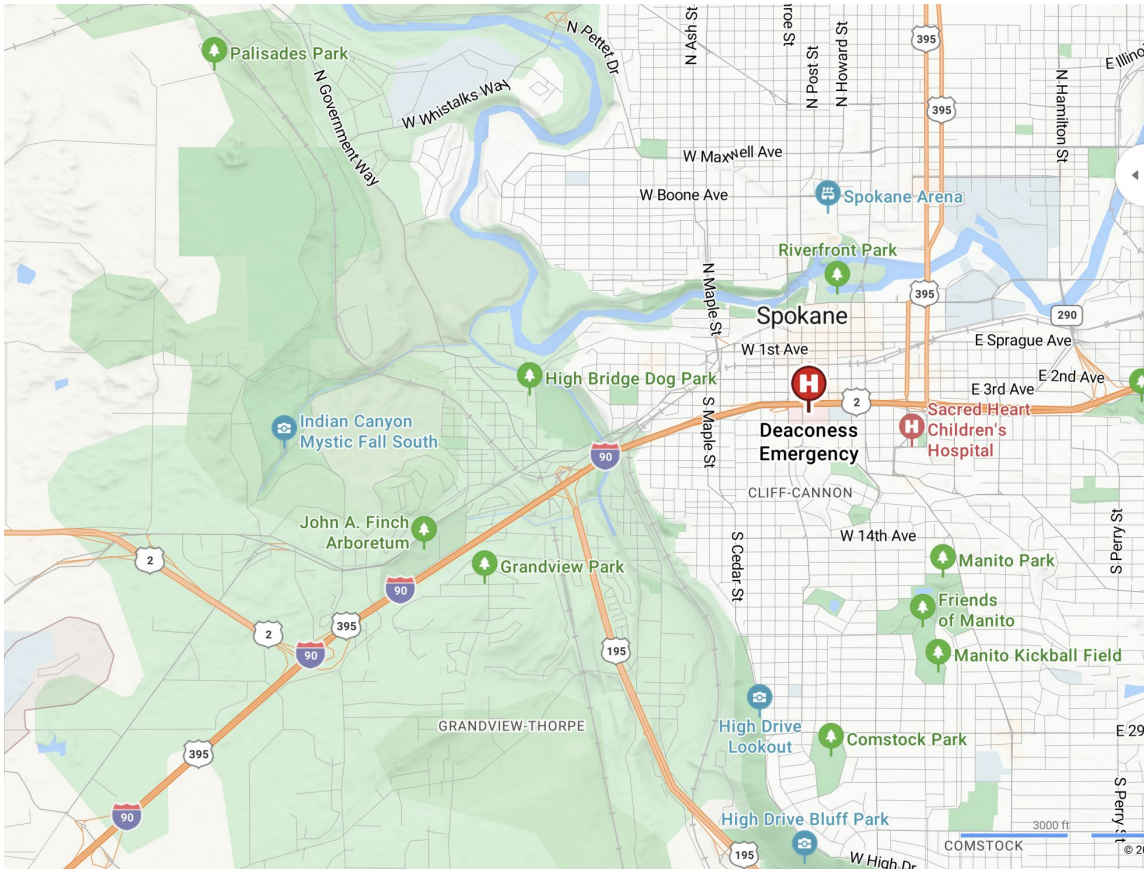
Location and phone number of nearest urgent care facility (attach map)

The nearest urgent care facility is MultiCare Indigo Urgent Care - Airway Heights located at 9746 W Sunset Hwy Suite D, Spokane, WA 99224, with operating hours 8am to 8pm, telephone number (509)-598-7940.



Location and phone number of nearest hospital with an emergency room (attach map).

