SUPPLEMENTAL NR 716 SITE INVESTIGATION WORK PLAN

BETA-BECHER ACQUISITION CO, LLC HISTORIC FILL SITE
147 EAST BECHER STREET, MILWAUKEE, WISCONSIN

BRRTS 02-41-589088

Intended for:
Wisconsin Department of Natural Resources
Milwaukee, Wisconsin

Prepared for:
Bear Development, Inc.

Prepared by:
Ramboll Americas Engineering Solutions, Inc.

Date:
April 16, 2024

Project Number:
1690023383

RAMBOLL

ENVIRONMENT
& HEALTH

CERTIFICATION

I, Dan Petersen, hereby certify that I am a hydrogeologist as that term is defined in s. NR 712.03 (1), Wis. Adm. Code, am registered per the requirements of ch. GHSS 2, Wis. Adm. Code, or licensed per the requirements of ch. GHSS 3, Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code.

Signature

April 16, 2024
Date

Title: Principal
License Number 36-13

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APPENDICES

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1. INTRODUCTION

Ramboll Americas Engineering Solutions, Inc. (Ramboll), on behalf of Bear Development, Inc. (Bear), submits this *Supplemental NR 716 Site Investigation Work Plan* (the "Work Plan") to conduct additional investigation activities related to the potential presence per- and polyfluoroalkyl substances (PFAS) and 1,4-dioxane in groundwater and sub-slab soil vapor sampling at the Beta-Becher Acquisition Company, LLC, property located in the city of Milwaukee, Wisconsin (the "site"). This Work Plan has been prepared in conformance with Wisconsin Administrative Code (WAC) Chapter NR 716 and is intended to investigate the detection of PFAS and potentially 1,4-dioxane at the site. This request was made by the Wisconsin Department of Natural Resources (WDNR) in their site investigation review letter dated July 11, 2023 (the "July 2023 letter"). This Work Plan presents a summary of site background information, the proposed focused site investigation approach, the scope of services, and the schedule.

1.1 Site Location and Description

The site address is 147 East Becher Street, Milwaukee, Milwaukee County, Wisconsin. The site is located in the southeast ¼ of the southeast ¼ of Section 5, Township 6N, Range 22E of the Public Land Survey System. The site is bounded by East Becher Street (North), Soo Line railroad right-of-way (East), East Lincoln Avenue (South), and commercial/industrial property (West). The location of the site is depicted in **Figure 1** and the site layout and surrounding properties are shown in **Figure 2**.

The Parcel identification number and legal description were obtained from the Milwaukee County Geographic Information System (GIS) and Land Information Interactive Map and the Transverse Mercator Coordinates were obtained from the WDNR online RR Sites Map[1] and are as follows:

- Parcel: 4670201100.
- Legal Description: J A BECHER'S SUBD IN SE 1/4 SEC 5-6-22 VAC & RE-PLATTED BY ORDER OF THE CIRCUIT COURT LOT 3 EXC VAC ZIEMER ST (WITH EASM'T FOR INGRESS & EGRESS OVER PROPERTY ELY OF ELY LI CMSTP&P RR ROW IN SW 1/4 SEC 4-6-22) & SUBJECT TO MMSD EASM'T BID #51, TID #117.
- Wisconsin Transverse Mercator Coordinates: - X: 690363, Y: 283476.

The site is on 9.98 acres and was formerly developed with nine buildings totaling approximately 170,524 square feet under roof. The remainder of the site surface was covered with mixed materials outside of the existing buildings including areas of asphalt and concrete pavements, gravel, and topsoil. The site is currently undergoing redevelopment beginning with the razing of the vacant buildings. The current site owner, FS Apartments, LLC, is currently preparing the site for the construction of eight multitenant housing buildings which are planned to be completed by 2026. An illustration of the planned development is presented in **Figure 3**.

The surrounding property uses are a mixture of residential, commercial, and industrial. The site is zoned as industrial mixed, which allows multifamily residential use. The local topography slopes to the southwest towards the Kinnickinnic River, which is located approximately 400 feet west at its nearest point.

[1] Viewed by Ramboll on March 06, 2024.

1.2 Involved Parties

The following parties are involved with the site:

Responsible Party/site Owner:	FS Apartments, LLC SR Mills, Authorized Member 4011 80th Street Kenosha, WI 53142 Phone: 262.842.0452
Regulatory Agency/Project Manager:	WDNR Ms. Jane Pfeiffer 2300 North Dr. Martin Luther King, Jr. Drive Milwaukee, WI 53212 Phone: 414.435.8021
Environmental Consultant:	Ramboll Americas Engineering Solutions, Inc. Richard Mazurkiewicz 234 West Florida Street, Fifth Floor Milwaukee, WI 53204 Phone: 262.901.0085

The following primary subcontractors provided services during the site investigation:

Drillers:	On-site Environmental Services, Inc. P.O. Box 280 Sun Prairie, WI 53590 Phone: 608.837.8992
Laboratory:	Pace Analytical Services, LLC 1241 Bellevue Street, Suite 9 Green Bay, WI 54302 Phone: 920.469.2436
The site-development firm is:	Bear Development, LLC Mr. Adam Templer 4011 80TH St Kenosha, WI 53142 262.694.2327Mr. Adam Templer 4011 80TH St Kenosha, WI 53142

2. PROJECT BACKGROUND

The current site owner, FS Apartments, LLC, purchased the property on December 21, 2023. The Past owners of the site included Corliss Engine Company (before 1890), Filer & Stowell Company (1890 to 1997), Beta-Becher Acquisition Company/Compassion4others LLC (2020), Read Development Company (December 9, 2020), and the Beta-Becher Acquisition Company, LLC (December 2021). Ramboll performed a Phase I Environmental Site Assessment (ESA) in July 2021 (updated October 2, 2023). The findings of the Phase I ESA included the presence of historical fill materials at the site, the potential presence of historical underground storage tanks, and long-term industrial operations at the site.

Ramboll initiated site investigation activities in September 2011. Soil analyses documented polynuclear aromatic hydrocarbons (PAHs), arsenic, barium, and lead concentrations on much of the site, limited volatile organic compounds (VOCs; benzene and naphthalene), and limited polychlorinated biphenyls (PCBs) impacts, all over the applicable WAC Chapter (Ch.) NR 720 Residual Contaminant Levels (RCLs). A release was reported to the WDNR for the site on January 10, 2022 (Bureau for Remediation and Redevelopment Tracking System [BRRTS] number 02-41-589088).

Between September 2021 and June 2022. A total of 49 borings (14 borings/temporary monitoring wells TW-1 through TW-14, 14 soil reuse samples, soil borings SB-1 through SB-3, NR 141 monitoring well boring MW-5, 13 VOC delineation samples [DB-4 through DB-16]), along with 4 test pits (TP 1 through TP-4) were used to characterize the soils at the site (**Figure 2**). Groundwater samples were collected from a total of 19 monitoring wells (temporary wells TW-1 through TW-4[2], TW-6 through TW-14, and MW-1 through MW-5).

Ramboll concluded the following from the site investigation activities:

- Historic urban fill is present over the entire site with thicknesses varying from 3 to 14 feet.
- Benzene and naphthalene are present in soil at concentrations above the WAC NR 720 migration to groundwater RCLs. These limited VOC impacts are delineated on-site by surrounding borings.

  PAHs and arsenic, barium, and lead concentrations are present above one or more of their respective non-industrial direct contact, industrial direct contact, and groundwater pathway NR 720 soil RCLs. The PAH and metals exceedances are located in the historic fill material but the impacts are vertically delineated by deeper (native soil) samples.

  There were two total PCB soil samples collected from the historic fill that just exceeded the groundwater pathway RCL. The PCB impacts are in the historic fill and are horizontally and vertically delineated on-site.
- Only one VOC (i.e., 1,1-dichloroethene) was detected in one well (TW-7) at a concentration above the WAC NR 140 Preventive Action Limit (PAL).

  Several PAHs were initially detected in groundwater samples collected from one temporary monitoring well (TW-1) at concentrations above the NR 140 Enforcement Standards (ES). However, sampling from permanent NR 141 wells demonstrates that PAH ES exceedances in the

[2] Temporary monitoring well TW-5 was dry during the sampling event and no groundwater sample was collected.

temporary well sample were a sampling artifact attributable to sediment in the sample and not representative of groundwater quality at the site.

Lead was detected above the NR 140 PAL in groundwater samples collected from three temporary monitoring wells and is also attributed to sampling artifacts due to the presence of sediment in the samples. Lead was not detected in laboratory samples collected from the NR 141 groundwater monitoring wells. Lead in groundwater is not a threat to human health at the site because the detected levels were below the NR 140 ES, there are no potable wells on the site, and the site area is provided potable water by the city of Milwaukee.

PCBs were not detected in any of the groundwater samples analyzed demonstrating that the soil PCB RCL exceedances are not adversely affecting groundwater at the site.

Several PFAS were detected above the laboratory method detection limits but not at concentrations above the enforceable standard (70 parts per trillion [ppt]). However, PFAS family compounds perfluorooctanoic acid (PFOA) and perfluoro-1-octanesulfonic acid (PFOS), collectively called "PFAS" in this Work Plan, were detected above the recommended Wisconsin Department of Health Services (DHS) proposed PALs or ESs. The detected PFAS concentrations appear to be at least partially due to PFAS migrating onto the site from upgradient because PFAS concentrations were detected in the upgradient monitoring well MW-10. Note that the low-level PFAS concentrations detected at the site were below the current enforceable standards, there are no potable wells on the site, and the site area is provided potable water by the city of Milwaukee. However, based on the WDNR request written in their July 2023 letter, Ramboll will address PFOA and PFOS concentrations in groundwater, as detailed in Section 4.2.2 of this Work Plan.

- The emerging contaminant 1,4-dioxane may potentially be present at the site due to its association with 1,1,1-trichloroethane (1,1,1-TCA) as a stabilizer. 1,1,1-TCA was detected in three soil samples below the RCLs and two groundwater samples at concentrations below the PAL. According to the Toxicological Profile for 1,4-dioxane prepared by the Agency for Toxic Substances and Disease Registry (April 2012), 1,1,1-TCA may have contained up to 4% of 1,4-dioxane as a stabilizer. Given the low concentrations of 1,1,1-TCA in groundwater at the site, the level of 1,4-dioxane would not be present at concentrations that would exceed its PAL in groundwater. However, the WDNR, in their July 2023 letter, requested sampling for 1,4-dioxane, based on it being associated with 1,1,1-TCA and having a slower degradation rate in comparison to 1,1,1-TCA. 1,4-Dioxane is addressed in Section 4.2.2 of this Work Plan.
- Ramboll sampled 21 sub-slab soil vapor sampling probes in select areas at the site (one area was sampled twice). Naphthalene was detected just above the commercial Sub-Slab Vapor Risk Screening Level (VRSL) in a sample collected from Building 9 in the east-central portion of the site. The location was resampled on November 23, 2021, and naphthalene was detected at a concentration well below the residential VRSL. In addition, the proposed building plans include the installation of passive radon piping systems beneath the slab-on-grade foundations in all the building living spaces that are not part of the parking footprint and sealed elevator pits. Therefore, vapor intrusion is not expected to be a threat to human health. As requested in the WDNR's July 2023 letter, additional sub-slab soil vapor sampling will be performed in each of the new multi-tenant housing structures before occupancy (see Section 4.2.3).
- Ramboll collected methane gas measurements from 23 Vapor Pins® and five groundwater monitoring wells, based on the presence of peat found in soils at the site. Methane measurements were well below the NR 507.22 limit; therefore, methane is not a health threat to human health or the environment.

