PFAS Soil Site Investigation Work Plan

Superior Refinery April 26, 2018 Incident
BRRTs Number: 02-16-581317

Prepared for
Superior Refinery Company LLC

Superior Refinery

July 2020

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1 Work Plan Objective

This purpose of this work plan is to outline the approach to the investigation for the release of per and polyfluoroalkyl substances (PFAS) impacts to soil as a result of the April 26, 2018 explosion and resulting fire Incident at the Superior Refinery (Site) in which Aqueous Film-Forming Foam (AFFF) containing PFAS was utilized by emergency response personnel to extinguish the resulting fires. Superior Refining Company LLC (SRC) has prepared this work plan in response to the Wisconsin Department of Natural Resources (WDNR) request in their letter dated September 18, 2018, following the transfer of the release Incident site from the WDNR Spill Program under NR 708 to an Environmental Repair Program (ERP) site under NR 716. Initial and interim actions in response to the Incident were immediately initiated by SRC and are ongoing.

This PFAS soil site investigation work plan (SIWP) follows the previously submitted and approved hydrocarbon soil SIWP and site investigation associated with an asphalt, Therminol® and # 6 fuel oil release during the Incident (Barr, 2019). This PFAS soil-specific work plan has been developed to review and investigate potential impacts that remain after the release of PFAS compounds resulting from the use of AFFF during firefighting efforts following the Incident. As requested by the WDNR, this work plan has been developed following the requirements of NR 716 and, in particular, the site investigation scoping requirements in NR 716.07 and *Site Investigation Work Plan Checklist* (WDNR, 2019).[1]

Since the Incident, SRC has monitored PFAS in surface water collected from the Incident impacted areas and has designed and implemented and is successfully operating an interim surface water PFAS treatment system. The approach outlined in this work plan is a phased PFAS investigation strategy that will allow for collection and evaluation of PFAS investigation data in the context of the areas affected by Incident related AFFF along with the ongoing surface water monitoring and interim surface water treatment program.

This SIWP includes the following activities:

- Assess and characterize the condition of soil beneath pervious surfaces within the Incident impacted area release area(s);
- Determine the need for additional investigation, interim action(s) and/or remedial action(s); and
- Collect/assess any additional information necessary to select an interim and/or recommended remedial action.

[1] This PFAS soil site investigation work plan (SIWP) demonstrates SRC's willingness to work with the WDNR in the investigation and remediation of AFFF released during the Incident, in direct response to WDNR's position that SRC must take such actions under current legal obligations enforced by WDNR with respect to PFAS. SRC is taking these actions without waiving but expressly preserving its right to object to, challenge, or dispute WDNR's position in any regard under any existing or future asserted legal obligation as to any PFAS compounds.

2 Site Description

Figure 1 provides a location map showing the Superior Refinery and the surrounding area using the USGS 7.5-minute topographic map (NR 716.09(2)(c)). Figure 2A provides an aerial image of the facility and the restricted access (fenceline) property boundaries in relation to the surrounding features along with area private water supply wells located within 1,200 feet of the facility boundary (NR 716.07 (7). Figure 2B provides an aerial image of SRC owned property in the vicinity of the operating refinery. Figure 3A and Figure 3B provide facility features and refining operational process area details (NR 716.09 (2) (c)).

Site Information:

The Bureau for Remediation and Redevelopment Tracking System (BRRTs) Number: 02-16-581317
Facility Identification Numbers: 816009590
Superior Refinery Company LLC (SRC)
2407 Stinson Avenue
Superior, Wisconsin
Douglas County, Wisconsin
NW ¼, NW ¼ of Section 36, T49N, R14W
Latitude / Longitude: 46.690927 / 92.07179 (Facility Center)
WTM91 Coordinates: X: 361511, Y: 692726 (Facility Center)

Responsible Party:

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3 AFFF Properties and PFAS Regulatory Guidance

The purpose of this section is to outline the characteristics and nature of PFAS compounds released to the surface soils and stormwater associated with the AFFF used during the Incident and to establish the methods and site characterization principles that apply to the proposed investigation work.

3.1 AFFF and PFAS

AFFF containing PFAS is a foam intended for fighting highly-hazardous flammable liquid fires. This AFFF is typically manufactured by combining hydrocarbon foaming agents with fluorinated surfactants (ITRC, 2020a). The composition of AFFF containing PFAS has varied over the last decade depending on the manufacturer and has transitioned from the historical formulation (perfluorooctanoic acid (PFOA) and perfluorooctanesulfonate (PFOS)-based) to a fluorotelomer based product and then to a shorter carbon chained (perfluorohexane sulfonate [PFHxS]-based) formulation.

Analytical results from the surface water from the Incident showed detections of multiple PFAS formulations likely due to multiple AFFF formulations that were used during the Incident. It is assumed that longer and shorter carbon chained PFAS as well as fluorotelomers were present in the AFFF products used. This affects both the parameters to be tested for during this investigation and the understanding of the ways these PFAS compounds will interact in the environment. Short-chain PFAS are currently considered lower in toxicity and have significantly reduced bioaccumulation potential compared to long-chain PFAS (USEPA 2018).

3.2 PFAS Regulatory Guidance

The physical setting, release specifics, proximity to receptors and fate and transport characteristics will guide the sampling locations and requirements (ITRC, 2020b, 2020c). Because this family of emerging contaminants is still being studied and their sampling methods and threshold risk screening comparison criteria are not fully developed or defined by applicable regulations, it is important to identify the framework and guidelines under which the site soil characterization work will be completed.

Despite the lack of regulatory certainty, the soil investigation was designed to be consistent with NR 716 and, in particular, the site investigation scoping requirements in NR 716.07 and *Site Investigation Work Plan Checklist* (WDNR, 2019) with a reliance on the body of knowledge related to PFAS properties and their fate and transport in soils (ITRC, 2020d, 2020e).

4 Physical Setting

The information provided in this section outlines the physiographical and geological setting of the Site necessary to develop a conceptual site model (CSM) and to choose sampling methods and locations in accordance with NR 716.09 (2) e. Additional information on the CSM can be found in section 7.

4.1 Topography and Hydrology

The topography at the refinery slopes gently to the east. Surface elevations range from approximately 660 feet above mean seal level (AMSL) at the west end of the facility to 650 feet AMSL at the eastern end of the facility. The closest natural surface water body is Newton Creek, whose headwaters begin at the Newton Creek Impoundment shown on Figure 3A. The creek flows easterly about 1.5 miles to Hog Island Inlet, which connects to Superior Bay and, ultimately, Lake Superior. The SRC stormwater retention and firewater ponds are located just northwest of the Newton Creek Impoundment, near the intersection of Stinson Avenue and Bardon Avenue (Figure 3A).

Other than the refinery process unit areas which have concrete surface cover, most of the facility property is unpaved. Based on the groundwater monitoring well network across the facility and depending on the time of year, the depth to groundwater ranges from less than 1.0 to greater than 5.9 feet below ground surface (bgs). The direction of shallow groundwater flow at the refinery is easterly towards Superior Bay.

4.1.1 Geology

Surficial geology in the region consists of Pleistocene-age glacial deposits of the Miller Creek Formation (Clayton, 1984). The Miller Creek Formation is composed of clayey glacial till, wave modified till, and glacial-lacustrine deposits. The glacial-lacustrine deposits are the uppermost surficial deposits in the region and were deposited in a water-logged state during high stages of Glacial Lake Duluth with subsequent isolated erosion and proglacial stream deposition associated with what is now incised Nemadji River channel (Clayton, 1984) located approximately ¾-mile southeast of the facility.

The Miller Creek Formation overlies the Copper Falls Formation which is also a glacial till that is Pleistocene in age. The Copper Falls Formation contains sandy glacial till interbedded with sand and gravel deposited by melt-water streams (Clayton, 1984).

The regional bedrock geology consists of sandstone of the Precambrian-age Bayfield Formation. Depth to bedrock in the refinery area is greater than 150 feet (Young and Skinner, 1974).

Soil boring data previously collected at the Site indicates that a homogenous layer of red-brown lean to fat clay is present across the refinery Site which extends to depths of at least 100 feet bgs (Gannett Fleming, 2014). No sand or silt lenses were reported to have been encountered within this clay layer. Desiccation and/or freeze/thaw fractures were described to be commonly encountered in the approximately upper 7 feet of the clay till (Gannett Fleming, 2014).

Additional information regarding the regional geology was identified from nearby private water supply well construction logs obtained from the Wisconsin Geological and Natural History Survey (Appendix A). Locatable wells are shown on Figure 2A. These area water supply wells ranged in depth from 108 feet bgs to 275 feet bgs. Logs indicate that red clay is present from ground surface to depths ranging from 85 to 170 feet. The wells in areas with a thinner clay layer are located near the Nemadji River at a lower surface elevation than the other wells. A hardpan layer was listed on all of the logs as being present below the clay. The thickness of the hardpan layer ranged from 5 to 120 feet. Several of the wells were drilled into the underlying sandstone formation with depths to bedrock ranging from 161 to greater than 260 feet bgs.

4.1.2 Hydrogeology

Data from previous groundwater monitoring reports associated with the facility indicate that the general groundwater flow direction at the refinery is to the east-southeast, with a horizontal gradient of approximately 0.003 (Gannett Fleming, 2018).

The median hydraulic conductivity of the clay is reported to be 2.4×10^{-7} centimeters per second (cm/sec), and the estimated groundwater velocity at the Site was reported at approximately 0.4 centimeters per year (cm/yr) or 0.013 feet per year (ft/yr) (Gannet Fleming, 2014). The clay is almost entirely saturated, with the average depth to water is generally 3 feet bgs. Because of the low permeability of the native clay, most wells installed at the refinery take several weeks to months before water levels stabilize following installation and/or subsequent sampling events, providing further evidence of the extremely low hydraulic conductivity of the clay.

4.1.3 Potential Exposure Pathways

The potential exposure pathways for PFAS in soil and groundwater are determined by the specific properties of the PFAS compounds and the site specific characteristics of the geologic media. Because of the relatively impermeable surficial clay at the refinery, releases tend to migrate horizontally along the ground surface, rather than vertically. As outlined in the *Final Site Investigation/Remedial Action Plan* (SI/RAP) for this facility (Gannett Fleming, 2014), some migration of contaminants is possible in the surficial air-filled desiccation fractures within the clay. However, once the contamination reaches the saturated conditions at the shallow groundwater table, it is not expected to penetrate the unfractured clay because of the high entry pressure (Bradbury et al., 1985). As a result, lateral and vertical subsurface migration of contaminates is not considered a significant transport pathway. Therefore, the potential for PFAS compounds from this release to migrate in soil beyond the estimated affected area as shown in Figure 5 is relatively low. In the event PFAS enters a dissolved-phase in groundwater, transport will be with the flow of groundwater (i.e. the hydraulic gradient). As stated above, groundwater velocities in the clay are on the order of 0.013 feet per year (ft/yr). Based on this, it would take more than 76,000 years for groundwater to travel more than 1000 feet, assuming advective transport at groundwater velocity with no retardation or degradation.