The nearest hospital with an emergency room is MultiCare Deaconess Hospital located at 800 W 5th Ave, Spokane, WA 99204, operating 24/7, telephone number (509)-603-5800



## 4.0 Project Organization, Personnel, & Training Requirements

### *4.1 Key Personnel*

| Position | Name | Phone (Pager/Cell Phone) |
|---|---|---|
| GSI Project Team Leader (PTL) | Kenia Whitehead | (564) 999-5192 |
| GSI Site Manager | Emily Stashak | (832) 647-9273 |
| GSI Field Safety Officer (SSO) | James Roman | (209) 712-8498 |
| Client Project Manager | Lisa Corcoran | (504) 455-6406 |
| Client Environmental Specialist | Keylin Huddleston | (509) 481-3489 |
| Subcontractor Foreman | TBD | |

### *4.2 Training Requirements – Check all that apply and list any additional*

| | | | |
|---|---|---|---|
| X | OSHA 40-hr HAZWOPER | X | OSHA 8-hr Annual Refresher |
| | Contractor Safety Council (CSC) – Basic + | | TWIC Card |
| X | Site-Specific (CSC or on-site) | | First Aid/ CPR |
| | Unit-Specific | | |

### *4.3 Requirements for Respirator Use*

**Will respirator use potentially be required? _____Yes __X__No**

If yes, GSI Respiratory Protection Plan, found in Section 6.0 of the GSI HASP, is applicable. Affected personnel must have physician's written opinion certifying fitness to use respirator based on pulmonary function test and other considerations, be trained in proper respirator use, and have quantitative fit test.

### *4.4 Personnel Documents*

List documentation of training or medical fitness project personnel will be required to provide.

Training certificates and documentation of medical clearance must be provided upon request.

## 5.0 POTENTIAL HAZARDS & HAZARD CONTROL MEASURES

### *5.1 General Site Access Control*

Specify site control measures as necessary to prevent unauthorized persons from entering the work area (e.g., fencing, barricades, tape, signs, etc.).

Private water well owners will be contacted via telephone prior to sampling mobilization in order to facilitate property access and sampling activities. Field activities will be planned around owner's availability to grant access and oversee sample collection.
Should there be any signs of potential violence or aggression from a landowner or tenant, all work will be halted immediately. Personnel should disengage, stop all communication, and vacate the property to facilitate de-escalation.

### *5.2 Project Personnel Access Control*

Specify sign-in and sign out procedures for project personnel and means of notifying site manager if unable to be on-site.

| |
|---|
| Field staff will utilize the buddy system as practicable during sampling (either with GSI personnel or subcontractor personnel). Field staff will contact the PTL to check in and out each day. |

### *5.3 Underground Utilities Clearance*

There will be no subsurface penetrations as part of this scope of work.

### *5.4 General Work Hazards and Avoidance*

General work hazards include slip, trip, and fall hazards, head or foot injuries from falling or dropped objects, strains from over-exertion or incorrect lifting, electrical shocks, etc. These hazards can be controlled by good housekeeping measures and safe work practices, as outlined below. See also GSI HASP.

***Housekeeping Measures:***

- Excess brush or high vegetation should be cleared from the work area to the extent practical prior to start of the job.
- The job site must be kept clean and free of trash and debris. Trash generated by field staff will be placed in bags or other suitable containers when generated. Disposable PPE must be disposed in designated containers upon removal.
- Field staff will, to the extent practicable, return the property to the general condition it was in before the field activities.
- Tools and equipment must be returned to the toolbox or designated area when they are no longer in use.

***General Safe Work Practices:***

- Use buddy system.
- Always stay alert to activities in your surroundings. Watch for on-coming vehicles, other workers, and overhead hazards.
- Work at a deliberate pace; do not rush the job.
- Avoid heavy lifting and lifting with knees bent.
- Use tools only for their intended use, and make sure tools are in good condition. Inspect power tool and extension cords prior to use.
- Maintain safe distance (at least 10 feet and an additional 4 inches for every 10 kilovolts (kV) over 50 kV) between overhead equipment and overhead lines.
- Avoid unauthorized entry to restricted areas including confined space areas.
- Do not operate property equipment; do not open or close valves except for the appointed water sampling point.
- Proper PPE (specified below) must be always worn. PPE must be inspected regularly and properly maintained.
- Remove gloves and wash hands before handling food or tobacco products.