Ramboll submitted the following information to the WDNR regarding the site:

- Site Investigation Report (SIR) and Remedial Action Options Report (RAOR) with review fee on February 24, 2022.
- Development at Historic Fill Site Exemption Application with review fee on February 24, 2022. (WDNR approved 4/8/22)
- Materials Management Plan Request with review fee on February 24, 2022.
- Phase I ESA on March 11, 2022.
- Ramboll also submitted various information (maps and additional information regarding the Site Investigation Report and the Materials Management Plan) in documents submitted on March 17, 21, and 29, 2022.
- Development at Historic Fill Site Exemption Application Addendum (modified because new site development plans include the demolition of all onsite existing structures). Approved by WDNR on July 11, 2023.
- Materials Management Plan Request Addendum (modified because new site development plans include the demolition of all onsite existing structures). Approved by WDNR on July 11, 2023.
- Ramboll also submitted various information (maps and additional information regarding the newly planned construction activities and schedules in emails and documents submitted to the WDNR between March 2022 to February 2024.
- On March 14, 2024, Ramboll reported an oil sheen finding during site redeveloping activities. On March 22, 2024, the WDNR sent a responsible party letter to Bear, assigning the oil-sheen release BRRTS number 02-41-594228.

Note that in April 2024, Ramboll will submit an NR 716 Site Investigation Work Plan (BRRTS 02-41-594228) to address the oil sheen impacts formerly beneath the historical building concrete floors at the site.

In January 2024, Bear began site demolition activities to prepare the site for redevelopment (to build eight multi-tenant residential buildings). The demolition began with the removal of the above-ground portions of the buildings (not the concrete building floors). Ramboll provided field oversight to inspect the soil conditions beneath the historical building floors, as recommended in the WDNR July 2023 letter. Bear began removing the historical buildings' concrete floors on February 15, 2024. There were some limited areas of impact (an oil sheen observed on the groundwater surface) that were discovered when Bear's general contractor, Construction Management Associates, Inc. (CMA), located in Kenosha, Wisconsin, was excavating and removing the historical building's foundation support walls. The details of the oil sheen impacts are provided in Ramboll's forthcoming April 2024 *NR 716 Site Investigation Work Plan* (BRRTS 02-41-594228, Oil Sheen Impacts*).*

This Work Plan presents Ramboll's approach for the completion of further groundwater and sub-slab soil vapor sampling under BRRTS No. 02-41-589088, Historical Fill.

3. OVERVIEW OF SUPPLEMENTAL SITE INVESTIGATION APPROACH AND STRATEGY

The objectives for the supplemental site investigation (SSI) activities are to further evaluate the following per the WDNR's July 2023 letter:

- Confirm if concentrations of PFOA and PFOS are detected above the recommended Wisconsin DHS proposed PALs or ESs. Groundwater samples for PFAS analysis will be collected from all six newly installed monitoring wells (MW-6 through MW-11) See **Figure 4** for proposed well locations. Monitoring wells MW-8 through MW-11 will be to evaluate 1) locations near the highest historical PFAS concentrations (MW-7 and MW-10), 2) PFAS in groundwater at the former spray paint booth (MW-6), and 3) PFAS at the site boundaries (MW-8 through MW-11).
- Evaluate emerging contaminant 1,4-dioxane to determine if is present in groundwater at the site. Groundwater samples for 1,4-dioxane will be collected from monitoring wells MW-6 (the location of the former spray paint booth), MW-7 (the location of the highest historical 1,1,1-TCA concentration (former well MW-2, 0.88 ppt), and from upgradient site boundary well MW-9 (to evaluate if 1,4-dioxane is migrating onto the site).
- Perform sub-slab soil vapor sampling in each of eight newly planned multi-tenant housing structures before occupancy. Although there are no residential living units on the first floor of the building, which is mostly open garage parking, Ramboll will perform sub-slab soil vapor sampling in the amenity areas (eating, athletic workout, dressing, laundry, etc.). Two sub-slab soil vapor samples will also be collected from the garage areas. The sampling locations will be representative of sub-slab conditions beneath the entire buildings.

The results from the investigations completed in this Work Plan will be presented in a Supplemental Site Investigation Report (the "Supplemental SIR").

4. SUPPLEMENTAL SITE INVESTIGATION WORK PLAN

The following section presents a description of the services to be provided during the supplemental site investigation. The contents of this section were prepared following WAC NR 716.

4.1 Pre-Site Investigation Activities

4.1.1 Health and Safety

The existing site-specific Health and Safety Plan (HASP), developed according to Occupational Safety and Health Administration (OSHA) 29 CFR 1910, will be reviewed with all field personnel before commencing the field activities.

4.2 Soil Investigation and Monitoring Well Installation Activities

4.2.1 Utility Clearance

Before conducting intrusive site investigation activities, utility mark-outs will be coordinated through the Diggers Hotline (262.785.5300). Ramboll will also contract with a private utility locator to complete a geophysical survey (e.g., using ground-penetrating radar and/or electromagnetic) to identify subsurface utilities and confirm their location before initiating any intrusive work in the areas where subsurface investigation activities will occur. Proposed sampling locations may be modified to avoid subsurface and overhead utilities or other obstructions, as appropriate.

4.2.2 Field Activities (Drilling, Soil Screening, and Groundwater Sampling)

A drill rig capable of turning 4.25-inch hollow-stem augers will be used to blind drill (no soil sampling) six groundwater monitoring wells (MW-6 through MW-11; Figure 4) to a depth of approximately 15 feet deep based on historical groundwater levels ranging from approximately 5 to 9 feet below ground surface (bgs). The drilling, well installation, and groundwater sampling activities will be performed under the supervision of an experienced Ramboll consultant. Drill cuttings will be observed to describe the general soil types in the area of the monitoring wells. No soil samples will be collected during the groundwater monitoring well installation activities.

Each well will consist of a 2-inch diameter, 10 feet of factory-cut (0.010-inch) polyvinyl chloride (PVC) well screen attached to a PVC riser. The monitoring wells will be constructed such that the water table bisects the screened section of the wells. The wells will be fitted with locked expansion plugs. Each well will be secured inside a 9-inch diameter steel flush-mount well compartment with a bolt-secured cover. A concrete pad will surround each well compartment. The wells will be developed before groundwater sampling to remove sediment introduced during well installation activities and to establish proper transmissivity with the surrounding unconsolidated saturated soils.

Before well purging, groundwater elevation measurements will be made using an electronic water level sensor (accuracy 0.01 foot) and recorded in the field. Groundwater measurements will be collected 1) on the same day, and 2) after the wells are opened and sufficient time is given to achieve hydrostatic equilibrium. Measurements will be documented at the beginning of the groundwater monitoring event and used to develop a groundwater potentiometric surface map of the shallow groundwater at the Site. The resulting groundwater elevation contours will be used to evaluate hydraulic gradients across the site and to assist with the determination of groundwater flow.

Following the collection of depth-to-groundwater measurements, the monitoring wells will be sampled utilizing low-flow groundwater sampling techniques using a peristaltic pump with polyethylene tubing

and a multiparameter sonde (In Situ Aqua Troll 600). New pump tubing will be used for each well to prevent cross-contamination. Field measurements of water quality parameters, including temperature, dissolved oxygen (DO), potential of hydrogen (pH), specific conductivity, oxidation-reduction potential (ORP), and turbidity will be recorded and stored in a tablet computer. The readings will be taken every 3 minutes during well purging before the collection of groundwater samples. The groundwater samples will be collected upon stabilization of the groundwater quality parameters, which typically occurs when three consecutive readings that do not vary more than plus or minus 10 percent for turbidity and DO, plus or minus 3 percent for conductivity and temperature, plus or minus 10 microvolts for ORP, and plus or minus 0.1 for pH.

Groundwater samples for PFAS analysis will be collected from all six newly installed monitoring wells (MW-6 through MW-11) Groundwater samples for 1,4-dioxane analysis will be collected from monitoring wells MW-6, MW-7, and MW-9. PFAS (and 1,4-dioxane) protocols for personal protective equipment (PPE), sampling equipment, and sampling procedures outlined below will be followed to eliminate PFAS and 1,4-dioxane cross-contamination. The following PFAS-sampling protocols will be performed:

Preparation

- Field technician, before sampling the field technician will shower only with PFAS-free soap and shampoo.
- Field technician, before sampling teeth brushed with fluoride-free toothpaste only, no mouthwash or dental floss.
- Field personal clothing will be laundered at least six times with non-PFAS-containing detergents without fabric softener. No new clothing will be worn in the field.
- No treated (stain, fire, water, or repellent proof) clothing, PPE, or field sampling equipment (e.g., waterproof notebooks) containing PFAS materials[3]. Boots made from polyurethane and PVC are allowable.
- No cosmetics, deodorants, moisturizers, hand creams, sunscreens, insect repellants, or other related health and beauty products will be used before sampling.
- Field technician, before sampling sample bottles will be pre-labeled before arrival at the sampling site; mark labels with a ball-point pen only, no markers.

During Sampling

- PFAS sampling will be scheduled at the beginning of the workday to avoid possible contamination sources. PFAS samples will be collected first (if other sampling is performed).
- No handling of any packaged food or drinks, aluminum foil, adhesive labels, etc. at or around the sampling location.
- No waterproof logbooks, spiral hardcover notebooks, plastic clipboards, or Post-It® notes will be used, only untreated paper and aluminum clipboards only. Aluminum foil will not be used.
- No Sharpies and permanent markers will be used only regular ballpoint pens.

[3] Gore-Tex®, Scotchgard™, Stainmaster®, Teflon™, coated Tyvek®, and RUCO®.

- No food or drink will be on-site except for bottled water and/or hydration drinks that are to be consumed only in the staging area (not while sampling is performed).
- Disposable, powderless nitrile gloves will be used. Extra caution will be used not to touch any surfaces before sample collection.
- Groundwater sampling equipment that is not disposable, i.e., the water level indicator, will be decontaminated in between sampling points with a solution of PFAS (and 1,4-dioxane) free laboratory-provided water and PFAS-free detergent (Alconox® and Liquinox®) and triple-rinsed with PFAS (and 1,4-dioxane) free laboratory-provided water.
- A peristaltic pump will be used to sample the wells. New single-use PFAS-free disposable high-density polyethylene sample tubing and silicone peristaltic pump tubing will be utilized for sample collection at each well location.
- Samples will be directly collected from the peristaltic pump discharge tubing into laboratory-provided and preserved high-density polyethylene sample (HDPE or polypropylene) bottles (caps unlined and made of HDPE or polypropylene, no Teflon®) sealed, and bagged immediately. The samples will be stored and transported in clean (polyethylene, polypropylene, and polystyrene), dedicated, coolers filled with fresh bagged ice (no chemical ice packs will be used).

A copy of Ramboll's PFAS sampling procedures is provided as **Appendix A**. Groundwater samples will be submitted to a Wisconsin-certified (405132750) laboratory (Pace Analytical Services, LLC [Pace] located in Green Bay, Wisconsin) for analysis. PFAS samples will be analyzed by United States Environmental Protection Agency (USEPA) Method 533 (isotope dilution method) and 1,4-dioxane will be analyzed by USEPA Method 8260D (selected ion monitoring).

4.2.3 Field Activities (Sub-Slab Soil Vapor Sampling)

Bear plans to build and occupy the multi-tenant buildings in a phased manner (starting from the north [Becher Street] to the south [Lincoln Avenue]). The buildings will be built as slab-on-grade buildings with no basements or subsurface areas. Each building will also be constructed on a vapor barrier and have passive (wind turbine) sub-slab depressurization system (SSDS) piping installed beneath the vapor barrier as a precaution.