Human exposure to PFAS compounds through direct or indirect contact with soil or groundwater is also low. Additionally, the refinery has internal controls in place that further minimize potential direct contact

exposure to impacted soil and groundwater. The refinery is surrounded by 24-hour per day, 7-day per week security controls that include a barbed-wire chain-linked fence, video surveillance system, and security guards. These safeguards prevent the general public from accessing any refinery area. The refinery also has an internal safe work permit program that requires any employees or contractors to obtain a safe work permit prior to working in any refinery area.

5 Facility History

The information in this section provides a summary of the facility history and previous reportable releases to soil, description of affected media, potential or known impacts to receptors and interim and immediate actions taken in response to this release.

5.1 Operational History

The Superior Refinery was constructed in 1951 by the Lake Superior Refinery Company and was sold to Murphy Oil USA, Inc. (Murphy) in 1958. Calumet Specialty Products Partners (Calumet) purchased the refinery from Murphy in October 2011. Effective November 8, 2017, Husky Superior Refining Holding Corp. (Husky Superior) purchased the refinery from Calumet and changed its legal name to SRC. The refinery's hydrocarbon processing areas remain shutdown following the April 26, 2018 Incident. SRC is currently focused on efforts to rebuild the refinery. The facility is tentatively scheduled to restart operations in 2022.

The Superior Refinery is primarily a transportation fuels and asphalt production facility. Products produced at the refinery include liquefied petroleum gases (LPGs) (propane/butane/etc.), gasoline (sub-grade/mid-grade/premium/etc.), distillates (kerosene/diesel fuels/etc.), heavy oils (#6 fuel oil/slurry oil/etc.) and asphalt (multiple grades).

The refinery-related activities occupy an area of approximately 250 acres. The total land owned by SRC at this location, including the refinery and adjacent property, is approximately 700 acres (Figure 2B). The overall facility and prominent geographical features are shown on Figure 2A and Figure 2B. Figure 3A & Figure 3B show prominent refining area detail. The topography surrounding the Superior Refinery consists of primarily open and undeveloped land to the west, north and east. Further to the west of the refinery is a Canadian Pacific rail yard and the Municipal Richard Bong Airport. To the east of the facility are residential and other commercial properties. To the south/southwest is Enbridge Energy's Superior Terminal and the Plains Midstream LPG facility. SRC also owns three aboveground storage tanks (ASTs) located on approximately 17 acres located south of the main refinery (Figure 2A) and adjacent to the Enbridge Terminal property.

5.2 History of Reportable Releases to Soil

As per NR 716.07 (3) this section provides a summary of the historical reportable releases to pervious surfaces at the facility. These sites have either received closure from WDNR or require ongoing monitoring and/or cleanup. More details regarding individual historical release sites can be found in previously submitted correspondence to the WDNR.

Past interim actions, site investigations and closures have followed the requirements of NR 708 and NR 716. To increase efficiency and streamline reporting for refinery release sites, a WDNR approved facility-wide SI/RAP (Gannett Fleming, 2014) was developed and became effective April 4, 2018. This SI/RAP was used as the basis for a Negotiated Agreement between SRC and the WDNR to establish a hydrogeologic performance standard to address the groundwater pathway associated with new and/or newly discovered

historical petroleum releases at the facility. One result of the Negotiated Agreement was the installation of a network of 23 groundwater wells and 8 piezometers for monitoring overall groundwater quality (Figure 4). Twice per year, starting in 2015, all groundwater wells and piezometers in the network are gauged (to check for non-aqueous phase liquids (NAPL), track seasonal changes in water levels, and prepare groundwater contour maps), and the perimeter wells and piezometers are purged and sampled for petroleum volatile organic compounds (PVOCs) plus naphthalene. As a result of the SI/RAP and associated Negotiated Agreement, the WDNR created a single, new refinery-wide ERP site designation (BRRTs Number 02-16-559511) that covers most petroleum releases that have occurred within the facility boundary.

According to information summarized in the SI/RAP (Gannett Fleming, 2014), the soil vapor exposure pathway has not been evaluated at any of the previously closed or currently active petroleum release locations. This decision was approved by the WDNR since these releases are located within, or adjacent to, the refinery's tank farm and the only structures in these release areas are the ASTs. No structures designed for human occupancy are present within 30 feet of known areas of petroleum-contaminated soil or groundwater (WDNR, 2018a) (Gannett Fleming, 2014). In addition, most petroleum product transfer lines are above grade, therefore, a vapor migration pathway of concern is not likely to exist.

5.3 April 2018 Incident

An Incident occurred at the Superior Refinery on April 26, 2018 while shutting down for a refinery-wide maintenance turnaround. Debris from the initial Incident punctured asphalt storage Tank 101 resulting in a release of asphalt that later ignited, causing significant damage in much of asphalt tank farm and also within multiple hydrocarbon processing units. During the Incident, fire also caused damage to piping that contained Therminol® and #6 fuel oil in the Asphalt Tank Farm, some of which was released at the approximate locations shown on Figure 5. The fire was later extinguished on the same day using a combination of water and AFFF which contained PFAS compounds.

The estimated extent of the release to pervious surfaces has been identified as the affected area outlined in red on Figure 5. Some of the water used for firefighting efforts flowed to the north ditch along Stinson Avenue, carrying with it dilute amounts of hydrocarbons and firefighting foam chemicals. The estimated release volumes are summarized in the table below.

Substance Released	Source	Estimated Release Volume	Potential Contaminants of Concern
Asphalt	Damage to Tank 101	17,000 bbls	Petroleum Hydrocarbons
Therminol®	Damaged Piping	42 bbls	Petroleum Hydrocarbons
#6 Fuel Oil	Damaged Piping	11 bbls	Petroleum Hydrocarbons
Aqueous film forming foam (AFFF)	AFFF Firefighting Foam	3,000 gallons*	Per and polyfluoroalkyl substances (PFAS)

bbls = barrels (1 bbl = 42 gallons)
* = Volume of AFFF used during the 4/26/18 Incident response

5.4 Interim Actions

In response to the Incident, immediate and interim actions were initiated. During the response, SRC closed the underflow weir located in the Stinson Avenue ditch and installed six (6) diesel powered pumps adjacent to the Stinson Avenue underflow weir to pump the ditch flow material into the on-site stormwater and firewater retention ponds. Once the fire was extinguished on April 26, 2018 and deemed safe to do so, SRC also installed sand berms inside the facility property boundaries to prevent additional Incident impacts from migrating off property. Following the immediate Incident response actions, recovery actions were initiated to address each of the released substances listed above. A brief summary of these recovery actions and their current status is summarized below. Documentation of the recovery, assessment, treatment and/or disposal of contaminated materials will be summarized in a subsequent submittal.

5.4.1 Asphalt, Therminol® and #6 Fuel Oil

Recovery of the combined asphalt, Therminol® and #6 fuel oil release was initiated shortly after the Incident, once the site was deemed safe for entry and authorization was received from the Incident regulatory investigation teams. Recoverable liquid hydrocarbons were retained for later re-refining. Incident impacted water was contained and routed to the onsite Waste Water Treatment Plant (WWTP) and interim PFAS treatment system prior to discharge. The non-recoverable hydrocarbons consisting of comingled asphalt, Therminol® and #6 fuel oil, were characterized, excavated, and disposed of at an appropriately permitted off-site disposal facility.

The Incident clean-up, recovery and rebuild efforts have included significant removal of refining equipment and associated insulation, electrical infrastructure, concrete cover, equipment foundations and soil from both inside the Incident damaged process units and in the Asphalt Tank Farm.

The initial asphalt/Therminol®/#6 fuel oil clean-up efforts were completed on March 27, 2019 and will be documented in a subsequent submittal.

As part of the refinery rebuild efforts at the Site, several excavations were completed to removed damaged civil engineering infrastructure and accommodate the new/replacement civil engineering infrastructure. These areas included a large portion of the Fluidized Catalytic Cracking Unit (FCCU), Crude Unit and the Asphalt Tank Farm as shown on Figure 6A. The construction excavations within the Incident affected areas generally ranged between 7-8.5' bgs and were completed in late summer of 2019. Pre-characterization of these areas for hydrocarbon impacts was completed prior to soil removal and has been documented in the Site Investigation Report (Barr, 2020).

In addition, SRC continues to contain storm water from Incident impacted areas which is then treated on an interim basis through the on-site waste water treatment plant prior to discharge. This is authorized by the Superior Refinery's WWTP Permit No WI-0003085-09-0 with additional authorization provided under the WDNR general permit for petroleum contaminated water (Wisconsin Pollutant Discharge Elimination System (WPDES) Permit No. WI-0046531-06-0). Efforts associated with the immediate actions were documented in the SRC *Immediate Action Report* to the WDNR dated June 8, 2018 (SRC, 2018).

5.4.2 Aqueous Film Forming Foam (AFFF)

During the Incident, PFAS containing AFFF was used to help extinguish the fire. Incident related PFAS impacts to soil, stormwater and firefighting water at the site have and are being mitigated by controlling and treating PFAS impacted water collected in affected areas with both granular activated carbon and ion-exchange resin treatment technologies. The implementation of these interim technologies has been successful in treating the facility's Incident related effluent water to below method detection limits (<10 parts per trillion) for PFOA and PFOS (<10 parts per trillion) prior to discharge off site.
In addition to the PFAS water treatment system monitoring, surface water retention Ponds 2, 3, 4, 7, 8 and Newton Creek samples continue to be collected on a monthly basis and submitted for analysis of 24 PFAS compounds by ASTM D7979 (M) with isotope dilution. The ongoing PFAS monitoring is further described in Section 6.

This PFAS soil investigation is limited to the Incident impacted area identified as the extent of firefighting water in the asphalt tank farm containment dikes (including Tanks 106/112/114), the pervious gravel roads within the process area, including the extent of firefighting water which migrated into low-lying areas, and the northern Stinson Avenue ditch.

6 Summary of Ongoing Investigations

6.1 2019 Hydrocarbon Soil Investigation

On behalf of SRC, Barr Engineering Co. (Barr) completed a post-Incident hydrocarbon investigation to document and characterize the potential impacts to soil as a result of a release of asphalt, Therminol®, and # 6 fuel oil during the Incident. The purpose of the hydrocarbon soil investigation was to determine if residual hydrocarbon impacts to soil remained following the immediate, interim and reconstruction actions completed by SRC. The investigation focused on characterizing soil conditions in pervious surface areas located within the release area boundary.

The estimated extent of the petroleum hydrocarbon release (asphalt, Therminol®, and #6 fuel oil) to pervious surfaces included portions of the asphalt tank farm, refinery process areas, and the northern Stinson Avenue ditch (Figure 6A). Residual asphalt, Therminol®, and #6 fuel oil was recovered using vacuum trucks, hand tools, skid steer loaders and by excavation. Incident impacted stormwater continues to be contained and treated through the on-site WWTP and PFAS treatment system prior to discharge from the facility.