### *5.5 Fire and Explosion Hazard Mitigation*

- Gasoline and other fuels must be stored in steel safety cans with mesh flame arresters and spring-mounted relief vent mechanisms. Flammable and combustible materials including paints and solvents must be properly stored away from sources of ignition.

- Fire extinguishers must be present on all vehicles, and in all areas where spark producing equipment is in use.

**Other Measures (check as applicable):**

__X__ Smoking is not permitted on-site, or
____ Smoking permitted only in designated areas
____ Matches and lighters not permitted on-site
____ Hot-work permits must be obtained for spark-producing equipment in designated area
____ Other _____

### *5.6 Heat Related Disorders*

The major varieties of heat-related disorders, their related symptoms and appropriate treatment are listed below in order of increasing severity.

| Condition & Related Symptoms | Heat Stress | Heat Exhaustion or Heat Syncope | Heat Stroke |
|---|---|---|---|
| Cramping | May be present | May be present | Absent |
| Mental State | Faint, dizzy, fatigue | May be disoriented | Stupor or coma |
| Skin & Complexion | Cool, moist, flush; rash may be present. | Cool, pale, moist | Red, hot, dry |
| Temperature | Normal | Normal to low | Very high (>105° F) |
| Pulse | Rapid (>110 beat /min) | Rapid, weak | Rapid, bounding |
| Blood Pressure | May be low | May be low | May be high in early stages |
| Treatment | Give water & electrolytes, loosen or remove clothing, move to shade | Give water & electrolytes, loosen or remove clothing, move to shade | Provide rapid cooling by immersion; cover in wet cloth and transport to emergency room |

**Prevention Measures:** All heat disorders are caused by loss of fluids and the body's inability to cool itself. Heat stress can be prevented by the following measures:

- Pre-hydrate before going into the field: water or water-electrolyte drinks are preferable to caffeinated beverages or soft drinks. Refrain from alcohol the night before field work.
- Drink frequently while in the field. Numerous small drinks at a tepid temperature are better than rapid, large volume intakes of iced drinks.
- Rest at least a few minutes every hour or two.
- Observe co-workers for signs of heat stress.

OSHA identifies the following Risk Levels for given values of the heat index and recommends increasing Protective Measures to be implemented at each level.

| Heat Index | Risk Level | Protective Measures |
|---|---|---|
| < 91° F | Lower (Caution) | Basic heat safety and planning |
| 91° to 103° F | Moderate | Implement precautions and heighten awareness |
| 103° to 115° F | High | Additional precautions to protect workers |
| > 115° F | Very High to Extreme | Aggressive measures (e.g., reschedule non-essential work) |

### *5.7 Heavy Equipment Operations*

There will be no heavy equipment operations as part of this scope of work.

### *5.8 Confined Space and Excavation Safety*

There will be no confined space entry as part of this scope of work.

### *5.9 Potential Chemical Exposure Hazards*

Summarize primary constituents of concern, relevant exposure levels, and the maximum expected concentrations in soil and/or groundwater, to the extent known. Provide Safety Data Sheets (SDSs) in Attachment A.

| Constituents of Concern (COCs) | Exposure Limits[1] | | | I.P.[3] | Max. Expected Concentration | Health Hazard Target Organ Route of Entry |
|---|---|---|---|---|---|---|
| Chemical Name/ CAS No. | PEL/TLV (ppm) | STEL (ppm) | IDLH[2] (ppm) | (eV) | Water (ng/L) | Ca = Carcinogen<br>Abs = Skin Absorption<br>Con = Skin or Eye Contact<br>Inh = Inhalation<br>Ing = Ingestion |
| PFBA [375-22-4] | NPV | NPV | NPV | n/a | 280 | Abs, Con, Ing, Inh |
| PFHxA [307-24-4] | NPV | NPV | NPV | n/a | 2100 | Abs, Con, Ing, Inh |
| PFOA [335-67-1] | NPV | NPV | NPV | n/a | 740 | Ca, Abs, Con, Ing, Inh |
| PFNA [375-95-1] | NPV | NPV | NPV | n/a | 36 | Abs, Con, Ing, Inh |
| PFBS [375-73-5] | NPV | NPV | NPV | n/a | 1100 | Abs, Con, Ing, Inh |
| PFHxS [355-46-4] | NPV | NPV | NPV | n/a | 16000 | Abs, Con, Ing, Inh |
| PFOS [1763-23-1] | NPV | NPV | NPV | n/a | 6300 | Ca, Abs, Con, Ing, Inh |