Based on the July 2023 WDNR letter, Ramboll proposes to complete sub-slab soil vapor sampling in the buildings as they are being built and before occupancy. Ramboll proposes to install four sub-slab soil vapor sampling points in each building (**Figure 5**). Note that the newly proposed multi-tenant buildings will have no living quarters on the first floor. As such, Ramboll will install a sub-slab soil vapor sampling point in each common area (lobby, fitness rooms, community rooms), one in a stairwell, and one in the open garage parking area in each of the planned buildings. The sub-slab soil vapor sampling results for the first phase of the occupancy will be reported to the WDNR in the forthcoming supplemental site investigation report. Ramboll will likewise submit the results of the remainder of the sub-slab vapor sampling results for each building separately (two additional) in a phased manner after each of the three seasonal sampling events for each building are completed. Each building will have a total of three sub-slab VI sampling events spaced out at 90-day intervals with at least one of the events conducted during the winter heating season (per WDNR RR-800, January 2018).

During construction and before installation of each of the vapor barriers, Ramboll will install 5/8-inch diameter plastic conduits[4] at the proposed vapor sampling locations (see **Figure 5**). Ramboll will work with Bear's general contractor CMA to place/locate the plastic sub-slab soil vapor sampling conduits in spaces that are accessible but will not interfere with the use of the area. The conduits will be sealed to the vapor barrier before the pouring of the concrete slab. The bottoms of the plastic conduits will extend through the vapor barrier and approximately 3 inches into the concrete foundation floor's substrate base material. The plastic conduits will be sealed to the vapor barrier with a non-VOC mastic and extend through the concrete foundation floor. The plastic conduits will be set at least 4 feet away from all SSDS piping. After building construction, each conduit will be cut flush with the concrete floor surface and over-drilled with a 1.5-inch diameter drill to 2 inches below grade. The Vapor Pins®[5] will be installed directly inside the plastic conduits. The Vapor Pins® will be sealed with rubber caps and the subsurface portions of the Vapor Pins® will be covered with a plastic cap that lies flush with the surrounding floor.

The sub-slab soil vapor sampling will be completed when the first floor is completed with the heating, ventilation, and air conditioning (HVAC) system running. Note that the HVAC on the first floor is completely independent (does not mix with) of the HVAC system for the residential floors above. A sub-slab vapor sample will be collected from each vapor pin using a 1-liter Summa canister fitted with a flow controller regulating the flow to approximately 100 to 200 milliliters per minute, which is recommended for sub-slab sampling; at these flow rates, a 1-liter canister would take approximately 5 to 10 minutes to fill. Low chemisorption (polyetheretherketone, Nylaflow®, or Teflon®) will be used to make connections between the Summa canister and the Vapor Pins®. The sub-slab vapor samples will be submitted to a Wisconsin-accredited laboratory for analysis of VOCs using the USEPA Method Toxic Organic-15. Quality control measures will be implemented during the sub-slab sampling, including vacuum testing of lines (shut-in test) and leak testing (water dam) of the Vapor Pins® to ensure the integrity of the sub-slab vapor samples that are collected. Three sub-slab VI sampling events (90 days apart) are included in this proposal. The Vapor Pins® will be left in place after the sub-slab soil vapor sampling for potential future sampling.

4.3 Investigation-Derived Waste Management

Soil cuttings, purge water, and decontamination water generated during site investigation activities will be contained in properly labeled Department of Transportation-compliant 55-gallon drums. The drums will be staged and secured on-site until the waste is profiled and properly disposed of at a licensed recycling and disposal facility. Waste disposal documentation will be provided in the forthcoming supplemental site investigation report.

4.4 Reporting

Ramboll will prepare an NR 716 Supplemental Site Investigation Report following the completion of the PFAS and 1,4-dioxane groundwater sampling activities and after the first round of sub-slab soil vapor sampling in the two northern-most buildings (Buildings 7L and 8L, Figure 3). Ramboll will also provide updated site figures (as requested by the WDNR in their July 11, 2023, Site Investigation Review letter) summarizing the analytical data. The supplemental site investigation report will include the PFAS and 1,4-dioxane groundwater sampling results from monitoring wells MW-6 through MW-11, the first round of sub-slab soil vapor sampling in Buildings 7L and 8L, and Ramboll's findings and recommendations. Ramboll will include a WDNR review fee for the supplemental site investigation.

[4] Sioux Chief PowerPEX® 3/4" X 5' Blue PEX (cross-linked polyethylene) Tubing (Menards), or similar.

[5] Sub-slab vapor sampling probes supplied by Cox-Colvin & Associates Inc.

Ramboll will also submit all laboratory results to the WDNR within 10 days of receipt of the analytical data according to WAC NR 716.14(2).

Because of the phased building approach, Ramboll will submit the additional sub-slab soil vapor sampling results to the WDNR after each event (two additional submittals for Buildings 7L and 8L) and a total of three additional submittals for each of the remaining buildings (5B and 6B, 3B and 4B, and 1L and 2L). Each of the supplemental sub-slab soil vapor sampling reports will be submitted to the WDNR under separate covers. Ramboll will include "technical assistance" review fees to get the WDNR's approval that the sub-slab soil vapor sampling and results have been completed to the Agency's satisfaction.

4.5 Schedule

The following schedules are based on Bear's current construction plan. Ramboll will initiate the monitoring well installation and groundwater sampling activities after Bear has completed the new grade of the site, estimated July 2024. Ramboll estimates that the supplemental site investigation and remedial action options report will be submitted in September 2024. Ramboll estimates that the first round of sub-slab soil vapor sampling in Buildings 7L and 8L will occur in September 2025.

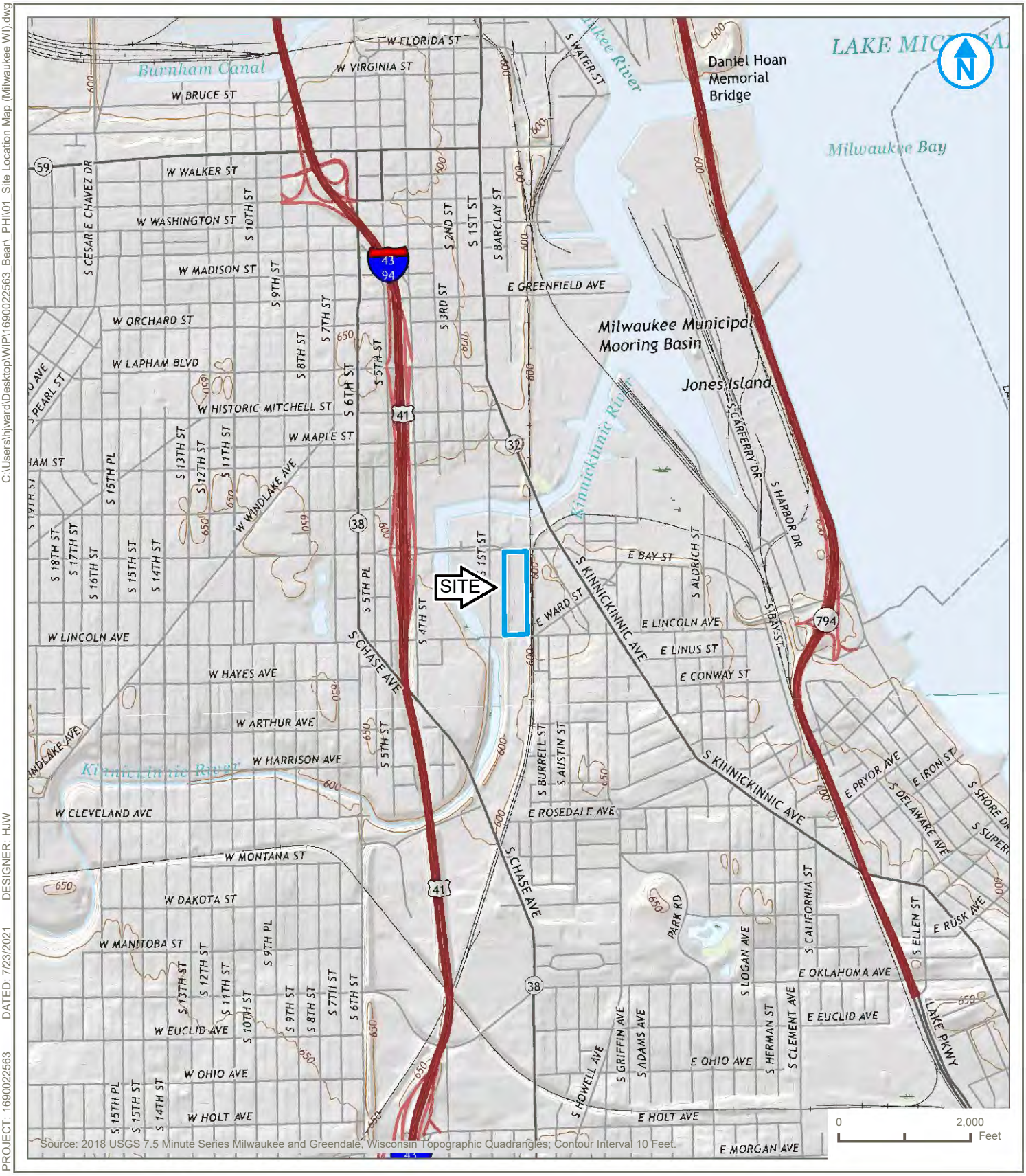
5. REFERENCES

Ramboll Americas Engineering Solutions, Inc., *716 Site Investigation Report and Remedial Action Options Report*, 02/24/2022.

Ramboll Americas Engineering Solutions, Inc., 716 Site Investigation Report and Updated Remedial Action Options Report, 02/01/2023.

Wisconsin Department of Natural Resources*, Site Investigation Review for Beta Becher Acquisition Co, LLC Historic Fill*, 07/11/2023.

FIGURES



Source: 2018 USGS 7.5 Minute Series Milwaukee and Greendale, Wisconsin Topographic Quadrangles; Contour Interval 10 Feet.

C:\Users\hjward\Desktop\WIP\1690022563_Bear_PHI\01_Site Location Map (Milwaukee WI).dwg

PROJECT: 1690022563 DATED: 7/23/2021 DESIGNER: HJW

KEY MAP

SITE LOCATION MAP

FIGURE 1

BETA-BECHER ACQUISITION CO LLC
147 EAST BECHER STREET
MILWAUKEE, WISCONSIN

Map Scale: 1:24,000
Map Center: 43°0'17.6868", -87°54'34.6824"

Ramboll Americas Engineering Solutions, Inc.