As outlined in the *Site Investigation Work Plan* (Work Plan; Barr, 2019), soil borings and hand augers were used to collect soil samples from within 4 feet of the ground surface in the investigation area. Soil sample locations are shown on Figure 6A. Soil samples were collected for laboratory analysis of PVOCs and polynuclear aromatic hydrocarbons (PAHs). Low level concentrations of petroleum compounds were detected in soil samples from three locations in the affected area with concentrations greater than the WDNR Groundwater Residual Contaminant Level (RCL). There were no detections above the WDNR Direct Contract Industrial RCL.

A *Site Investigation Report* was prepared (Barr, 2020) to summarize the hydrocarbon investigation results and submitted to the WDNR on February 28, 2020 for review and comment. The WDNR responded to SRC with comments related to the hydrocarbon site investigation report in a letter dated June 25, 2020 (WDNR, 2020). Based on these comments, SRC will be providing additional information to WDNR regarding the hydrocarbon investigation results and may collect additional confirmation. This additional information will be documented and provided to the WDNR in a separate addendum to the hydrocarbon investigation report.

6.2 Ongoing PFAS Surface Water Sampling and Treatment

PFAS are currently being monitored in the onsite stormwater and firefighting water retention ponds at the Site. The four onsite retention ponds that are currently being monitored include: Firewater Ponds 2/3 (conjoined), Stormwater Pond 4, and WWTP Recycle Ponds 7/8 (conjoined) (Figure 3A).

Firewater Ponds 2/3 represent the largest water storage capacity on property and are the primary supply for the refinery's firewater/deluge systems. Stormwater Pond 4 captures runoff from the Incident impacted areas of the facility and. WWTP Recycle Ponds 7/8 are utilized as recycle ponds for effluent from the onsite WWTP and can also be used for additional surge capacity for stormwater storage.

Due to the Incident, the refinery's hydrocarbon process areas are not currently in operation. Stormwater from Incident impacted areas of the facility as well as the PFAS impacted water in the onsite retention ponds are being routed and treated through the WWTP followed by a granular activated carbon (GAC) and ion exchange (IX) resin treatment system for PFAS removal. The interim PFAS Water Treatment System is authorized under the General Permit to Discharge Under the Wisconsin Pollutant Discharge Elimination System: Petroleum Contaminated Water. The interim GAC/IX PFAS treatment system was brought online in May 2018 and was approved by the WDNR in a "No-objection to temporary treatment system for water containing firefighting materials – WI-003085-08-0" letter received on June 4, 2018.

Current and historical PFAS surface water and GAC/IX water treatment system monitoring locations are shown on Figure 6B. SRC provides monitoring results to the WDNR on a monthly basis.

7 Conceptual Site Model (CSM)

A preliminary CSM was developed as part of this Work Plan as a guide to focus investigation activities in the area(s) affected by the Incident and to ensure efficient and effective data collection in support of the scientific and engineering basis for investigation decision-making. The CSM provides a framework for combining data and observations from the study area and other historical, environmental, and geological information to identify and evaluate potential risks and to guide investigation components (ITRC, 2020c, 2020e). The CSM will be updated and refined as new data is collected and the impacts of the Incident are better understood.

The preliminary CSM (Figure 7) developed for the affected area is based on existing information and is used to identify potential transport mechanisms and exposure pathways. This will help guide the selection of soil sample locations which is the focus of this Work Plan.

The Site sits in a relatively flat area and is surrounded by both developed parcels and undeveloped wetlands. As described above, surficial geology consists of a glacio-lacustrine lean to fat clay layer that extends to at least 100 feet in depth. The affected area includes the glacio-lacustrine clay layer with ground surface cover consisting of vegetation, gravel, asphalt pavement, and concrete. Groundwater in this area is present at an average depth of approximately 3 feet with an estimated velocity of approximately 0.013 feet per year (ft/yr. Stormwater and process water from Incident impacted areas collected at the refinery is treated through the WWTP & GAC/IX systems prior to discharge off site.

During the Incident, PFAS containing AFFF was used along with firefighting water to extinguish the fire. The fire-fighting water acted as a transport mechanism for PFAS, as fire-fighting water followed the existing stormwater drainage features at the facility. Surface water samples collected immediately following the Incident show the presence of PFAS in the onsite water retention ponds, as well as in surface water samples collected from Newton Creek.

8 Sampling and Analysis Plan

As described in Section 1, the objectives of this investigation are to assess the current soil conditions in the Incident impacted areas and to investigate migration pathways to assess the nature, degree and extent of PFAS impacts to determine the need for additional investigation, interim mitigation measures and/or remedial action(s). In order to accomplish these objectives, a phased investigation strategy will be implemented to collect the necessary data to characterize and evaluate the impacts of PFAS compounds related to the AFFF firefighting activities deployed during the Incident. Once this initial PFAS soil investigation phase has been completed, the CSM will be updated and, if necessary, additional investigation phases may be evaluated, designed and implemented.

8.1 Incident Impacted Release Area Assessment

The Incident and subsequent firefighting efforts resulted in the release of hydrocarbons and PFAS containing AFFF to pervious ground surfaces. These products became comingled during the Incident response and were dominantly contained onsite in containment dikes, stormwater and fire water retention ponds and/or stormwater drainage features.

The investigation of the hydrocarbon compounds was initiated in 2019 under a WDNR approved Work Plan (Barr, 2019). Results of the hydrocarbon investigation are summarized above in Section 6 and in the *Site Investigation Report* (Barr, 2020).

The proposed PFAS soil investigation will focus on the characterization of Incident impacted areas due to PFAS containing AFFF. The presumed extent of PFAS impacted areas is described in Section 5.4.2 and shown on Figure 5.

Emergency, recovery, interim and reconstruction actions which have been completed to date are summarized in Section 5.4. These actions include PFAS treatment of stormwater and process water, cleanup of residual asphalt/Therminol®/#6 fuel oil, removal and disposal of damaged process equipment and associated insulation, removal and disposal of soil from the asphalt tank farm area and construction excavations associated with the rebuild efforts.

To assess the Incident related PFAS impacts to soils, this investigation will focus on characterization of soils within 3 to 5 feet of the original ground surface with a deeper characterization soil sample to be collected at approximately 10 feet bgs to evaluate soil below the depth of the construction excavations as shown on Figure 8. Soil borings and/or hand auger borings will be completed to investigate pervious surfaces such as grassy areas, gravel roads, asphalt tank farm containment areas, and potential migration pathways along the Stinson Avenue Ditch. Soil samples will be collected from these areas for laboratory analysis. The proposed sample locations are shown on Figure 8.

Due to the Site setting and post-release actions already taken, assessment of groundwater is not proposed at this time. Soil quality data collected during this first phase of investigation will be evaluated to determine if the potential for impacts to groundwater is present, and if necessary, additional investigations will be designed to focus on groundwater.

Site stormwater is being addressed by ongoing surface & process water sampling and interim treatment for both hydrocarbon and PFAS containing AFFF. Therefore, stormwater quality will not be evaluated as a part of this PFAS soil investigation phase. A summary of stormwater sampling and treatment information to date has been provided in Section 6.

8.2 Laboratory Analysis

The Incident related PFAS released as a result of PFAS containing AFFF use during firefighting efforts included short and long-chain PFAS compounds. To determine the impact to soils in the release area, samples will be analyzed for the 24 PFAS compounds listed in Table 2 by a modified ASTM D7968 using isotope dilution.). These are the same 24 PFAS compounds currently being analyzed for at the onsite ponds, WWTP and offsite surface water receptors (Figure 6B). If evidence of petroleum hydrocarbon contamination is identified during completion of the boings or hand augers based on visual evidence and field screening, we will also be prepared to collected petroleum volatile organic compounds (PVOCs) and polycyclic aromatic hydrocarbons (PAHs) per the pervious hydrocarbon soil investigation work plan (Barr, 2019). PFAS soil sampling procedures, analytical methods and quality assurance are detailed in Section 8.5.

8.3 Data Evaluation

As described above, WDNR applies soil RCL criteria for the direct contact pathway at residential and industrial sites for several specific PFAS compounds. WDNR currently has no RCL criteria established for the soil / groundwater pathway. The current residential and industrial direct contract RCLs criteria obtained from the WDNR RCL calculator spreadsheet (WDNR, 2018b) are summarized below:

Residential Direct Contact Soil RCLs

Contaminant	CAS Number	NC RCL (mg/kg)	C RCL (mg/kg)	Not-To-Exceed D-C RCL (mg/kg)	Basis
Perfluorobutane sulfonic acid (PFBS)	375-73-5	1,260.	-	1,260.	nc
Perfluorobutanesulfonate	45187-15-3	1,260.	-	1,260.	nc
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	1.26	-	1.26	nc
Perfluorooctanesulfonate	45298-90-6	1.26	-	1.26	nc
Perfluorooctanoic acid (PFOA)	335-67-1	1.26	7.75	1.26	nc

Industrial Direct Contact Soil RCLs

Contaminant	CAS Number	NC RCL (mg/kg)	C RCL (mg/kg)	Not-To-Exceed D-C RCL (mg/kg)	Basis
Perfluorobutane sulfonic acid (PFBS)	375-73-5	16,400.	-	16,400.	nc
Perfluorobutanesulfonate	45187-15-3	16,400.	-	16,400.	nc
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	16.4	-	16.4	nc
Perfluorooctanesulfonate	45298-90-6	16.4	-	16.4	nc
Perfluorooctanoic acid (PFOA)	335-67-1	16.4	32.8	16.4	nc

Analytical data from soil samples will be compared to WDNR industrial direct contact soil RCL screening criteria to evaluate risk to human health and worker safety during future property use scenarios.

8.4 Methods

Field activities discussed in this section have been designed as an initial step to provide the necessary data for completion of the project objectives defined above. The soil PFAS investigation will be completed using a combination of soil borings and hand augers. The work may be completed in phases based on site access during rebuild efforts and analytical results. Detailed descriptions of the planned investigation activities are presented below. This section has been developed in accordance with the requirements of NR 716.09 (2) (f).

8.4.1 Project Health and Safety Plan

A project health and safety plan (PHASP) will be prepared for the investigation.

8.4.2 Standard Operating Procedures

PFAS compounds are present in many everyday items and have been widely used to produce products that are water resistant, stain resistant, heat resistant and/or oil resistant. Field personnel will be required to use specific sampling techniques, decontamination procedures, PFAS-free equipment and avoid wearing lotion, deodorant, cosmetics, sunscreen, waterproof clothing, stain-resistant clothing and clothing washed in fabric softener when completing PFAS sampling field work.

Appendix B provides the primary standard operating procedures (SOPs) that will be followed during this field investigation including Barr's SOP with specific PFAS information, *Collection of Per-and Polyfluorinated Alkyl Substances (PFAS) Samples*. Updates to this work plan and associated SOPs will be prepared as needed for each subsequent phase of investigation work.

8.4.3 Soil Borings

As part of the PFAS soil investigation, up to 13 soil borings will be completed using a hydraulic probe in the tank farm areas and refinery process areas to evaluate PFAS soil impacts in these pervious areas. Soil conditions will be evaluated within the upper five feet of the ground surface with a single deeper sample collected from 9.5 to 10 feet bgs. The samples from the upper five feet will be collected using a 5-foot

macro core sampler. The deeper 9.5 to 10 ft. sample will be collected using a dual tube or discrete sampling method to protect the deeper sample from cross-contamination. The proposed sample locations presented on Figure 8 have been chosen to provide representative coverage of the affected pervious surface areas.