1 Unless otherwise noted, Permissible Exposure Limits (PEL) and Threshold Limit Values (TLVs) are permissible time-weighted average exposure limits (ppm in air), which must not be exceeded for an 8-hour work-day/40-hour work week. Short-Term Exposure Limits (STELs) must not be exceeded over a 15-minute period.
2 IDLH = Immediately Dangerous to Life or Health; must not be exceeded at any time.
3 I.P. = Ionization Potential. A photoionization detector specified in Section 6.0 should have a lamp with an IP (i.e. 10.6 eV or 11.7 eV) that is greater than the largest IP of COCs from this table that may reasonably be expected to occur as volatiles.
4 NPV = No published value; ND = Not determined.
5 Exposure limits, ionization potentials, and associated health hazards can be found in the NIOSH Pocket Guide to Chemical Hazards and the ACGIH Guide to TLVs and BEIs and Cal-OSHA 8 CCR 5155 Table AC-1.

To minimize potential chemical exposure, the following measures will be taken:

- SDS must be provided for any chemical brought on-site for project use.
- Workers should remain upwind of contaminated materials to the extent practical.
- PPE specified below will be worn to prevent skin or eye contact with constituents.
- Air quality monitoring will be conducted and respiratory protective equipment used as needed, as described below.
- Eating, drinking, smoking, gum chewing and oral tobacco use are not permitted in areas where chemical exposure could occur.
- Workers must remove gloves in the work area and drink from a water source outside the immediate work zone.

- PPE must be removed and hands thoroughly washed prior to breaking for meals.

### *5.10 Other Potential Hazards*

List other potential hazards associated with the site and/or specific tasks and describe hazard mitigation methods.

Wildfire Smoke - When air quality is a concern, staff members are encouraged to spend as much time as possible in a location with filtered without sacrificing the quality of their work. Staff sensitive to poor air quality are encouraged to have their work reassigned until air quality conditions improve. If the AQI is above 151 outdoor fieldwork is limited to 8 hours per day, and frequent breaks are required. If the AQI is above 201 the field personnel access the safety of their current work zone and cease work if it is deemed unsafe.

High Winds – Wind Advisories are issued by the National Weather Service for sustained winds 25 to 39 mph and/or gusts to 57 mph. When these wind advisories are issues the field personnel access the safety of their current work zone and cease work if it is deemed unsafe.

Fog and Low Visibility – Dense Fog Advisories are issued by the National Weather Service for conditions when widespread fog reduces visibilities to ¼ mile or less. When these low visibility advisories are issues the field personnel access the safety of their current work zone and cease work if it is deemed unsafe.

**Interaction with Property Owners and Animals**
With private property visits, there is the potential for hostile responses from property owners. All GSI and subcontractor staff will wear clothing that clearly identifies their company. In the event of a hostile verbal reaction, all staff will immediately vacate the property. If uncontrolled/hostile dogs are present in the yard or other access point to the front door of a residence or business, staff should not approach the property. If a contact telephone number is to be provided to a property owner, a GSI contact number is preferred.

**Biological Hazards**
Project personnel will be aware of potential contact with poisonous plants and animals (e.g. snakes, scorpions, spiders). This hazard is expected to be highest when clearing trash and vegetation from around an outside well discharge point. All materials should be cleared with a hoe or rake to maintain a safe distance until the absence of dangerous fauna can be confirmed. In addition, project personnel will be aware of potential exposure during field activities to fecal coliform bacteria that may exist in groundwater. Untreated water directly from a well will not be consumed, and handwashing should be performed after any direct contact with that water. Any direct contact with a biological hazard that results in the need for medical treatment will be reported immediately to SSO and appropriate medical response action taken.