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LEGEND

- FILER & STOWELL SITE BOUNDARY (APPROXIMATE)
- PROPERTY BOUNDARY (APPROXIMATE)
- TO BE DEMOLISHED
- TW-1 BORING/ABANDONED TEMPORARY MONITORING WELL LOCATION
- MW-1 ABANDONED NR 141 GROUNDWATER MONITORING WELL
- B-1 SOIL BORING LOCATION
- 1 CONCRETE TEST PIT LOCATION
- 14 SOIL REUSE SAMPLE LOCATION
- MW-1 SUB-SLAB SOIL VAPOR SAMPLING LOCATIONS
- CATCH BASIN
- DRAIN
- MANHOLE COVERS
- VAULT
- PIPE

New Barons Brewing Coop, Twisted Path Distillery, Beer City Screen Printing)

Boat Storage

BP AMOCO

E Becher St

Wheel & Sprocket

S Robinson Avenue

Railroad

Restaurant Depot

Former Industrial Property

Multi-Tenent Apartments

S 1st Street

Staffing Partners

Former Industrial Property

Kinnickinnic River

W Lincoln Avenue

MKE Urban Stables

SITE FEATURES:
1. GARAGE (BUILDING A-1)
2. FOUR-STORY OFFICE BUILDING (BUILDING D-1)
3. INTEGRATED TOOL & MACHINE BUILDING (D-2)
4. SAW MILL BUILDING (C-1)
5. PAINT AND SAND BLAST BOOTHS
6. STORAGE BUILDING (BUILDING C-3)
7. FORMER FORGE BUILDING (BUILDING C-4)
8. BOAT STORAGE
9. FORMER BOAT MAINTENANCE AREA (BUILDING B-3)
10. POWER HOUSE (BUILDING A-3 THROUGH A-6)
11. PATTERN STORAGE (BUILDING A-2)
12. OFFICE (BUILDING B-7)
13. TREE/LOG STORAGE AREA

0 120
SCALE IN FEET

SITE LAYOUT

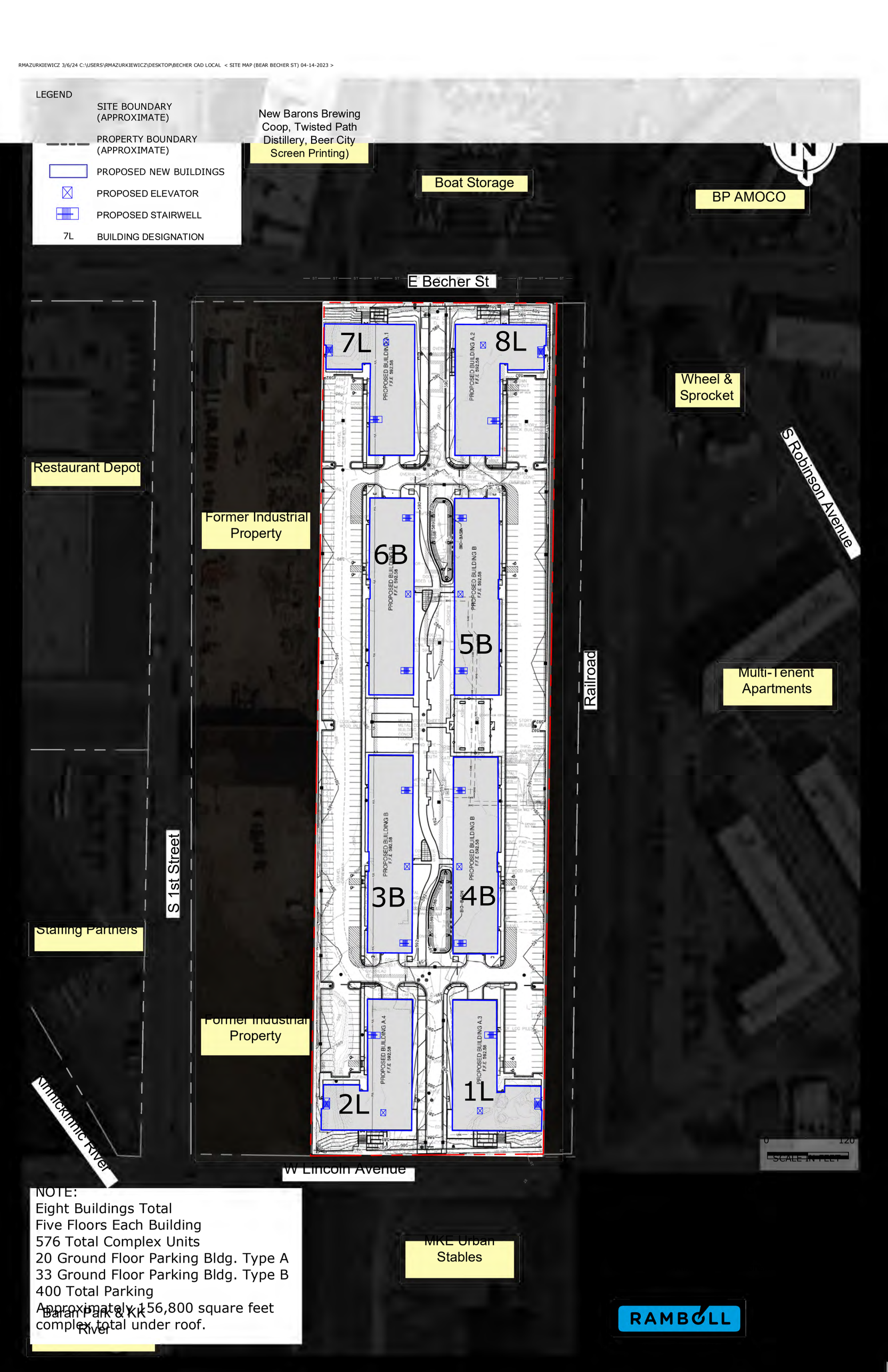
Beta-Becher Acquisition Co, LLC
147 East Becher Street
Milwaukee, Wisconsin 53207

RAMBOLL

FIGURE 2

DRAFTED BY: RPM | DATE: 03/05/2024 | PROJECT: 1690023383

RMAZURKIEWICZ 3/6/24 C:\USERS\RMAZURKIEWICZ\DESKTOP\BECHER CAD LOCAL < SITE MAP (BEAR BECHER ST) 04-14-2023 >



NOTE:
Eight Buildings Total
Five Floors Each Building
576 Total Complex Units
20 Ground Floor Parking Bldg. Type A
33 Ground Floor Parking Bldg. Type B
400 Total Parking
Approximately 156,800 square feet complex total under roof.

RAMBOLL

RMAZURKIEWICZ 3/12/24 C:\USERS\RMAZURKIEWICZ\DESKTOP\BECHER CAD LOCAL < SITE MAP (BEAR BECHER ST) 04-14-2023 >

LEGEND

- FILER & STOWELL SITE BOUNDARY (APPROXIMATE)
- PROPERTY BOUNDARY (APPROXIMATE)
- TO BE DEMOLISHED
- TW-1 BORING/ABANDONED TEMPORARY MONITORING WELL LOCATION
- MW-1 ABANDONED NR 141 GROUNDWATER MONITORING WELL
- B-1 SOIL BORING LOCATION
- 1 CONCRETE TEST PIT LOCATION
- 14 SOIL REUSE SAMPLE LOCATION
- MW-1 SUB-SLAB SOIL VAPOR SAMPLING LOCATIONS
- CATCH BASIN
- DRAIN
- MANHOLE COVERS
- VAULT
- PIPE
- MW-8 PROPOSED GROUNDWATER MONITORING WELL

New Barons Brewing Coop, Twisted Path Distillery, Beer City Screen Printing)

Boat Storage

BP AMOCO

E Becher St

Wheel & Sprocket

S Robinson Avenue

Restaurant Depot

Former Industrial Property

Railroad

Multi-Tenent Apartments

S 1st Street

Staffing Partners

Former Industrial Property

Kinnickinnic River

W Lincoln Avenue

MKE Urban Stables

SITE FEATURES:
1. GARAGE (BUILDING A-1)
2. FOUR-STORY OFFICE BUILDING (BUILDING D-1)
3. INTEGRATED TOOL & MACHINE BUILDING (D-2)
4. SAW MILL BUILDING (C-1)
5. PAINT AND SAND BLAST BOOTHS
6. STORAGE BUILDING (BUILDING C-3)
7. FORMER FORGE BUILDING (BUILDING C-4)
8. BOAT STORAGE
9. FORMER BOAT MAINTENANCE AREA (BUILDING B-3)
10. POWER HOUSE (BUILDING A-3 THROUGH A-6)
11. PATTERN STORAGE (BUILDING A-2)
12. OFFICE (BUILDING B-7)
13. TREE/LOG STORAGE AREA

0 120
SCALE IN FEET

PROPOSED MONITORING WELL LOCATIONS

Beta-Becher Acquisition Co, LLC
147 East Becher Street
Milwaukee, Wisconsin 53207

RAMBOLL

FIGURE 4

DRAFTED BY: RPM | DATE: 03/12/2024 | PROJECT: 1690023383

RMAZURKIEWICZ 3/27/24 C:\USERS\RMAZURKIEWICZ\DESKTOP\BECHER CAD LOCAL < SITE MAP (BEAR BECHER ST) 04-14-2023 >

LEGEND

- FILER & STOWELL SITE BOUNDARY (APPROXIMATE)
- PROPERTY BOUNDARY (APPROXIMATE)
- BUILDING PERIMETER
- PROPOSED SUB-SLAB VAPOR SAMPLE LOCATION
- L7 BUILDING DESGNATION

E Becher St

W Lincoln Avenue

S 1st Street

Railroad

N

7L
storage
lobby
storage
open garage parking
stairwell
trash

8L
fitness rm
storage
open garage parking
stairwell

6B
fitness rm
open garage parking
storage

5B
parking
fitness rm
parking
storage

3B
storage
open garage parking
fitness rm

4B
storage
open garage parking
fitness rm
parking

2L
stairwell
open garage parking
trash
stairwell

1L
stairwell
open garage parking
trash
stairwell

storage
common area

common area
lobby
storage
fitness rm

Five Buildings Total
Five Floors Each Building
595 Total Complex Units
265 Total Interior Parking
480 Total Exterior Parking
Approximately 144,400 square feet complex total under roof.

0 90
SCALE IN FEET

SUB-SLAB VAPOR SAMPLING LOCATIONS

Beta-Becher Acquisition Co, LLC
147 East Becher Street
Milwaukee, Wisconsin 53207

..\..\Downloads\RadOrladow.jpg

FIGURE 5

DRAFTED BY: RPM | DATE: 03/14/2024 | PROJECT: 1690023383

APPENDIX A

RAMBOLL'S PFAS SAMPLING FIELD GUIDANCE DOCUMENT

FIELD GUIDANCE DOCUMENT NO. 1.07

PFAS SAMPLING

RAMBOLL

FIELD GUIDANCE DOCUMENT NO. 1.07

PFAS SAMPLING

Prepared By:	Jim Fenstermacher
Peer Reviewed By:	Jose Sananes Matthew Traister Jason Wilkinson Steve Luis Paul Hare Scott Hayter Clifford Yantz Carol Serlin
Approved By:	J. Mark Nielsen, PE
Applicable To:	North American offices
Effective Date:	October 6, 2020
Revision Date:	MARCH 30, 2024
Revision Notes:	1. Clarification on Trizma use, updated Attachments A and B.
Documents Used as Reference During Preparation:	California State Water Quality Control Board Division of Water Quality, Per- and Polyfluoroalkyl Substances (PFAS) Sampling Guidelines, March 20, 2019. Department of Defense (DoD) Environmental Data Quality Workgroup and Department of Energy Consolidated Audit Program Data Quality Workgroup, United States Department of Defense and Department of Energy Consolidated Quality Systems Manual (QSM) for Environmental Laboratories Version 5.3, May 2019. ITRC, Site Characterization Considerations, Sampling Precautions, and Laboratory Analytical Methods for Per- and Polyfluoroalkyl Substances (PFAS), March 2018. Michigan Department of Environmental Quality, General PFAS Sampling Guidance, October 16, 2018. U.S. Environmental Protection Agency, Validated Test Method 8327: Per-and Polyfluoroalkyl Substances (PFAS) Using External Standard Calibration and Multiple Reaction Monitoring (MRM) Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS), June 2019. U.S. Environmental Protection Agency Office of Research and Development, EPA Method Development Update: Per- and Polyfluoroalkyl Substances (PFAS), April 16, 2019.

This document will be routinely evaluated and updated as new information becomes available.