Soil borings will be advanced using a push probe. Soil boring locations may vary from the planned locations (or be eliminated) depending on utility locations, accessibility in the field, or if surface or subsurface obstructions prevent boring completion. Boreholes will be backfilled according to WDNR NR 141 requirements.

8.4.4 Hand Augers

Hand auger samples will be collected from six locations along the Stinson Avenue ditch. The proposed hand auger locations shown on Figure 8 are not easily accessible by a drill rig. Sample locations will be modified or eliminated (with SRC approval) as needed depending on utility locations, accessibility in the field, or if surface or subsurface obstructions prevent boring completion. To reduce the changes of cross contamination between samples, the hand augers will be advanced using a discrete sampling method.

Hand augers will be advanced to a depth of two feet and sample collection will follow applicable Barr Engineering Co. (Barr) SOPs (Appendix B). Since some areas within the ditch may be wet throughout the year, the samples will be collected from the north (SRC) side of the ditch above the water line.

8.4.5 Soil Classification and Field Screening

Samples will be described in the field in accordance with the Universal Soil Classification System. Soils encountered will be described in accordance with ASTM-2488, *Standard Soil Practice for Description and Identification of Soils (Visual/Manual Method)*. Soil samples will be screened in the field for volatile organic vapors with a photoionization detector (PID). Additionally, soil samples will be inspected for other evidence of contamination such a staining, odors, discoloration, and/or sheen, and the observations documented on a soil boring log for each location. Depth to water will be recorded, where encountered.

The field screening techniques for soils are as follows: visual examination, distinguishable odor, headspace organic vapor screening (>10 ppm), and oil sheen. The results of these four screening procedures will be used to screen soil samples for possible hydrocarbon contamination. A PID with a 10.6 eV lamp will be used to complete soil headspace screening for each sample interval in accordance with the applicable Barr SOP (Appendix B). The PID will be calibrated or checked against a known concentration of a calibration gas standard prior to collection of field measurements. Field representatives will document the field screening activities and measurements in a project-dedicated field logbook or on field log data sheets.

8.4.6 Soil Sample Collection and Analysis

Six representative soil samples from each soil boring and three from each hand auger location will be collected for possible PFAS analysis, or a maximum of 78 soil samples. If there is observed evidence of hydrocarbon contamination based on field screening, additional samples will be collected for PVOC and PAHs per the previous hydrocarbon soil investigation work plan (Barr, 2019).

Soil samples will be collected at five vertical intervals in the upper five feet and from a deeper interval at 9.5 to 10 ft bgs from all soil borings, for a maximum of 78 soil samples. The sample intervals will be as follows: 0 to 0.3 ft., 0.5 to 1.0 ft., 1.5 to 2.0 ft., 2.5 to 3.0 ft. 4.5 to 5.0 ft and 9.5 to 10.0 ft.. The lower sample at 9.5 to 10 ft. and the two upper samples from each soil boring will be analyzed for PFAS. If impacts are documented (via laboratory confirmation) in the upper two samples, the next deeper sample will be analyzed for vertical definition. This approach will be used as needed for each deeper interval.

Three soil samples will be collected for PFAS analysis from each hand auger in the Stinson Ave Ditch area, or a maximum of 18 soil samples. The sample intervals will be as follows: 0 to 0.3 ft., 0.5 to 1.0 ft., and 1.5 to 2.0 ft. Samples collected from the upper and middle sampling intervals will be analyzed from each hand auger and if impacts are documented (via laboratory confirmation) the sample collected from deepest sampling interval will be analyzed for vertical definition.

A summary of the proposed sampling network including analytical methods and Quality Assurance/Quality Control (QA/QC) field samples is presented in Table 1. A summary of analytes, laboratory methods, method detection limits (MDL), reporting limits (RL), and criteria is presented in Table 2. Soil sample collection, collection of PFAS samples, decontamination procedures, chain-of custody documentation, and transport of samples will follow applicable Barr SOPs (Appendix B).

Appropriate sample handling and documentation procedures, as described in Barr's SOP (Appendix B), will be followed.

8.4.7 Sample Labeling and Numbering

Soil boring/test pit/hand auger locations, composite sample locations, and/or sample type will be represented by abbreviated letter designators, followed by a unique location number. Samples will be labeled according to the location from which they are collected. Standard designators are as follows: PFAS SB = soil boring; PFAS HA = hand auger; EB = equipment blank, FB = field blank, RB = rinse blank and FD = field duplicate.

8.4.8 Field Records

All field activities and data will be recorded daily in a dedicated field notebook or on dedicated field data collection forms. The Barr field technician will record work times and dates, field data (soil boring logs, field screening results, field analytical data, sample depths, water levels, etc.), project health and safety information, internal Barr communications, client communications, decision-making processes and rationale, documentation of changes to the investigation scope, and any other observations or activities relevant to the project. Field investigation information will also be recorded as appropriate on the field forms.

8.4.9 Investigation Derived Waste

Plans for investigation-derived waste are being provided in accordance with NR 716.09 (2) (f) 7. Waste generated by this investigation will be disposed of in accordance with federal, state and local regulations

and Barr's SOP: *Investigative Derived Waste*. It is anticipated that soil cuttings will be placed in the on-site soil disposal containment building (3-Sided Building).

8.4.10 Reporting

Investigation activities, analytical results and data evaluations will be summarized in an Investigation Report in accordance with NR 716.15. The report will summarize the data collected during the investigation phase and compare analytical results to current State of Wisconsin risk-screening criteria relevant to the media and facility setting, if any, and to potential worker safety during proposed construction activities. The report will include the following elements: introduction; property setting; investigation results; QA/QC procedures and results; a preliminary risk-screening evaluation; conclusions; and recommendations. Soil boring and/or hand auger boring logs and a property map showing all sampling locations and soil conditions will be developed. Laboratory reports will also be attached to the report. Recommendations for future investigation work or response action plan development will be based on the results presented in the report.

8.5 Quality Assurance / Quality Control

8.5.1 Project Data Quality Objectives

The data and investigative information generated will be used to determine impacts to soil to determine the overall nature and extent of any potential risks to human health and environment at the Site. This section has been developed in accordance with the requirements of NR 716.09 (2) (f) 5 and 6. The data will satisfy the Property Data Quality Objectives (DQOs) presented below:

- Analytical results must accurately reflect the soil quality.
- Field collection of samples for risk-based evaluations will require a high level of data quality since the sampling will be used to determine the potential risks associated with the release.
- Laboratory results must be of sufficient quality to demonstrate that the identified chemicals of concern (COCs) either do or do not present risks to human health or the environment. In most cases, for COCs with established criteria, the MDL (also referred to as limits of detection (LOD) in the State of Wisconsin) will be lower than the appropriate risked-based values and applicable State criteria. In some cases, laboratory instrumentation limitations and sample matrix may result in final MDLs greater than the associated risk standard. Guidance on how to handle these situations will be evaluated on a case-by-case basis.

8.5.2 Quality Assurance Objectives

The laboratory analyses will be used for the determination of overall compliance with project objectives. The WDNR is in the process of certifying laboratories for PFAS analysis but currently, there are no certified laboratories in Wisconsin. If available and timely for this phase of the PFAS investigation, the chosen PFAS analytical laboratory will be certified in the state of Wisconsin. If the State of Wisconsin has not certified any laboratories for PFAS analysis, a WDNR approval of the proposed laboratory will be pursued. The laboratory will ensure the production of quality analytical data by overall quality assurance systems that

are supported by documented quality control checks. The particular types and frequencies of quality control checks analyzed with samples are defined in the laboratory's SOPs and Quality Assurance Manual (QAM), which are available for review upon request. Laboratory acceptance criteria is included with each analytical report.

Quality assurance objectives (QAOs) have been established to ensure precision, accuracy, representativeness, comparability, and sensitivity (PARCCS) of laboratory analytical data and to meet the quality control (QC) acceptance criteria of analytical protocols in support of project needs. Overall, QAO procedures for field sampling, chain-of-custody, laboratory analysis, and reporting will provide the level of data required for determining the concentration of potential contaminants.

8.5.3 Precision

Precision measures the reproducibility of measurements under a given set of conditions.

8.5.3.1 Field Precision Objectives

Precision of field sampling will be assessed by comparing the analytical results between field duplicate samples. A field duplicate sample is a second aliquot of a sample generated in the field that, when collected, processed, and analyzed by the same organization, provide precision information for the entire measurement system, including: sample acquisition, sample constituent heterogeneity, handling, shipping, storage, preparation, and analysis. Field duplicate samples are submitted to the laboratory as blind (masked) samples. The relative percent difference (RPD) will be calculated using the equation below for each pair of duplicate analysis where both results are greater than five times the reporting limit.

$$RPD = \frac{|S - D|}{(S + D)/\,2}\ x\ 100$$

Where:

S = First sample value (original or matrix spike value)

D = Second sample value (duplicate or matrix spike duplicate value)

Table 4 lists the frequency and criteria for field duplicate samples.

8.5.3.2 Laboratory Precision Objectives

Precision in the laboratory is assessed through the calculation of RPDs for matrix spike/matrix spike duplicates (MS/MSD) and/or laboratory duplicates and will be analyzed at the frequency presented in Table 3. Laboratory precision criteria will be included in the laboratory's reports.

8.5.4 Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference value and measures bias in a measurement system.

8.5.4.1 Field Accuracy Objectives

Accuracy in the field is assessed through field equipment calibration and maintenance, use of field and equipment blank samples, and through the adherence to sample handling, preservation and holding time requirements. Field equipment is tested and maintained when needed using manufacturers' recommendations. Table 4 lists the frequency, description, and criteria for blank samples.

8.5.4.2 Laboratory Accuracy Objectives

Accuracy of laboratory results may be assessed using the analytical results of laboratory control samples (LCS), MS/MSD samples, extracted internal standards (EIS), and/or method blanks. The percent recovery (%R) for LCS, MS, and EIS will be calculated using the following equation: (for LCS and EIS, B is zero):

$$\%R = \frac{A - B}{C} \; x \; 100$$

Where:

A = The analyte concentration determined experimentally from the spiked sample

B = The background level determined by a separate analysis of the unspiked sample

C = The amount of the spike added

Table 3 lists the frequency and criteria for the LCS, MS, EIS, and method blank samples. Laboratory accuracy criteria will be included in the laboratory's reports.

8.5.5 Representativeness

Representativeness is defined as a measure of the degree to which data accurately and precisely represents a characteristic of a population, a parameter variation at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter that is dependent upon the proper design of the sampling program to provide samples representative of Site conditions and proper laboratory protocol. The representativeness criteria will be satisfied by following the associated work plan and by the use of proper sampling techniques and appropriate analytical procedures. Sample collection procedures (Appendix B) will describe proper sample homogenization techniques for soil samples that will aid in ensuring a sample is representative of Site conditions.