**Traffic** Project personnel will stay vigilant when working around roads and be aware of vehicles, tractors, mowers, and livestock. Maintain ample distance from livestock. Wear reflective vests or clothing when working along roadways. Use caution when driving off-road, and walk areas of soft, uneven ground to scope the area before driving, as necessary. Use a spotter when backing up to park a field vehicle.

## 6.0 AIR QUALITY MONITORING

Air Monitoring Instrument

_____ Photoionization Detector (PID) _____

_____ Drager Tube (specify compound & use) _____

_____ Personal Badges (specify compound & use) _____

_____ Lower Explosive Level (LEL) Meter _____

_____ Other (Specify) _____

Monitoring Frequency and Location

Identify tasks during which air monitoring is to be performed?

| |
|---|
| Air monitoring is not required for this work. |

Specify where monitoring is to be performed (e.g., Worker's breathing zone, site perimeter, contaminant source area, or other area) and Monitoring Frequency (e.g., Continuous, Periodic {hourly, etc.}, upon detection of noticeable odor)

| |
|---|
| N/A |

## 7.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

### *7.1 Level D PPE*

A minimum of Level D PPE is always required for all project team members, upgraded as necessary depending on task and conditions. Basic Level D PPE shall include the following elements: **1) Hard Hat** (w/ mono goggles); **2) Safety Glasses** (w/side shields); **3) Safety Shoes** (w/steel toes); **4) Body Covering** (long pants, shirt w/ sleeves, collar). Basic Level D equipment will be supplemented as follows:

### *7.2 Supplemental Level D PPE*

| Item | When/Where to be Used |
|---|---|
| Flame Retardant Clothing (FRC) | |
| Hearing Protection | |
| Work gloves | Work gloves are to be worn when using cutting tools. |
| Latex or vinyl surgical gloves | |
| Neoprene or Nitrile gloves | Nitrile gloves are to be used when there is a chance of contacting water or sample preservatives. |
| Tyvek Coveralls | |
| Polycoat Tyvek Coveralls | |
| Chemical-resistant boots | |
| Face Shield | |

### *7.3 Level C PPE*

Specify action level conditions for Level C PPE (use of Air-Purifying Respirator)

Level C work is not expected to be conducted as part of this work.

Specify equipment and limitations

_____Half-face Respirator up to _____ ppm, TOV or ___ ppm (compound) by Draeger

_____Full Face Respirator up to _____ ppm, TOV or ___ ppm (compound) by Draeger

Specify Cartridge Type_____

Specify action level conditions for Level B (Supplied Air) if applicable, or suspension of work.

N/A

### *7.4 Level B PPE*

Specify Level B Equipment (pressure demand, continuous flow, etc.).

Level B work is not expected to be conducted as part of this work.

Specify Level B Procedures (personnel, air supply monitoring, etc.).

N/A

Specify conditions For Project Shutdown.

N/A

## 8.0 DECONTAMINATION PROTOCOL

Specify procedures for personnel decontamination and management of disposable PPE.

On-site consumption of food and drink should be minimized and not occur within the sampling or staging area. Following consumption, hands should be washed thoroughly before returning to the staging area.

Disposable PPE will be disposed of in trash bags for disposal in off-property trash containers.

Specify procedures for response to non-emergency chemical release.

N/A

## 9.0 ADDITIONAL INFORMATION

Provide any additional information, procedures, or instructions as needed.

This work is to be performed in accordance with the GSI EHS Program Manual.

A daily safety meeting should be conducted at the beginning of each day with the entire sampling team to discuss the day's anticipated job hazards. If any unanticipated hazard is encountered, stop work immediately, notify the PTL before proceeding, and modify this HASP as appropriate.