CONTENTS

ATTACHMENTS

1. INTRODUCTION

This Field Guidance Document (FGD) supplements and modifies the general guidelines provided in other FGDs developed by Ramboll US Consulting, Inc. (Ramboll) where environmental samples are to be collected for laboratory analysis of per- and polyfluoroalkyl substances (PFAS). These supplemental guidelines are based on evolving and ongoing recommendations being developed by various regulatory agencies (refer to **Attachment A**). While this document focuses primarily on groundwater sampling procedures, the guidelines presented in this FGD can be readily applied to sampling of other media (i.e., soil, surface water, sediment, storm and sanitary sewers). Consult with the PFAS Subject Matter Expert (SME) team (refer to **Attachment B**) to develop site-specific procedures for these media and other associated activities (e.g., drilling, well installation).

Due to the widespread use of PFAS (applications include food wrappers, water repellent outdoor gear, firefighting foams, mist suppressants, wire/cable coatings, specialty fabrics, and even car wash and ski wax materials) and the very low target detection limits (nanograms per liter, ng/L), specific measures should be implemented during sampling for PFAS to enhance sample integrity and generate representative data. Potential causes of non-representative PFAS results stem from (a) most commonly, the inadvertent introduction of PFAS into the sample through sampling equipment/supplies, personal care products (PCAs) and personnel protective equipment (PPE), or (b) the inadvertent loss of PFAS to the environment or equipment used in sample collection, which is less common but still requires diligence on the part of the sampling team. The procedures outlined in this FGD are to be used along with the latest versions of the PFAS Pre-Sampling Checklist in **Attachment C**.

Although this FGD supplements guidelines for collection of samples associated with typical field activities and projects, it should be understood that for certain projects, more specific sampling procedures, including site-specific or state-specific or regulatory program-specific guidelines, requirements, or procedures may be applicable. Specific requirements for each project will be reviewed by the Ramboll Principal-in-Charge/Project Director (PIC/PD) and Project Manager (PM) in consultation with the PFAS SME team (refer to **Attachment B**), and any additional requirements will be defined in a project-specific Work Plan, Field Sampling Plan, or Quality Assurance Project Plan (QAPP). It should be emphasized that this FGD is not meant to serve as a project-specific work plan, but as a reference for developing project-specific requirements.

This FGD does not supersede Ramboll health and safety procedures or site-specific Health and Safety Plan (HASP) requirements; in the event of conflict between this FGD and the site-specific HASP, the procedures outlined in the HASP shall prevail. Ramboll employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP, followed by approved site-specific procedures, which may include those in this FGD. The Ramboll PIC/PD and/or PM shall verify that project field personnel review and sign the applicable HASP, and that the signed HASP and relevant project information are maintained in the project file for the duration of the project, or as established by Ramboll's applicable document handling and retention policies. The signatures of the PIC/PD and/or PM indicate approval of the methods and precautions outlined in the site-specific HASP.

For ease of reference, the procedures outlined in this FGD are color coded as follows:

- A red dot (●) identifies items or materials that are understood to contain PFAS or that PFAS are used in their manufacture and **should not be used** when sampling for PFAS.
- A yellow triangle (▲) identifies items or materials for which the potential for PFAS bias or cross-contamination is not fully understood and **may be allowable with special considerations** and/or adjustment to protocols after consultation with the PFAS SME team (refer to **Attachment B**).
- A green square (■) identifies items or materials that are understood to not be sources of PFAS bias or cross-contamination and are **allowed or preferred** when sampling.

2. EQUIPMENT / MATERIALS

Equipment and materials required for environmental sampling for PFAS analyses are generally the same as those typically required for collection of environmental samples for other analyses, except that PFAS sampling will impose certain restrictions to avoid use of PFAS containing items or material to avoid potential PFAS bias or cross-contamination. Refer to Equipment/Materials requirements detailed in the FGD for the specific sampling activity being performed, as modified in **Section 4.1** below.

Additional equipment may be specified in the site-specific HASP, Work Plan, Field Sampling Plan, or QAPP. More specialized sampling equipment may be required depending on the media being sampled, site conditions, and project-specific needs. Field personnel should understand and be familiar with the operation and safe handling of the equipment and materials that are required for PFAS sampling. A PFAS Pre-Sampling Checklist is provided in **Attachment C**. Refer to **Section 4.1** of this FGD regarding specific sampling equipment and material limitations.

3. REFERENCED GUIDANCE DOCUMENTS

The following FGDs may relate to this FGD and should be reviewed prior to mobilization, as needed, with the provision that content of this FGD supplements and modifies these FGDs due to the unique requirements related to PFAS sampling (e.g., restrictions on equipment and materials, the types and frequency of quality control [QC] samples):

- **SPI 27**, Subsurface Clearance.
- **FGD 1.01**, Field Notes and Records.
- **FGD 1.02**, Sample Handling, Shipping, and Chain of Custody.
- **FGD 1.03**, Data Management.
- **FGD 1.04**, Documenting Sampling Locations.
- **FGD 1.05**, Field Quality Control Samples.

- **FGD 4.04**, Field Screening – Water Quality.
- **FGD 4.06**, Equipment Calibration.
- **FGD 5.04**, Surface Soil Sampling.
- **FGD 5.05**, Soil Sampling for VOC Analysis.
- **FGD 5.07**, Subsurface Soil Sampling - Direct Push.
- **FGD 5.08**, Subsurface Soil Sampling - Split Spoon and Shelby Tube.
- **FGD 5.09**, Soil Boring Log Preparation.
- **FGD 5.15**, Stockpile Sampling.
- **FGD 5.16**, Soil Sampling for PCBs.
- **FGD 6.02**, Groundwater Sampling.
- **FGD 6.04**, Groundwater and Free Product Level Measurements.
- **FGD 6.06**, Temporary Overburden Well Installation and Sampling.
- **FGD 6.07**, Well Development.
- **FGD 6.09**, Groundwater Sampling - Private and Domestic Wells.
- **FGD 6.16**, Groundwater Sampling – Free Product/NAPL.
- **FGD 6.19**, Groundwater Sampling – Hydra Sleeves.
- **FGD 6.20**, Groundwater Sampling - Low Flow.
- **FGD 7.01**, Surface Water Sampling.
- **FGD 8.01**, Sediment Sampling.
- **FGD 8.05**, Sediment Pore Water Sampling.
- **FGD 14.01**, Sampling Equipment Decontamination.
- **FGD 15.01**, Waste Handling.
- **FGD 15.02**, Waste Sampling.
- **FGD 16.02**, Storm and Sanitary Sewer Grab Sampling.

The list above is not intended to be all-inclusive. Other FGDs and Standard Practice Instruction (SPI) may need to be referenced based on the specific requirements of a site-specific Work Plan, Field Sampling Plan, or QAPP (e.g., field screening FGDs, FGDs for sampling of other media, etc.).

4. PROCEDURES

4.1 Planning and Design Considerations

Strategic decisions will be approved by the PIC/PD and/or PM in consultation with the PFAS SME team before the initiation of associated field activities, and will be documented in the Work Plan, Field Sampling Plan, and/or QAPP. The Work Plan, Field Sampling Plan, and/or QAPP will be designed for the collection of quality data to meet the objectives of the site

activities and will include information such as the location, depth, number of samples per location, and the laboratory analyses to be performed on each sample, as well as quality assurance/quality control (QA/QC) requirements. The Work Plan, Field Sampling Plan, and/or QAPP will generally provide some discretion in the field depending on the conditions encountered; however, significant departure from prescribed sampling activities should be discussed with and approved by the PIC/PD and/or PM.

When planning a PFAS sampling event, the following should be considered:

- *Laboratory Analysis*. The current state of practice for laboratory analysis for PFAS is continuing to evolve. The United States Environmental Protection Agency's (EPA's) third Unregulated Contaminant Monitoring Rule (UCMR3) required that Method 537 be used to analyze UCMR3 samples for perfluorooctanoic acid (PFOA), perfluorooctane sulfonic acid (PFOS), and four other PFAS in drinking water. Since then, Method 537.1 has been developed to quantify 18 PFAS in drinking water (including HFPO-DA or "GenX") using solid phase extraction (SPE) and liquid chromatography/tandem mass spectrometry (LC/MS/MS). EPA has also developed Method 533 to quantify 25 PFAS in drinking water by isotope dilution, anion exchange, SPE, and LC/MS/MS.

  The EPA is currently in the process of validating laboratory methodology for analysis of PFAS in non-drinking water matrices, including surface water, groundwater, wastewater, and solids. For non-drinking water samples, some U.S. laboratories have been commonly using "modified" methods based on Method 537.1. These modified methods often lack consistent sample collection or analytical guidelines and have not been validated or systematically assessed for data quality by a regulatory agency. However, most well-known laboratories can provide analysis of non-drinking water matrices using a modified Method 537.1 where the precision and accuracy are typically suitable to meet Ramboll's project objectives, with reporting limits typically in the ng/L or micrograms per kilogram (ug/kg) range for liquids and solids, respectively. For analyzing matrices other than drinking water, regulatory acceptance may be enhanced if the laboratory complies with quality control requirements provided in Table B-15 of the United States Department of Defense and Department of Energy Consolidated Quality Systems Manual (QSM) for Laboratories Version 5.3 dated 2019 (or later).

  As of the date of this document, EPA is currently developing several analytical methods for media other than drinking water, including:

  - **Method 8327**, which is designed to measure a group of 24 PFAS compounds in groundwater, surface water, and wastewater samples and is expected to:
    - Incorporate direct injection instead of SPE.
    - Retain LC/MS/MS for analyte resolution.
    - Not incorporate isotope dilution.
    - Be similar to American Society for Testing and Materials (ASTM) Method D7979 (a currently validated method for non-potable media).
    - Include a 24-analyte target compound list, including HFPO-DA ("Gen-X").
    - Allow sample holding times of 28 days.

  - Have target quantitation limits of 10 ng/L.

- **Method 8328**, which is being developed to measure PFAS compounds in groundwater, surface water, wastewater and solid (soils, sediments, biosolids) samples expected to:
  - Retain SPE and therefore be a more complex method relative to direct injection.
  - Retain LC/MS/MS for analyte resolution.
  - Incorporate isotope dilution to account for matrix effects (e.g., sorption).
  - Intended to be more robust for complex matrices (e.g., wastewater influents, biosolids).
  - Include a 24-analyte target compound list, including HFPO-DA ("Gen-X").
  - Allow sample holding times of 28 days.
  - Have target quantitation limits of 10 ng/L.
- **Method 3512**, which is a preparation procedure for diluting non-potable water samples with an organic solvent prior to analysis by the appropriate determinative method for PFAS in order to minimize sample size and solvent usage. The method is currently an appendix to Method 8327, but is expected to eventually become a standalone method.

The laboratory methods to be used in support of a site-specific PFAS sampling program should be evaluated at the earliest stages of sampling program development, and should be discussed with the PFAS SME Team and/or the local regulatory agency(ies), as appropriate (refer to **Attachment B**).

In addition, as outlined in **Section 4.8** below, consideration for QC sampling should be discussed with the laboratory at the early stages of planning or designing a PFAS sampling program.

- *Sample Preservation*. As detailed in **Section 4.6**, Method 537.1 is a drinking water method and specifies the use of Trizma as a preservative for PFAS samples to remove any residual free chlorine. However, Trizma does not have a functional purpose for environmental samples, and **should not** be used for preservation of non-drinking water or non-chlorinated water samples. Note, however, *that laboratories will typically supply Trizma pre-preserved bottleware unless otherwise directed*. Therefore, unless Trizma is specifically required for the project *communicate early and clearly* with the laboratory to ensure that pre-preserved bottleware ***will not*** *be provided*.
- *PFAS-Free Water*. Water used for equipment decontamination should be "PFAS-free." For the purpose of this FGD, PFAS-free water is defined as water that does not contain any site-specific target PFAS analytes above laboratory detection limits. Since site or public water supplies have been identified in many instances to contain detectable levels of PFAS, confirmation of PFAS-free public water, if public water will be used for equipment decontamination on the project, through laboratory analysis should be performed prior to the commencement of work. Alternatively, laboratory-supplied and verified PFAS-free water can be used for sampling equipment decontamination.