8.5.6 Comparability

Comparability is defined as the confidence with which one set of data can be compared with another. The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling methods, sample preparative procedures, analytical methods and holding times. Comparability will be satisfied by ensuring that the sample plan is followed and proper and consistent sampling techniques are used.

8.5.7 Sensitivity

Sensitivity expresses the methodology's and laboratory's ability to meet or exceed the applicable criteria. Sensitivity is dependent upon instrument sensitivity, sample matrix, and composition effects, and will be

monitored by the laboratory. Laboratory sensitivity will be assessed by comparing the analytical MDLs to the applicable criteria. Actual MDLs achieved will depend on sample size available, sample matrix interferences, dilutions, and sample percent moisture. Laboratory MDLs are listed in Table 2.

8.6 Data Reporting

8.6.1 Field Data Reporting

Field data reporting shall be conducted principally through the transmission of report sheets containing tabulated results of the measurements made in the field. Field documentation of well logs, boring logs, sample identifications, etc. will be contained in the final field reports.

8.6.2 Laboratory Data Reporting

Laboratory analyses reports will be submitted to Barr upon completion. Results will be reported to the MDL. The results between the MDL and RL will be qualified ("J") indicating estimated concentrations. As part of their report, the laboratory may qualify (flag) their data for such items as concentration between the MDL and RL, estimated concentration due to poor spike recovery, or concentration of chemical also found in the laboratory method blank. The laboratory will perform a final review of the report summaries and case narratives to determine whether the report meets project requirements. In addition to the chain-of-custody, the report format shall consist of the following:

- Date of issuance
- Project name and number
- Condition of samples upon receipt at the laboratory
- Cross-referencing of laboratory sample to project sample identification numbers
- Sample collection and receipt date
- Laboratory analysis performed
- Reference method used for analysis
- Laboratory batch number
- Sample preparation and analysis dates
- Sample results reported in the acid form (including units and percent moisture and/or solids data used in dry weight corrections, if applicable)
- Laboratory MDL and RL for each analyte
- Quality control data and acceptance criteria (including method blank results, laboratory control sample recoveries, and extracted internal standard recoveries,

- Discussion and/or qualification of any laboratory quality control checks which failed to meet acceptance criteria
- Discussion and/or qualification of any holding times that were not met
- Data qualifier definitions
- Discussion of technical problems or other observations which may have created analytical difficulties
- Any deviations from intended analytical strategy
- Signature of the laboratory project manager

8.7 Data Review

Analytical and data review procedures will be performed on the data. Data quality evaluation procedures will use the QC acceptance limits specified in the laboratory reports. The specific requirements which will be checked during data evaluation (where applicable) are:

- Holding times
- Preservation
- Blank data
- Laboratory control sample data
- Matrix spike data
- Extracted internal standard data
- Duplicate sample data

The data reviewer will identify any out-of-control data points and data omissions and interact with the laboratory to correct data deficiencies. Upon completing data review, the data reviewer will provide any qualifiers and will indicate whether the data are usable as reported, usable as an estimated concentration, or unusable.

The electronic data deliverable (EDD) sample data will be verified against the laboratory hard copy report by a Barr data technician to verify that the results in the EDD and the hardcopy report accurately reflect the data collected. The EDD will be entered into a Barr computer database and the data will be output in a spreadsheet format to be used in report data tables. Data tables are reviewed by the Barr project manager before the report is submitted to the WDNR.

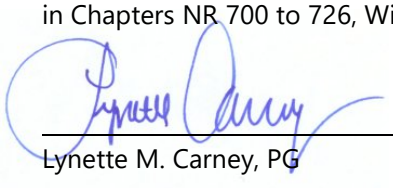
9 Schedule

Depending on site and weather conditions, the investigation activities outlined above will begin within 30-60 days of receiving WDNR approval of this work plan. However, the investigation field work will be completed in phases due to site access associated with rebuild efforts and receipt of analytical results. Following the collection of soil samples, laboratory analysis will take approximately 3 to 5 weeks to complete, depending on the number of deeper vertical samples needing analysis.

Within 90 days of receiving laboratory results from the final phase of field work, an interim investigation report will be prepared to summarize the results of this PFAS soil investigation. If necessary, this report will make recommendations for additional investigation, interim action or remedial action. Final schedules will be dependent on approval of this work plan by the WDNR, coordination with the contractors, weather conditions, facility accessibility during the refinery rebuild activities and receipt of analytical results.

10 Certifications

"I, Lynette M. Carney, hereby certify that I am a hydrogeologist as that term is defined in s. NR 712.03(1), Wisconsin Administrative 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 Chapters NR 700 to 726, Wisconsin Administrative Code."



Lynette M. Carney, PG	07/22/2020	1138
	Date	Reg. No.

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Tables

Table 1

Sample Network Summary
PFAS Soil Investigation Work Plan
Superior Refinery April 2018 Incident
Superior, Wisconsin

Sample Type	Laboratory Analytical Parameter	Laboratory Method	Estimated Maximum Number of Investigative Samples[1]	Grab Sample	Quality Assurance/Quality Control (QA/QC) Samples				
					Rinsate Blank (RB)[2]	Field Duplicate (FD)	Equipment Blank (EB)	Field Blank (FB)	Total
Equipment (e.g., acetate liner)	PFAS	ASTM D7968(M)	0	X	1	0	0	0	1
Soil Boring	PFAS	ASTM D7968(M)	78	X	0	1	1	2	82
Hand Auger	PFAS	ASTM D7968(M)	18	X	0	1	0	1	20

PFAS - Per and polyfluoroalkyl substances

Field screening parameters at each sampling location will include visual, distinguishable odor, and soil organic vapor headspace.

[1]Actual number of samples will be determined based on field observations and/or locations as described in Section 5 of the Work Plan.

[2]One blank collected per equipment type when the equipment is not known to be PFAS-free. Further information is provided in Table 4.

Table 2
Soil Analytical PFAS Compounds,Minimum Detections Limits, and Criteria
Site Investigation Work Plan
Superior Refinery April 2018 Incident
Superior, Wisconsin

Parameter	MDL/LOD (mg/kg)	RL (mg/kg)	Wisconsin Not to Exceed Direct Contact Residential RCLs (mg/kg)	Wisconsin Not to Exceed Direct Contact Industrial RCLs (mg/kg)
Per- and Polyfluorinated Alkyl Substances (PFAS) by ASTM D7968(M) w/Isotope Dilution				
Perfluorobutanoic acid (PFBA)	0.0000270	0.000100	---	---
Perfluorobutanesulfonic acid (PFBS)	0.0000115	0.000050	1260	16400
Perfluoropentanoic acid (PFPeA)	0.0000160	0.000050	---	---
Perfluoropentanesulfonic acid (PFPeS)	0.0000140	0.000050	---	---
Perfluorohexanoic acid (PFHxA)	0.0000100	0.000050	---	---
Perfluorohexanesulfonic acid (PFHxS)	0.0000070	0.000050	---	---
Perfluoroheptanoic acid (PFHpA)	0.0000140	0.000050	---	---
Perfluoroheptane sulfonic acid (PFHpS)	0.0000150	0.000050	---	---
Perfluorooctanoic acid (PFOA)	0.0000085	0.000050	1.26	16.4
Perfluorooctanesulfonic acid (PFOS)	0.0000085	0.000050	1.26	16.4
Perfluorononanoic acid (PFNA)	0.0000130	0.000050	---	---
Perfluorononanesulfonic acid (PFNS)	0.0000105	0.000050	---	---
Perfluorodecanoic acid (PFDA)	0.0000240	0.000050	---	---
Perfluorodecane sulfonic acid (PFDS)	0.0000140	0.000050	---	---
Perfluoroundecanoic acid (PFUnDA)	0.0000120	0.000050	---	---
Perfluorododecanoic acid (PFDoDA)	0.0000130	0.000050	---	---
Perfluorooctanesulfonamide (FOSA)	0.0000100	0.000050	---	---
Perfluorotridecanoic acid (PFTrDA)	0.0000115	0.000050	---	---
Perfluorotetradecanoic acid (PFTeDA)	0.0000095	0.000050	---	---
N-ethyl perfluorooctanesulfonamidoacetic acid (EtFOSAA)	0.0000195	0.000050	---	---
N-methyl perfluorooctanesulfonamidoacetic acid (MeFOSAA)	0.0000110	0.000050	---	---
4:2 FTS	0.0000110	0.000050	---	---
6:2 FTS	0.0000165	0.000050	---	---
8:2 FTS	0.0000200	0.000050	---	---

MDL/LOD - Method Detection Limit/Limit of Detection

RL - Reporting Limit

MDL/LOD and RL values are subject to change and may vary based on initial mass, dilution factor, % moisture, and possible matrix interferences. Results will be reported on a dry weight basis.

mg/Kg = nmillgram per kilogram

RCL = Residual Contaminant Level

Merit typically reports PFHxS and PFOS as linear and branched also.

Table 3
Laboratory PFAS Quality Control Samples
Site Investigation Work Plan
Superior Refinery April 2018 Incident
Superior, Wisconsin

Parameter	Frequency	Comments
Method Blank	1 per batch of 20 or fewer samples, with every analytical batch or as stated in the method, whichever is more frequent	Analyte-free media processed simultaneously with, and under the same conditions, as samples. Used to assess possible sources of laboratory contamination present at concentrations that may impact analytical results. Target analytes should not have a reportable concentration above half the method reporting limit or 1/10 the sample concentration, whichever is higher.
Laboratory Control Sample (LCS)	1 LCS per batch of 20 or fewer samples, with every analytical batch or as stated in the method, whichever is more frequent	Analyte-free media spiked with a known concentration of analyte processed with, and under the same conditions, as samples. Recovery is used to evaluate overall analytical method accuracy independent of sample matrix effects. If analyzed in duplicate, the calculated relative percent difference (RPD) is used to assess the overall analytical method precision.
Matrix Spike (MS) / Matrix Spike Duplicate (MSD)	1 MS or 1 MS/MSD set analyzed every 20 samples, where applicable	A sample spiked with a known concentration of analyte processed with and under the same conditions in order to assess the accuracy of a method in a given sample matrix. If analyzed in duplicate, the calculated RPD is used to assess the precision of a method in a given sample matrix.
Extracted Internal Standard (EIS)	Added to each sample (blanks, spiked samples, project samples, QC samples) prior to sample extraction	Isotopically labeled internal standard (exact match, if available) added prior to extraction, centrifuging, filtering, or phase separation that goes through the same sample extraction and analysis. It is used to calculate a target analyte concentration.