- *Sampling Equipment*. PFAS sampling equipment can be divided into three major groups:
  - Equipment and materials to be **avoided**, which includes:
    - Polytetrafluoroethylene (PTFE), including the trademarks Teflon® and Hostaflon®.
    - Fluorinated ethylene propylene (FEP), including the trademarks Teflon® FEP, Hostaflon® FEP, and Neoflon®.
    - Polyvinylidene fluoride (PVDF), including the trademark Kynar®.
    - Polychlorotrifluoroethylene (PCTFE), including the trademark Neoflon®.
    - Ethylene-tetrafluoroethylene (ETFE), including the trademark Tefzel®.
    - Trademarks Viton®, Gore-Tex® and Decon 90® products with the term "fluoro" in the product name.
    - Waterproof field notebooks.
    - New clothing, as it may have fabric treatment applied.
    - Post-It® notes or similar.
    - Decon 90®.
  - Equipment and materials that **may be permissible** pending discussion with a PFAS SME team member, which includes:
    - Chemical or blue ice is not known to be manufactured with PFAS-containing compounds; however, its use is to be avoided because blue ice packs are typically used across multiple sites and sampling events and may cross-contaminate samples from prior exposure to PFAS.
    - Aluminum foil.
    - Low-density polyethylene (LDPE) does not contain PFAS in the raw material but may contain PFAS contamination from the manufacturing process and should be avoided unless: (a) the manufacturer certifies the LDPE as PFAS-free; (b) it has been previously tested and demonstrated not to contain PFAS; and/or (c) an equipment blank of the product has been collected before initiation of field work to confirm the LDPE product does not impart measurable PFAS mass to the sample. For example, Ramboll has found equipment blanks performed on the LDPE double-bonded tubing from Leroy Plastics (Le Roy, NY) used for operating bladder pumps has consistently yielded non-detection results.
    - Glass can sorb PFAS mass (specifically PFOS and other higher molecular weight PFSAs), potentially suppressing the analytical results. Unless alternate materials are not available, sample contact with glass surfaces should be avoided.
    - Rental equipment, pumps, pressure washers, etc., where prior uses, care of maintenance, and an understanding or control of all relevant internal parts are not known.
    - Permanent markers (e.g., Sharpies®) may be used in the staging area, but not the sampling area.

- Equipment and materials that are **preferred for use**, which include:
  - Loose-leaf paper, or notebooks that have not been coated with waterproofing materials may be used to record field notes.
  - LDPE storage bags (e.g., Ziploc®) that do not come into direct contact with the sample media may be used.
  - High-density polyethylene (HDPE), polypropylene, silicone, or acetate may be used.
  - HDPE, polypropylene, polyurethane, polyvinylchloride (PVC), silicone, stainless steel, neoprene, and nylon twine a permissible to come in contact with sampling media.
  - Alconox®, Liquinox® and Citranox® branded products may be used for equipment decontamination.
  - Waxed fabrics and well-washed cotton fabrics are preferred materials for clothing.
  - Double-bagged water ice.
  - Ball point pens or pencils are preferred for taking notes or writing in the sampling zone.
  - Hercules Megaloc® thread compound by Oatey.
  - Poly-Sal® brand drilling fluid additive/lubricant and PFAS-free pipe thread compounds that contain degradable guar gums are preferred materials to be used by drillers.

- *Field Clothing and Personal Protective Equipment*. Due to the extensive use of PFAS in many industries and products, and their unique properties in water and oil repellency, clothing (e.g., pants, jackets, boots, shoes, gloves, and jackets) and PPE may contain PFAS. During a PFAS investigation, clothing and PPE containing PFAS should be avoided to prevent cross-contamination. While preparing for sampling and to the extent reasonably possible, avoid clothing that has been advertised as having waterproof, water-repellant, or dirt and/or stain resistant characteristics as these types of clothing are more likely to have had PFAS used in their manufacturing. Consult with a PFAS SME as necessary, and allow common sense to prevail. For instance, a treated insulating undergarment used in the winter and covered by layers of well-washed over garments should be of little concern. Well-worn, treated work boots should likewise be of limited concern, provided typical care is taken to avoid excessive boot-to-equipment contact and boots are kept away from environmental samples or clean equipment when not being worn. Conversely, use of a brand-new treated rain jacket or newly treated boots should be avoided.

  Unless required by the site-specific HASP, field clothing and PPE to be **avoided** include:

  - Clothing that has recently been washed with fabric softener.
  - Coated (i.e., yellow) Tyvek®.
  - Clothing chemically treated for insect resistance and ultraviolet protection.

- Clothing that has been treated with water and/or stain resistant coatings such as:
  - Any Teflon® fabric protectors (e.g., Gore Tex)
  - Any Scotchgard™ fabric protectors
  - Bionic Finish®
  - GreenShield®
  - High-Performance Release Teflon®
  - Lurotex Protector RL ECO®
  - NK Guard S series
  - Oleophobol CP®
  - Repel Teflon® fabric protector
  - Repellan KFC®
  - Resists Spills™ and Releases Stains™
  - RUCO®
  - RUCO-COAT®
  - RUCO-GUARD®
  - RUCO-PROTECT®
  - RUCOSTAR®
  - Rucostar® EEE6
  - RUCOTEC®
  - Ultra Release Teflon®
  - Unidyne™

  The types of field clothing and PPE that are **permissible** include:

  - ▲ Latex gloves may be used if necessary to satisfy site-specific HASP requirements; however, large sampling programs should consider submitting a sample of the glove material for testing of PFAS content. Further, some regulatory agencies or states (e.g., California) prohibit the use of latex sampling gloves, and latex gloves should not be used by individuals who are sensitive or allergic to latex.
  - ▲ Weather-proof boots may be used as they are not likely to be in significant contact or proximity to sampling equipment (assuming best practices are followed).
  - ■ Powderless nitrile gloves.
  - ■ PVC or wax-coated fabrics.
  - ■ Clothing made from, containing, or treated with neoprene, polyurethane, or PVC.
  - ■ Synthetic and natural fibers (preferably cotton) that are well-laundered (more than six times with no fabric softener) clothes and cotton overalls.
  - ■ Non-coated (i.e., white) Tyvek.

- *Sun and Biological Protection*. Because sun and biological hazards (sunburn, mosquitos, ticks, etc.) may be encountered during sampling, the elimination of specific clothing materials or PPE (sunscreens and insect repellants) could pose a health and safety hazard to staff. The safety of field and contract staff must be the primary focus of decisions around site-specific field procedures and selection of sun and biological protection. With that in mind, however, any necessary deviations from this PFAS FGD must be made in consultation with a member of the Ramboll PFAS SME team.

  Ideally, rather than repellants and sunscreens, the preferences are (a) tucking pant legs into socks and/or boots to reduce exposed skin and reduce the risk of being bitten by ticks; (b) wearing well-washed, light-colored clothing to easily see ticks during field activities; and (c) wearing light-colored clothing, long sleeves, and large-brimmed hats to avoid sunburn. However, if it is necessary to use sunscreens and insect repellants, the following guidance is provided: (a) do not apply products near the sample collection

area; (b) wash hands well following application or handling of sunscreen and/or repellents, and (c) subsequently don powderless nitrile gloves for the sampling activities.

Other entities (e.g., the states of California, Michigan and New Hampshire) are constantly testing and updating products, the most recent of which have been listed below, to evaluate PFAS content. If required, sun and biological protection products **preferred for use** (however, care should be taken to use these exact products because similar products from the same brand may contain PFAS) include:

- Alba Organics Natural Sunscreen
- Aubrey Organics
- Avon Skin So Soft Bug Guard-SPF 30
- Baby Ganics
- 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
- California Baby Natural Bug Spray
- Coppertone Sport High-Performance AccuSpray Sunscreen SPF 30
- Coppertone Sunscreen Lotion Ultra Guard Broad Spectrum SPF 50
- Coppertone Sunscreen Stick Kids SPF 55
- Herbal Armor
- Jason Natural Quit Bugging Me
- Jason Natural Sun Block
- Kiss My Face
- 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+
- Neutrogena Ultra-Sheer Dry-Touch Sunscreen Broad Spectrum SPF 30
- Repel Lemon Eucalyptus
- Sawyer Permethrin
- Yes To Cucumbers
- ▲ In addition, products listed as "baby-safe, "free," or "natural" are typically PFAS-free, however any of the above products are preferred

Some sampling guidance documents recommend that personal hygiene and personal care products (PCPs; e.g., cosmetics, shampoo, sunscreens, dental floss, toothpaste, etc.) not be used prior to and on the day(s) of sampling over concerns regarding the potential presence of PFAS in these products. If sampling protocols are followed however, these items should not come into contact with sampling equipment or samples being collected, and employing best practices while sampling will minimize the potential that these products, PFAS-containing or not, bias the PFAS analytical results. The following precautions should be taken when dealing with personal hygiene or PCPs before sampling:

- Do not handle or apply PCPs in the sampling area.
- Do not handle or apply PCPs while wearing PPE that will also be worn during sampling.
- ▲ For best practices, shower at the end of the workday.
- ▲ Hair nets can be used if hair care products are a concern as a potential PFAS source.
- ■ Move to the staging area and remove PPE if applying PCPs becomes necessary.
- ■ Wash hands after the handling or application of PCPs and, when finished, put on a fresh pair of powderless nitrile gloves.

- *Food Packaging*. PFAS have been used by the paper industry as a special protective coating against grease, oil, and water for paper and paperboards, including food packaging, since the late 1950s. PFAS application for food packaging includes paper products that come into contact with food such as paper plates, food containers, bags, and wraps. In January 2016, the Food and Drug Administration banned the use of PFAS having eight or more carbon atoms (e.g., PFOA, PFOS and PFNA); however, short-chain PFAS have not been banned for use in the manufacturing of contact food materials in the U.S. and may still be present in the coating materials of some food wrappers.

  When staff require a break to eat or drink, they must remove their gloves, coveralls, and any other PPE in the staging area and move to the designated area for food and beverage consumption (e.g., the "clean zone"). When finished, staff must wash their hands, then don any coveralls or other PPE, and, lastly, put on a fresh pair of powderless nitrile gloves immediately before sampling.

  Other procedures to be followed include:

  - Avoid handling, consuming, or otherwise interacting with pre-wrapped food or snacks, carry-out food, fast food, or other food items while on-site during sampling events.
  - ■ Move to the staging area and remove PPE prior to leaving the sampling and staging areas if consuming food on site becomes necessary.

- *Filtration*. Field-filtration must be avoided as field filtering may result in potential cross contamination. Further, PFOS and higher molecular weight PFSAs may sorb onto glass filters in the field or in the lab. If field-filtered samples for PFAS or other analytes are to be collected because of a client or regulator request:

- Request clarification from the client or regulator regarding the intent of collecting filtered results (field or laboratory) and whether those results will be meaningful and/or necessary to meet the overall project goals for the PFAS sampling program.
- Use low-flow sampling to the extent practical to avoid field-filtration.
- Consider the use of centrifugation by the laboratory instead of filtration.
- If filtering cannot be avoided, do not use glass, and control for the use of field-filtration by collection of equipment blanks from the filters and filtering equipment in contact with the samples and, if possible, a spiked (positive) control provided by the laboratory.