Table 4
Field PFAS Quality Control Samples
Site Investigation Work Plan
Superior Refinery April 2018 Incident
Superior, Wisconsin

Parameter	Frequency	Comments
Equipment Blank	1 per sampling event[1]	A sample of analyte-free water that has been collected after field decontamination of sampling equipment (not collected for hand auger) and prior to sampling the next location. It measures the potential for sample cross contamination due to insufficient decontamination. An equipment blank is not collected from disposable or dedicated equipment. Target analytes should not have a reportable concentration above half the reporting limit or 1/10 the sample concentration, whichever is higher.
Field Blank	1 per sampling event[1]	A sample of analyte-free water exposed to environmental conditions at the sampling site by transferring from one sample container to another or by removing the lid and exposing a container filled with analyte-free water to the atmosphere for the time equivalent necessary to fill a container. Collected instead of an Equipment Blank if disposable/single use sampling equipment is used. Target analytes should not have a reportable concentration above half the reporting limit or 1/10 the sample concentration, whichever is higher.
Field Duplicate	1 per sampling event[1]	Sample collected in duplicate using the same collection methods to verify reproducibility. Analyzed at the laboratory. RPD ≤ 40% for analyte concentrations > 5x the reporting limit. For analyte concentrations ≤ 5x, professional judgement used.
Rinsate Blank	Prior to equipment use unless equipment is known to be PFAS-free	A sample of analyte-free water that has been collected from the rinsing of sampling equipment. It is used to check that equipment being considered for use at a project site would not introduce the target analyte of concern to the samples being collected. Best practice is to evaluate prior to using the equipment at the project site. Target analytes should not have reportable concentrations above half the reporting limit or at levels that would impact the project samples.

[1] Sampling event is equivalent to an investigation phase (multi-day or back-to-back field event).

Figures

Douglas County

Newton Creek

Site Location

Nemadji River

Approximate SRC Property Boundaries for Contiguous Operations

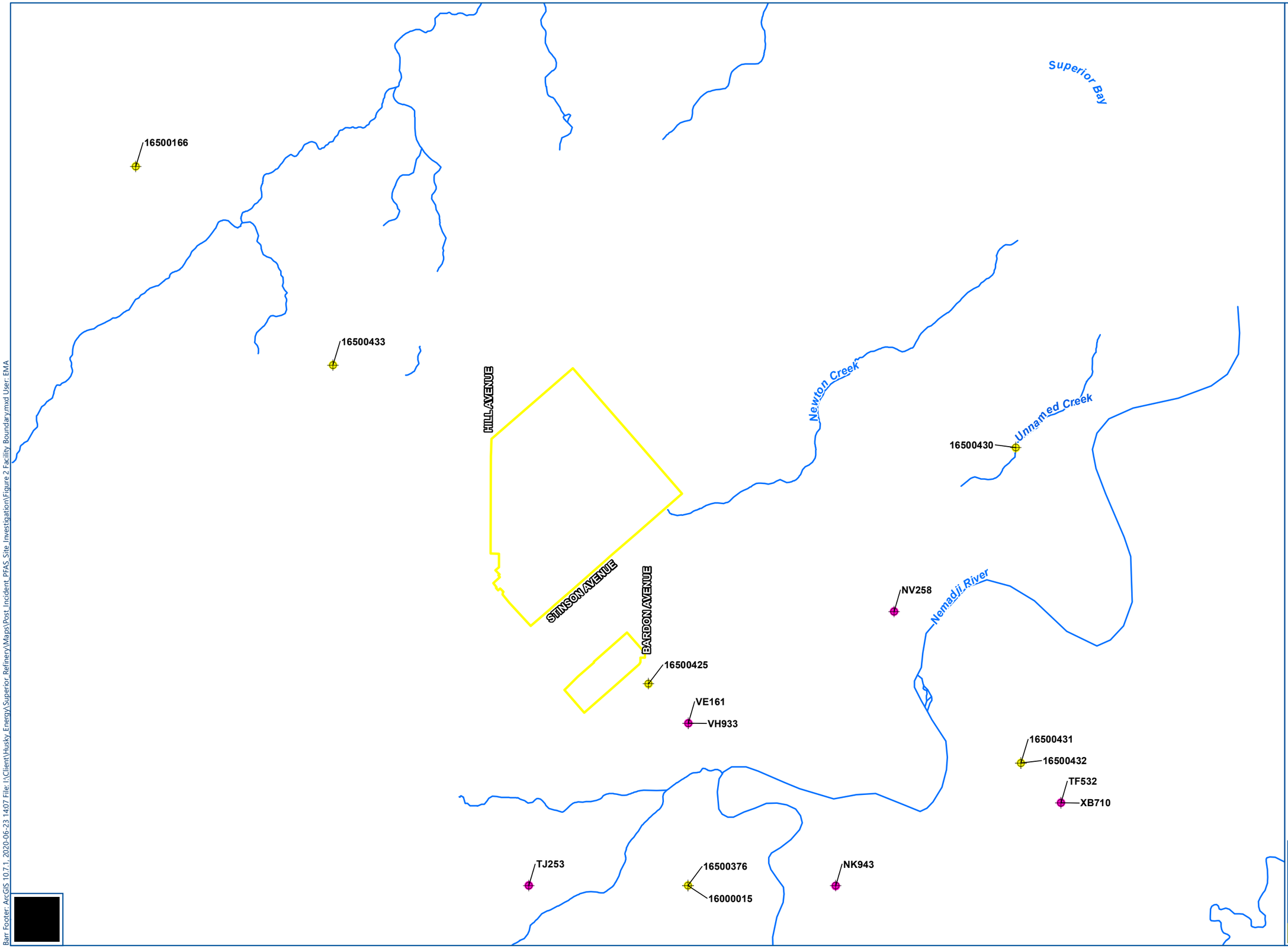
Approximate Fenceline Boundaries for Refining-Related Activities

0 750 1,500

Feet

SITE LOCATION
Superior Refining Company LLC (SRC)
Superior, WI

FIGURE 1



Approximate Fenceline Boundaries for Refining-Related Activities

Surficial Water

Private Water Supply Well (Historical)

Private Water Supply Well (Post-1989)

Note: Private water supply well locations were obtained from WDNR (post-1989) and the Wisconsin Geological Survey database (pre-1989). Creek/River data from USGS.

N

0 750 1,500

Feet

PROPERTY BOUNDARY
Superior Refining Company LLC (SRC)
Superior, WI

FIGURE 2A

Barr Footer: ArcGIS 10.7.1, 2020-06-23 14:07 File: I:\Client\Husky_Energy\Superior_Refinery\Maps\Post_Incident_PFAS_Site_Investigation\Figure 2 Facility Boundary.mxd User: EMA

Approximate SRC Property Boundaries for Contiguous Operations

Surficial Water

Superior Bay

Newton Creek

Unnamed Creek

Nemadji River

HILL AVENUE

STINSON AVENUE

BARDON AVENUE

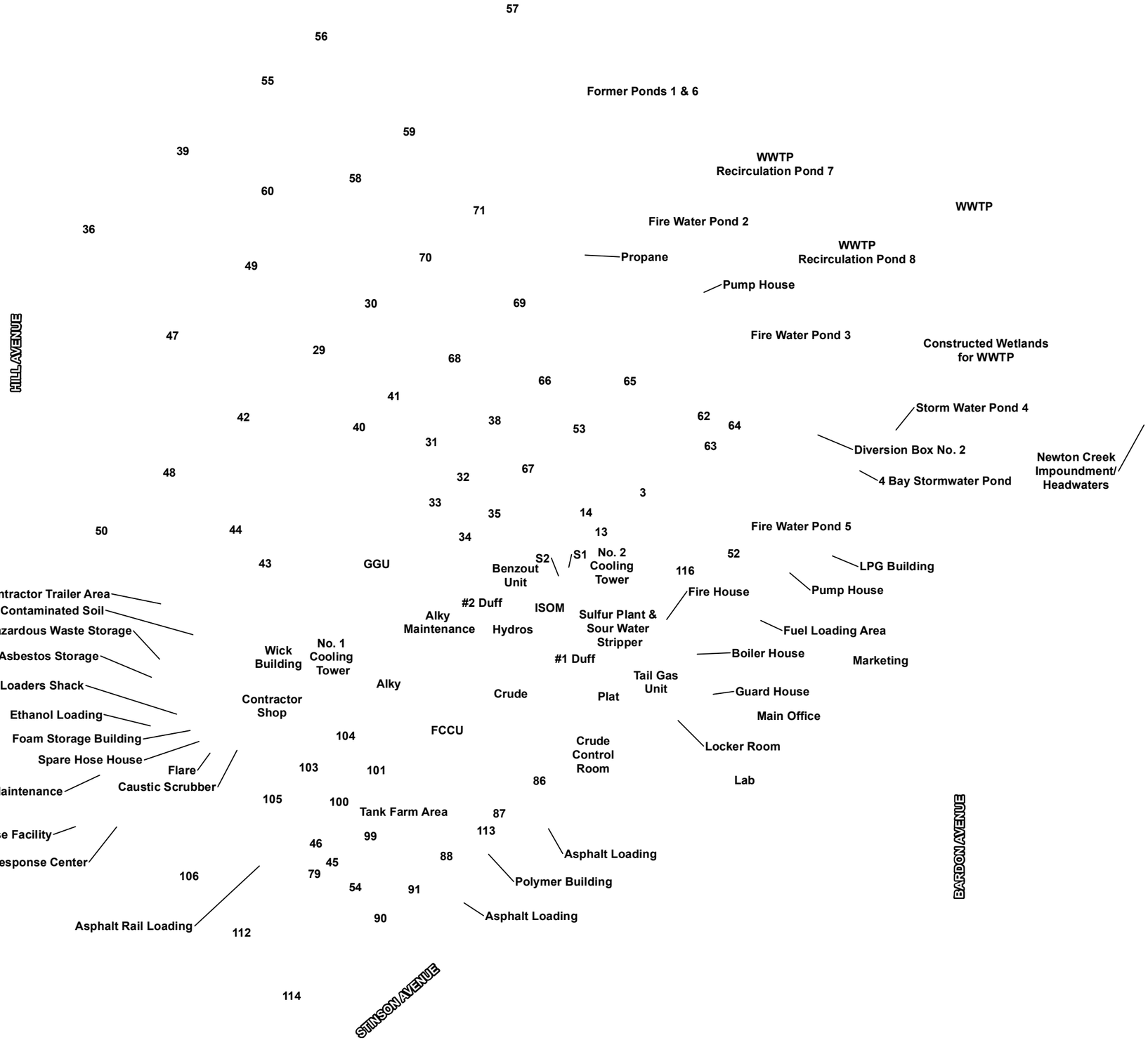
0 750 1,500

Feet

SRC OWNED PROPERTY
Superior Refining Company LLC (SRC)
Superior, WI

FIGURE 2B

Barr Footer: ArcGIS 10.7.1, 2020-07-16 11:30 File: I:\Client\Husky_Energy\Superior_Refinery\Maps\Post_Incident_PFAS_Site_Investigation\Figure 2B SRC Owned Property.mxd User: EMA



Approximate Fenceline Boundaries for Refining-Related Activities

Process Unit Battery Limits

N

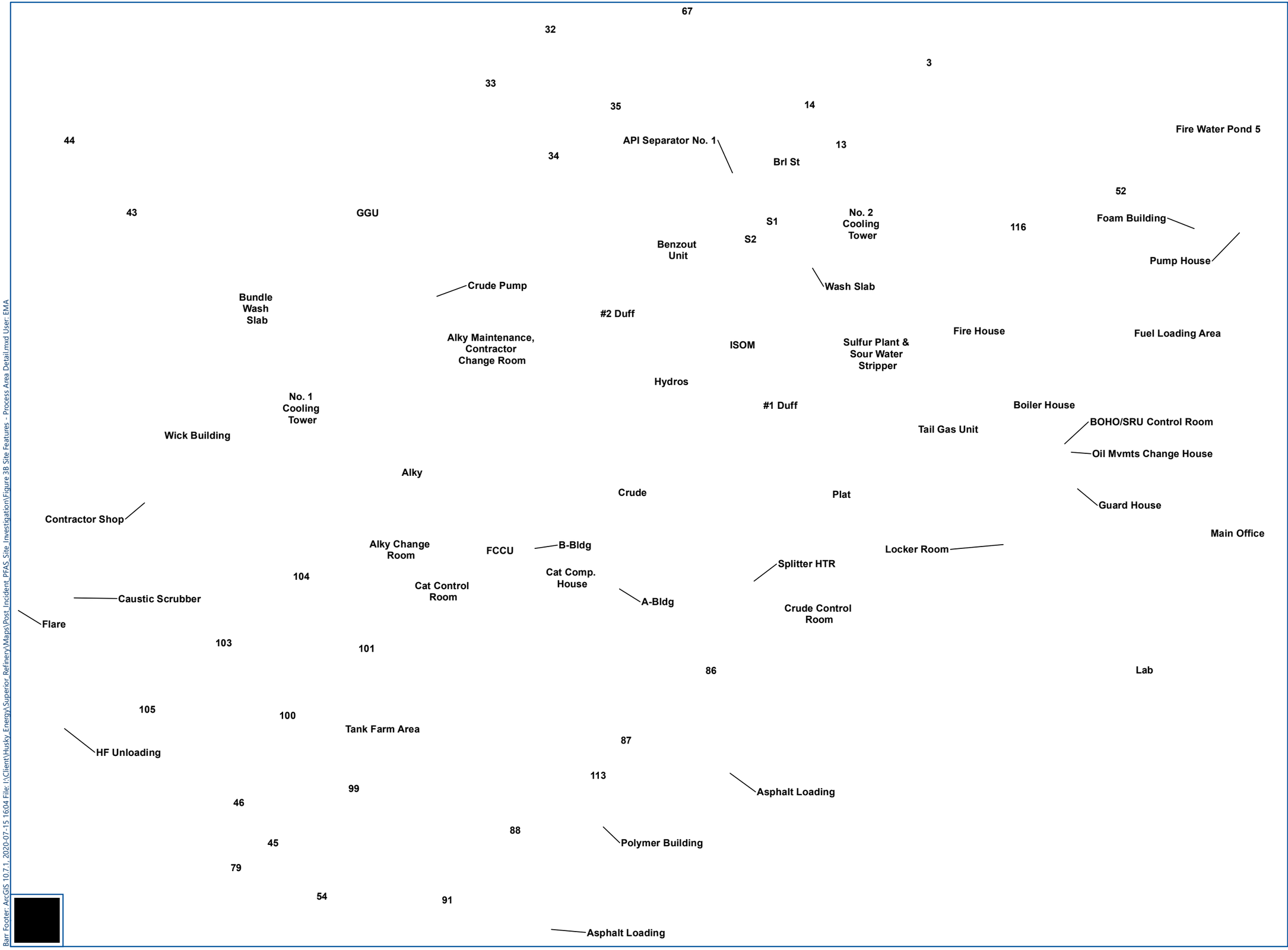
0 150 300

Feet

SITE FEATURES
REFINING-RELATED ACTIVITIES
Superior Refining
Company LLC (SRC)
Superior, WI

FIGURE 3A

Barr Footer: ArcGIS 10.7.1, 2020-07-15 16:10 File: I:\Client\Husky_Energy\Superior_Refinery\Maps\Post_Incident_PFAS_Site_Investigation\Figure 3A Site Features - Refining Related Activities.mxd User: EMA



Process Unit
Battery Limits

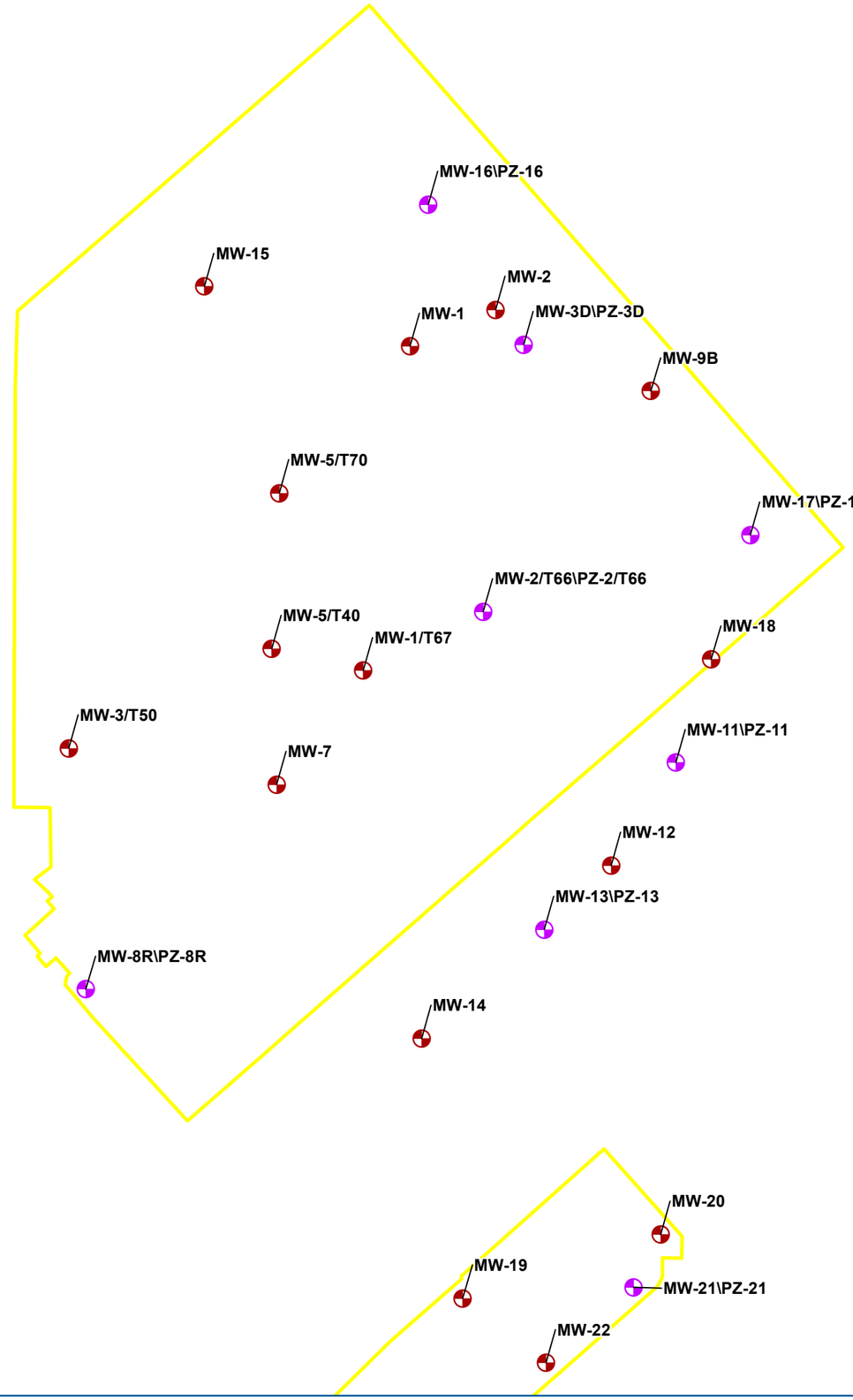
N

0 60 120

Feet

SITE FEATURES
PROCESS AREA DETAIL
Superior Refining
Company LLC (SRC)
Superior, WI

FIGURE 3B



Approximate Fenceline Boundaries for Refining-Related Activities

Existing Monitoring Well

Existing Monitoring Well & Piezometer Pair

N

0 250 500

Feet

SITE MONITORING WELL LOCATIONS
Superior Refining Company LLC (SRC)
Superior, WI

FIGURE 4

[redacted]

Barr Footer: ArcGIS 10.7.1, 2020-06-23 14:15 File: I:\Client\Husky_Energy\Superior_Refinery\Maps\Post_Incident_PFAS_Site_Investigation\Figure 4 Monitoring Well Location Map.mxd User: EMA

MW-2
MW-1
MW-3D\PZ-3D
MW-9B
MW-5/T70
MW-17\PZ-17
MW-2/T66\PZ-2/T66
MW-18
MW-5/T40
MW-1/T67
MW-3/T50
MW-11\PZ-11
MW-7
MW-12
MW-13\PZ-13
MW-8R\PZ-8R
MW-14
57 56 55 59 39 58 60 36 71 49 70 30 69 47 29 68 66 65 41 62 64 42 40 38 53 63 31 48 32 67 3 33 35 14 50 44 34 13 52 43 116 104 103 101 86 105 100 87 113 46 99 88 45 79 54 91 106 90 112 114

Existing Monitoring Well

Existing Monitoring Well & Piezometer Pair

Potential Incident Impacted Pervious Surface

Stinson Ave Ditch

Culvert

Approximate Fenceline Boundaries for Refining-Related Activities

Incident Impacted Unpaved (Pervious) Surface- Firefighting Water Storage

Incident Impacted Paved (Impervious) Surface

Incident Impacted Unpaved (Pervious) Surface

PFAS Impacted Surface Water Storage and Treatment System

Note: Release extent based on information provided to Barr by SRC.