4.2 Pre-Field Work Preparation Guidelines

Before initiating field activities, field staff should review and complete pertinent tasks identified in **FGD 2.02** (Site Preparation, Inspection and Housekeeping). Further, to the extent that non-dedicated, non-disposable equipment is to be used (e.g., water level indicator, trowel), to minimize potential cross-contamination between sampling locations (e.g., monitoring wells, soil borings), such equipment should be decontaminated before use as described in **Section 4.4** of this FGD. Used disposable equipment (e.g., tubing) that is considered investigation derived waste (IDW) should be managed in accordance with **FGD 15.01** (Waste Handling) following the sampling event.

At a minimum, the following tasks should be completed to prepare field staff for implementation of the work:

- Review and sign the site-specific HASP.
- Comply with **SPI 27**.
- Coordinate and obtain permission for site access (as necessary).
- Review the project-specific Work Plan, Field Sampling Plan, and/or QAPP, where applicable.
- Review and discuss with the PIC/PD and/or PM the proposed Work Plan, Field Sampling Plan, QAPP or other sampling and testing strategy documentation.
- Document that the equipment and materials required to complete the work have been secured and packed prior to travel.
- Confirm sampling locations.

When ordering equipment or sampling materials, be sure to specify with the rental company and laboratory representative that the equipment is to be used for a PFAS sampling program. Analytical laboratories will need to supply suitable containers without affecting the concentration of constituents in the sample. Reputable field equipment rental companies will have their own protocols for preparing and supplying equipment intended for use in PFAS sampling programs, including such things as supplying multiparameter probes and water level meters that have been modified or specially manufactured to be Teflon-free and PFAS-free. Similarly, confirm that drillers and other subcontractors are aware that the proposed field activities will include sampling for PFAS constituents, and that all materials brought on site are to be PFAS- and Teflon-free. For example, a potable or non-potable water source to

be used for equipment decontamination on a drilling program may need to be pre-tested to demonstrate that it is PFAS-free.

Particularly for large sites where equipment is driven from sampling location to sampling location, consider using two dedicated vehicles – a "dirty" vehicle used for transport and handling of ancillary equipment, and a "clean" vehicle used for transport and handling lab water, fresh tubing, ice packs, bottleware, and coolers with samples.

Prior to initiating groundwater sampling activities, field personnel should field-verify the well identity and construction against available documentation (site plans, well construction logs, etc.). Typically, groundwater sampling or testing FGDs recommend "tagging" the bottom of the well as one means to verify the correct well is being sampled. In order to minimize introduction of materials and equipment into wells during PFAS sampling, it is recommended that for PFAS sampling depth-to-water readings necessary for low-flow sampling be collected first, followed by sampling for PFAS and any other required analytes, and last of all the well bottom be "tagged" for identification verification if necessary. If the well is found to have been incorrectly sampled, discard or relabel the samples, note in the field log, and notify the PM accordingly.

If dedicated equipment is encountered inside a monitoring well, obtain depth-to-water readings prior to disturbing the equipment, remove all equipment prior to sampling, and document (with photos, recommended) equipment encountered and measures taken prior to sampling. If the equipment or materials of construction are suspected of potentially compromising the PFAS sample integrity, contact the PM and PFAS SME team. Further, prior to the commencement of the field effort, field personnel should inspect, test, and/or calibrate equipment that may be used to take field measurements (refer to **FGD 4.06**, Equipment Calibration).

A preferred sampling sequence should be established in the Work Plan, Field Sampling Plan, and/or QAPP before the sampling event to reduce the risk of cross-contamination. In general, sampling should begin in areas where PFAS concentrations are known or expected to be lowest (i.e., upgradient or farthest downgradient), proceeding systematically to areas known or expected to have the highest PFAS concentrations (i.e., source areas). Samples known to be upgradient from all source areas should be sampled first, followed by those lateral to the suspected source areas, and then by those that are farthest downgradient from the suspected sources. Remaining locations should be progressively sampled from the most distant downgradient to those closer to the known PFAS source, moving upgradient. Bear in mind "upgradient" may mean relative to groundwater movement and/or dominant air depositional directions.

When evaluating multiple aqueous media, consider carefully the order of sample collection. Assuming "typical" levels of PFAS in the environment, a multi-media sample collection scheme could be in the following order:

- Drinking water (e.g., residential wells).
- Surface water.
- Groundwater.

- Wastewater and/or leachate waters.

If collecting surface water and sediment samples, the surface water sample at a given location should be collected before the sediment sample, and the sampling should proceed from downstream sampling locations to upstream sampling locations. Since the concentration of PFAS at the air-water interface may be higher than the concentration within the water column, surface water samples should generally be collected from below the air-water interface unless defined otherwise in the Work Plan, Field Sampling Plan, and/or QAPP.

4.3 General PFAS Sampling Guidelines

This FGD provides recommended practices for sampling of environmental media for PFAS analysis in addition to those related to the sampling activity itself.

- When sampling for PFAS, avoid placing samples in direct contact with cloth surfaces inside vehicles, especially newer vehicles.

- Subcontractors, as for Ramboll staff, are required to abide to the PFAS sampling requirements and restrictions outlined in the Work Plan, Field Sampling Plan, and/or QAPP. Once on site, inspect all lubricants, detergents, and any other equipment that will or could come in contact with environmental media to confirm that the subcontractor has understood and conforms to the requirements and restrictions outlined in the Work Plan, Field Sampling Plan and/or QAPP.

- Work areas may be covered areas with plastic (HDPE or LDPE) as long as no direct contact is made with the sampled media.
- If dedicated sampling equipment is found in a well, avoid using any in-well dedicated equipment for PFAS sampling until it is established to be PFAS-free. The equipment needs should be evaluated to see if it could be a source for PFAS as follows:
  - Retrieve the equipment from the well and collect an equipment blank from the equipment.
  - Sample the well using non-dedicated equipment brought to the site for the PFAS sampling program.
- At a minimum, change gloves between each sampling location, after collecting each QC sample, and after handling any non-sampling equipment (i.e., clipboards, coolers, sample labels, etc.).

4.4 Decontamination

All non-disposable equipment to be used in a PFAS sampling event should be decontaminated prior to first use, between sampling locations, and at end of each workday as described in **FGD 14.01** (Sampling Equipment Decontamination), the project-specific Work Plan, Field Sampling Plan, and/or QAPP. In addition:

- Laboratory-supplied, PFAS-free water should be used for decontamination; commercially available deionized water in an HDPE container, or municipal drinking water, may be used for decontamination if the water is verified to be PFAS-free ahead of the field sampling program.

- Alconox®, Liquinox®, and Citranox® should be used as surfactants for equipment decontamination.
- Decon 90® should **not** be used.
- If sampling equipment requires manual scrubbing, use a polyethylene or PVC brush.
- Decontamination procedures should include a final triple-rinse with PFAS-free water.

When sampling sources (e.g., soil and/or groundwater in source areas, tanks, etc.), a more thorough decontamination should be performed between samples. In addition, increasing the frequency of equipment blanks should also be considered.

4.5 Sample Containers

As outlined in **FGD 1.02** (Sample Handling, Shipping and Chain of Custody), equipment and sample containers that will come into contact with aqueous, solid or gas media should be constructed of materials that will not affect the concentration of constituents in the sample. The sample container requirements should be outlined in the project-specific Work Plan, Field Sampling Plan, and/or QAPP.

All bottles used for PFAS sampling should come from the laboratory that will also be performing the PFAS analysis. Each sample container must be kept sealed at all times and only opened during the sample collection. The sampling container cap or lid must never be placed directly on the ground or on a surface that is not known to be PFAS-free.

The current standard is for samples to be submitted in containers (including caps/lids) made of polypropylene or HDPE. Glass sample containers should not be used due to potential loss of analyte through adsorption to glass. Most laboratories require a minimum volume of 250 milliliters (mL) to perform an analysis, with a duplicate bottle held in reserve in the event of analytical loss of the first bottle. This may change however when other methods are adopted (e.g., 15 ml vials are proposed for Method 8327, and ASTM D7979 requires the use of three vials). Coordination with the laboratory is recommended if collecting samples in an area or from a location where elevated PFAS concentrations are known or expected to occur.

4.6 Sample Preservation

Method 537.1 is a drinking water method and specifies the use of Trizma as a preservative for PFAS samples to remove any residual free chlorine. Trizma does not have a functional purpose for environmental samples and the "modified" Method 537.1 protocols of most laboratories allow for collection of non-reagent preserved samples.

For non-drinking water / non-chlorinated samples (i.e., the vast majority of samples likely to be collected at client sites), **Trizma is not to be used**. Typically, laboratories will include Trizma pre-preserved bottleware unless otherwise directed; therefore, unless Trizma is specifically required for the project, communicate early and clearly with the laboratory to ensure that pre-preserved bottleware **will not** be provided.

Although private supply wells (residential, commercial or industrial) are used for drinking water, samples collected from private groundwater wells (in the well or at the tap) **should not** be preserved with Trizma because drinking water from the well is not likely disinfected with a chlorine-containing product on a regular basis. However, it is good

practice to ask if the supply well has recently been disinfected before collecting a sample from the supply well, and if so, then Trizma should be considered for use as a preservative for that sample.

Upon receipt of sampling bottleware, field personnel should confirm receipt of the appropriate (i.e., preserved or non-preserved) bottleware. In addition, because the volume of Trizma preservative (when requested) needs to be accounted for by the laboratory when injecting internal calibration spikes into samples during sample preparation, field personnel should also confirm with the laboratory, or clearly indicate on the Chain-of-Custody record, the preservation status of the samples being shipped.

Samples should be chilled to 4°C to 6°C for preservation, using water ice that is double bagged in polyethylene plastic (i.e., Ziploc®). To avoid potential cross-contamination, reusable chemical or gel-based cooling products should not be used. Samples should be transported to the laboratory daily to maintain sample temperatures near target preservation temperatures with the limited longevity of water ice.

4.7 Sample Transport and Storage

Samples shall be handled, transported and stored in an attempt to maintain the structural integrity of the container and chemical qualities of the samples. Sample bottles should be handled as outlined in **FGD 1.02** (Sample Handling, Shipping and Chain of Custody). Samples should be kept in an ice-filled transport container during field work and covered to limit light penetration. As a typical procedure, laboratories will supply a thick plastic liner with each cooler to keep samples from contacting the inside of the cooler. Field samples and any ice are kept within the liner, which is then tucked and folded so that nothing else can contact the samples, and the Chain of Custody (COC) is placed in a polyethylene (i.e., Ziploc®) resealable storage bag that is placed on the bag and inside the cooler.

4.8 Quality Assurance / Quality Control

The QA/QC procedures should be outlined in the project-specific Work Plan, Field Sampling Plan, and/or QAPP and must be followed throughout the sample collection, processing, handling, and analysis process. In their absence, the QA/QC guidelines of **FGD 1.05** (Field Quality Control Samples) as modified below should be followed.

- *Trip Blanks*. The Trip Blank (TB) consists of a bottle of PFAS-free water that is prepared by the laboratory, shipped to the site (but not opened), and then returned to the laboratory for analysis. TBs are typically not required by regulatory agencies for PFAS analyses, and typically do not yield results meaningfully different from the field reagent blanks (below), but can be collected if requested or required by a specific agency or client.
- *Field Reagent Blanks*. Field Reagent Blanks (FRBs) should be collected during PFAS sampling events. An FRB is generated by manually pouring PFAS-free water in one sample container that is provided by the laboratory into an empty sample container that is also supplied by the laboratory in the field at the location of an environmental sample. An FRB differs from a TB in that the laboratory PFAS-free water is exposed to the sampling environment during the bottle-to-bottle transfer process. The purpose of an FRB is to quantify whether target analytes or other interferences are present in the field

environment, and can help provide insight if PFAS analytes are found in the associated Equipment Blank (EB) but not the TB.

FRBs are helpful in assessing whether the PFAS-free water supplied by the lab remains "PFAS-free" throughout the sampling event and confirming that the bottleware remains PFAS-free as well. One FRB should be collected for every 20 samples of a given medium, or once per event regardless of the number of media sampled if the sampling event is limited to one day. However, the frequency of collecting FRBs is a project-specific decision, and the location(s) of the FRB(s) should be considered in advance of the sampling event in consultation with a PFAS SME team member, with intentional bias towards location(s) where the possibility of introducing ambient PFAS is/are highest.

- *Equipment Blanks*. EBs are used to assess the potential contamination of samples by the equipment used at the site to collect those samples. To collect an EB, PFAS-free water provided by the laboratory is poured over, in, or through a particular piece of sampling equipment (for example, a new, disposable bailer, or a pump that has been decontaminated after its prior use) and collected in a sample container. Conceptually, field crews should attempt to transfer laboratory-supplied PFAS-free water to the EB sample container using the part of the equipment that comes in direct contact with the environmental samples.

  Like FRBs, one EB should be collected for every 20 samples of a given medium, or at least once per event regardless of the number of media sampled if the sampling event is limited to one day. However, the frequency of collecting EBs is a project-specific decision and when considering the number of EBs to collect, in consultation with a PFAS SME team member, thought should be given to the range of concentrations expected to be encountered (e.g., are there orders of magnitude between highest and lowest expected concentrations), the complexity of the field event (e.g., sampling of a limited number of wells, or sampling of multiple media types using multiple sampling devices and techniques), and whether EBs should be collected at the beginning, end, or randomly in the middle of the work day.

  EBs collected adequately through a sampling event can greatly increase data reliability by confirming the adequacy of decontamination methods when laboratory-reported results are consistently non-detect, and by providing insight to where, when and how any systematic issues with field procedures may have arisen if EB analytical results contain detections. For example, and as discussed in **Section 4.4**, it may be advisable to collect EBs at a higher frequency when sampling in a suspected or known source area to minimize the potential for having to qualify or discard an excessive amount of laboratory reported data.

- *Field Duplicates*. Field Duplicate (FD) samples should be collected in accordance with **FGD 1.05** (Field Quality Control Samples). In general, the frequency of FD collection for PFAS should be one per every 20 environmental samples of a given medium, or once per event regardless of the number of samples if the sampling event is limited to one day.

- *Matrix Spike and Matrix Spike Duplicates*. The Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples should be collected in accordance with **FGD 1.05** (Field Quality Control Samples), and are samples into which the laboratory adds a known mass of specific PFAS after receipt and log-in, but prior to analysis. Essentially, collecting an MS/MSD sample pair is the same as collecting two field duplicate samples at a sampling

location except that these containers are identified with the sampling location as MS and MSD samples and are not "blind" to the laboratory. Laboratories add known amounts of analytes (typically concentrations at or near the middle of the calibration range) when they perform MS and MSD analyses, so it is often most useful to use locations that are known or believed to have relatively moderate analyte concentrations for collecting the MS/MSD samples such that the laboratory results remain within the instrument calibration limits. The necessity for and frequency of collecting MS/MSD sample pairs is a project-specific decision and depends on several factors (e.g., client, regulatory agency, or regulatory program directives). However, if required or if data validation is to be performed, then a frequency of one MS/MSD sample pair for every 20 environmental samples for each medium, or once per event per sampled media if the sampling event is limited to one day, is recommended.

- *Temperature Blanks*. When used on a project, temperature blanks must be provided by the lab in a new (not previously used) sample bottle of the same type and size of the other aqueous field samples collected during the sampling program. The bottle must be filled with PFAS-free water, must be labeled clearly as the temperature blank, and should remain in the cooler throughout the sampling event.

5. PRECAUTIONS AND OTHER CONSIDERATIONS

Precautions to be taken during environmental sampling for PFAS analyses are generally the same as those typically required for collection of environmental samples for other analyses. Refer to the Precautions and Other Considerations Section of relevant FGDs for the specific sampling activity being performed. For PFAS sampling, the following additional considerations are provided:

- There are far more individual PFAS than can be currently quantitated. Determining which PFAS to quantitate during the analysis is a project-specific determination based on several factors. One important factor to consider is guidance from the relevant regulatory agency. For example, some states have a standard PFAS list (e.g., New York is currently asking for 21 PFAS, and Michigan is currently asking for 28 PFAS). Another factor is the time period of the release and whether it was a legacy event, or possibly a more recent event where quantification of replacement chemicals (e.g., GenX instead of PFOA) could require the use of an expanded analyte list.
- Some states require that only personnel licensed or certified in the state where the work is being performed perform groundwater sampling. Therefore, state regulations and guidance governing groundwater should be consulted prior to conducting the work. In addition, local Ramboll staff should be contacted for any other regional or local requirements.

6. RECORDKEEPING

Document all sampling locations in accordance with **FGD 1.04** (Documenting Sampling Locations) and record all information in accordance with **FGD 1.01** (Field Notes and Records) and **FGD 1.03** (Data Management).

ATTACHMENT A
AVAILABLE PFAS SAMPLING REGULATORY GUIDANCE

Regulatory requirements and guidance related to the sampling and analysis of PFAS are continuously evolving. Thus, recent changes to sampling procedures, target analyte lists, or regulatory requirements in the state where sampling is to occur should be confirmed. Below are links to a representative sample of some of the more active regulatory programs and guidance information.

Consult with a PFAS SME during development of site-specific procedures for environmental sampling and/or other associated activities. In addition, consult the latest guidance or requirements from the regulatory agency of the state in which the work is to be completed, and the additional resources identified below..

US Environmental Protection Agency: https://www.epa.gov/water-research/pfas-methods-and-guidance-sampling-and-analyzing-water-and-other-environmental-media or https://www.epa.gov/pfas

CA: https://www.waterboards.ca.gov/pfas/

MA: https://www.mass.gov/info-details/per-and-polyfluoroalkyl-substances-pfas

MI: https://www.michigan.gov/documents/pfasresponse/General_PFAS_Sampling_Guidance_634597_7.pdf

NH: https://www4.des.state.nh.us/nh-pfas-investigation/

NJ: https://www.nj.gov/dep/srp/emerging-contaminants/

NY: https://www.dec.ny.gov/chemical/108831.html

PA: https://www.dep.pa.gov/Citizens/My-Water/drinking_water/PFAS/Pages/default.aspx

WI: https://dnr.wi.gov/topic/contaminants/PFAS.html

Additional Resources:

Interstate Technology & Regulatory Council: https://pfas-1.itrcweb.org/

US Department of Defense and Department of Energy: https://denix.osd.mil/edqw/documents/manuals/qsm-version-5-3-final/

ATTACHMENT B
PFAS SME TEAM

PFAS Subject Matter Expert Team		
Name	**Location**	**Primary Expertise**
Eric Wood*	Westford, MA	Litigation Support/Site Investigation
Jim Fenstermacher*	Blue Bell, PA	Site Investigation/Remediation
Linda Dell	Amherst, MA	Epidemiology
Janet Egli	Nashville, TN	Water, wastewater
Paul Hare	Albany, NY	Site Investigation/Remediation
Debra Kaden	Boston, MA	Toxicology
Matt Longnecker	Raleigh, NC	Epidemiology
Steve Luis	Irvine, CA	CST/Product Stewardship
John Newsted	Lansing, MI	Ecological Risk, Site Investigation, Transport
Mark Nielsen	Princeton, NJ	Site Investigation/Remediation
Jaana Pietari	Westford, MA	Forensics
Imants Reks	Syracuse, NY	Growth Team Lead
Sonja Sax	Amherst, MA	Epidemiology
Rebecca Siebenaler	Princeton, NJ	Human Health/Eco Risk and Due Diligence
Sarah Stoneking	Arlington, VA	CST/Site Investigation
Matthew Traister	Cincinnati, OH	Air Transport
Steve Washburn	Emeryville, CA	Litigation Support
Jason Wilkinson	Westford, MA	Site Investigation/Remediation
Annette Nolan	New South Wales, AUS	ANZ PFAS Lead
Raisa Gabriela Salvi	Sao Paulo, Brazil	South America PFAS Lead
Dorte Harrekilde	Odense, Denmark	Europe PFAS Lead
Aldo Trezzi	Milan, Italy	Europe PFAS Lead
Notes: * PFAS SME team co-leaders.		

ATTACHMENT C
PFAS PRE-SAMPLING CHECKLIST

RAMBOLL

ENVIRONMENT & HEALTH

PFAS Pre-Sampling Checklist

Site Name: _____ Task: _____

Weather (temp/precip): _____ Date: _____

Pre-Mobilization:

- ☐ The QAPP or other site-specific field guidance has been consulted for sample locations, QC sampling requirements, and sample nomenclature

Field Clothing and PPE:

- ☐ Using white Tyvek®; not using yellow Tyvek®
- ☐ Clothing has not been most recently washed with fabric softeners or other treatments
- ☐ Clothing has not been permanently chemically treated for insect resistance or UV protection
- ☐ Clothing has not been treated with materials or formulations potentially containing PTFE or other PFAS products listed in Section 4.1 of FGD 1.07
- ☐ Any personal care products, if used, have been applied outside sampling zone, hands have been washed, and new nitrile gloves are being used
- ☐ Any use of sunscreens or insect repellants is consistent with the commercial products named in Section 4.1 of FGD 1.07

Field Equipment:

- ☐ Subcontractor (e.g., driller) materials and equipment conform to the requirements of FGD 1.07
- ☐ Sampling equipment is free of PTFE and other potentially PFAS-containing components listed in Section 4.1 of FGD 1.07
- ☐ Sampling equipment is made from stainless steel, HDPE, acetate, silicon, high-density polypropylene, or nylon
- ☐ Waterproof field books, waterproof paper, and Post-It Notes® are not used
- ☐ Markers (e.g., Sharpies®) are used only in the staging area or are not used

Sample Containers:

- ☐ Water ice is in use only, not chemical (blue) ice packs
- ☐ Sample containers have been received and are made of HDPE or polypropylene
- ☐ Bottleware for non-drinking water samples do not contain preservative
- ☐ Caps are unlined and made of HDPE or polypropylene

Wet Weather (as applicable):

- ☐ Wet weather gear made of polyurethane and PVC only, or is being worn under white Tyvek® covering

Equipment Decontamination:

- ☐ On-site or off-site public or private water, if to be used for equipment decontamination, has been analyzed and is "PFAS-free," as defined in Section 4.1 of FGD 1.07
- ☐ Alconox®, Liquinox®, or Citranox® are being used as decontamination cleaning agents; Decon 90® is not being used

Food Considerations:

- ☐ Any pre-wrapped food or snacks, carry-out food, fast food, or other food items will remain in the staging area
- ☐ Any food items, will be consumed outside the sampling zone, hands will be washed, and new PPE and nitrile gloves will be used

Work Area and Vehicle Considerations:

- ☐ Work areas, including vehicle interiors if used for sample handling, are covered with HDPE or LDPE plastic to prevent contact with potentially PFAS-containing materials and surfaces

If any applicable boxes cannot be checked, describe deviations below and work with field personnel to address issues prior to commencement of that day's work. Materials present and identified as potentially containing PFAS through use of this checklist should be relocated to the support area or other area of the site away from the sampling locations and noted below.

_____ _____

Field Team Leader Name and Signature Time