N

0 150 300

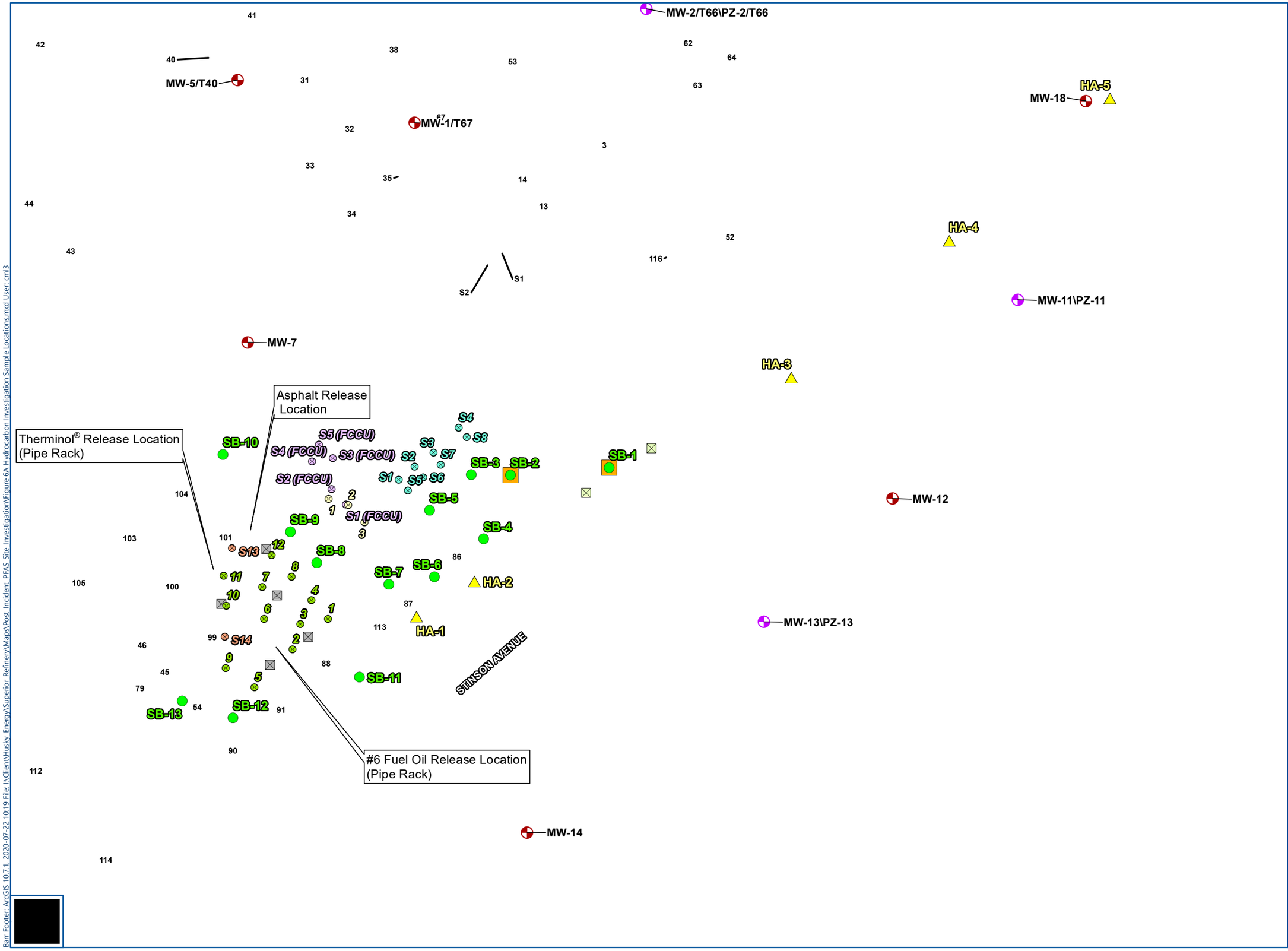
Feet

INCIDENT IMPACTED AREAS
Superior Refining Company LLC (SRC)
Superior, WI

FIGURE 5

[redacted]

Barr Footer: ArcGIS 10.7.1, 2020-07-22 10:11 File: i:\Client\Husky_Energy\Superior_Refinery\Maps\Post_Incident_PFAS_Site_Investigation\Figure 5 Affected Areas.mxd User: cml3



Approximate Fenceline Boundaries for Refining-Related Activities

Potential Incident Impacted Pervious Surface

Incident Impacted Paved (Impervious) Surface

Incident Impacted Unpaved (Pervious) Surface

Incident Impacted Unpaved (Pervious) Surface- Firefighting Water Storage

PFAS Impacted Surface Water Storage and Treatment System

Existing Monitoring Well

Existing Monitoring Well & Piezometer Pair

Stinson Ave Ditch

Culvert

Approximate Location of Refinery Rebuild Construction Excavation (7 to 8.5 ft bgs)

Soil Boring Location

Hand Auger Location

Test Pit Location

Previously Proposed Boring Locations (Removed)

Previously Proposed Boring Location (Moved)

Insight Soil Characterization Sample Locations

- Crude Unit, 5/5/2019
- FCCU Unit, 6/13/2019
- Tank Farm Unit, 6/13/2019
- Tank Farm Unit, 8/1/2019
- FCCU Unit, 11/19/2019

Note:
- Release extent based on information provided to Barr by SRC.
- Bathtub excavation limits are based on information provided to Barr by SRC.

N

0 90 180

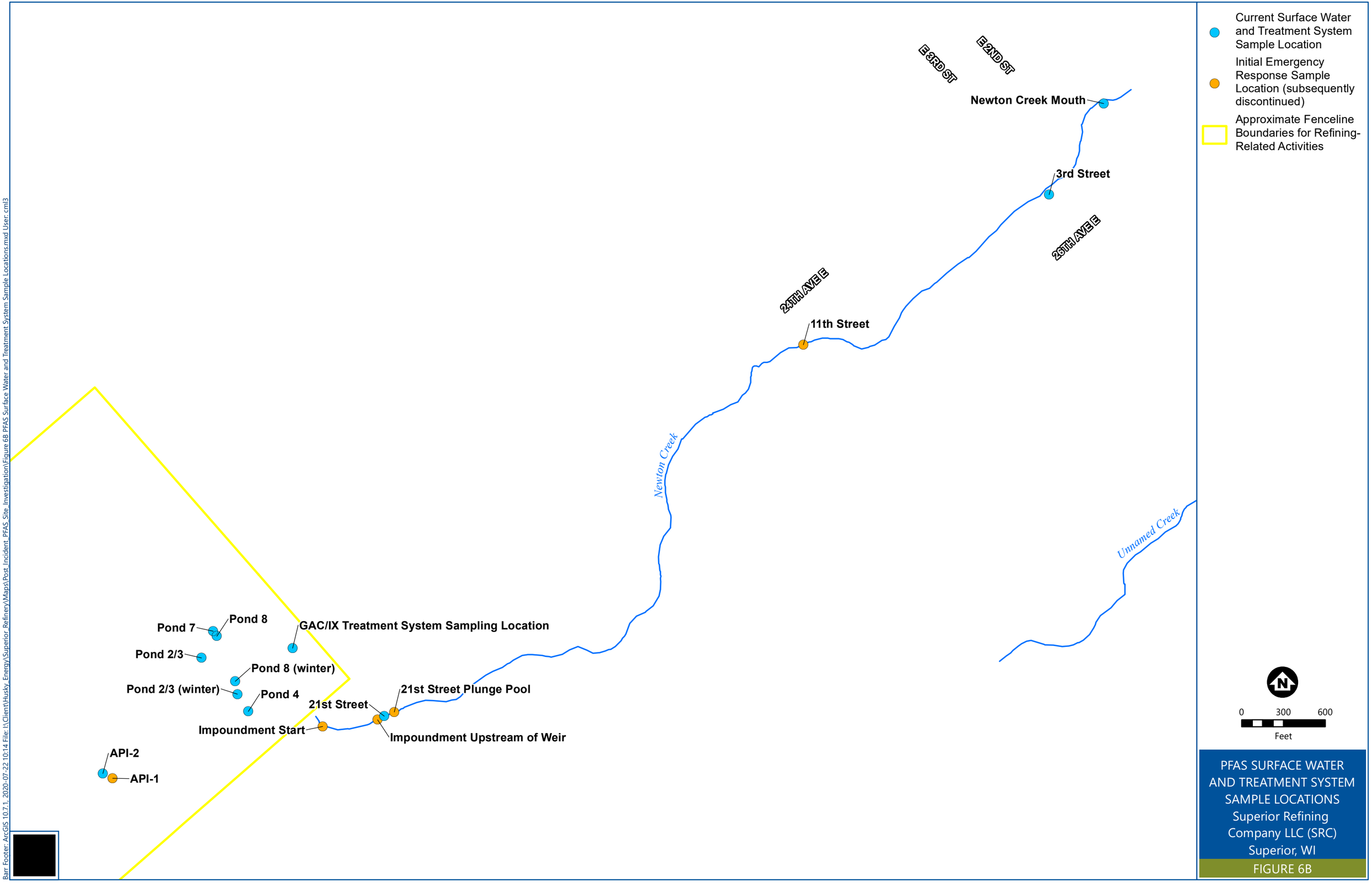
Feet

HYDROCARBON INVESTIGATION SAMPLE LOCATIONS

Superior Refining Company LLC (SRC)
Superior, WI

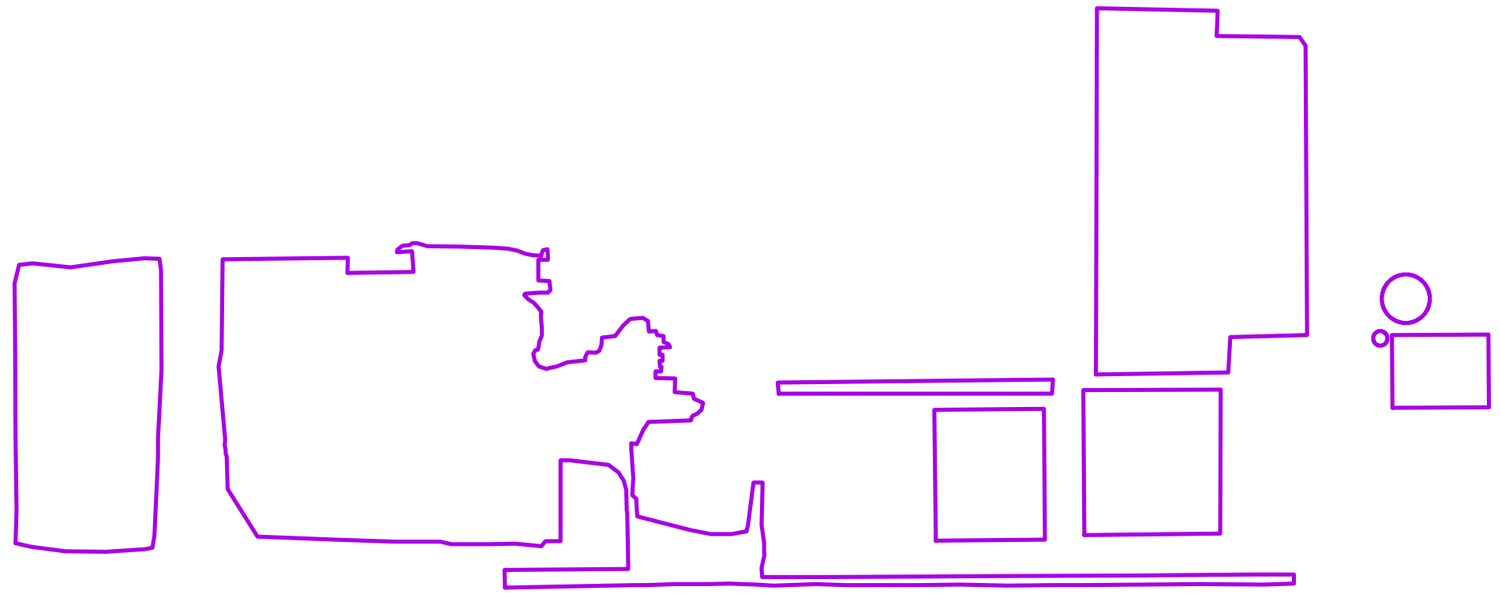
FIGURE 6A

[redacted]



PFAS SURFACE WATER AND TREATMENT SYSTEM SAMPLE LOCATIONS
Superior Refining Company LLC (SRC)
Superior, WI

FIGURE 6B



Area in contact with AFFF and/or firefighting water

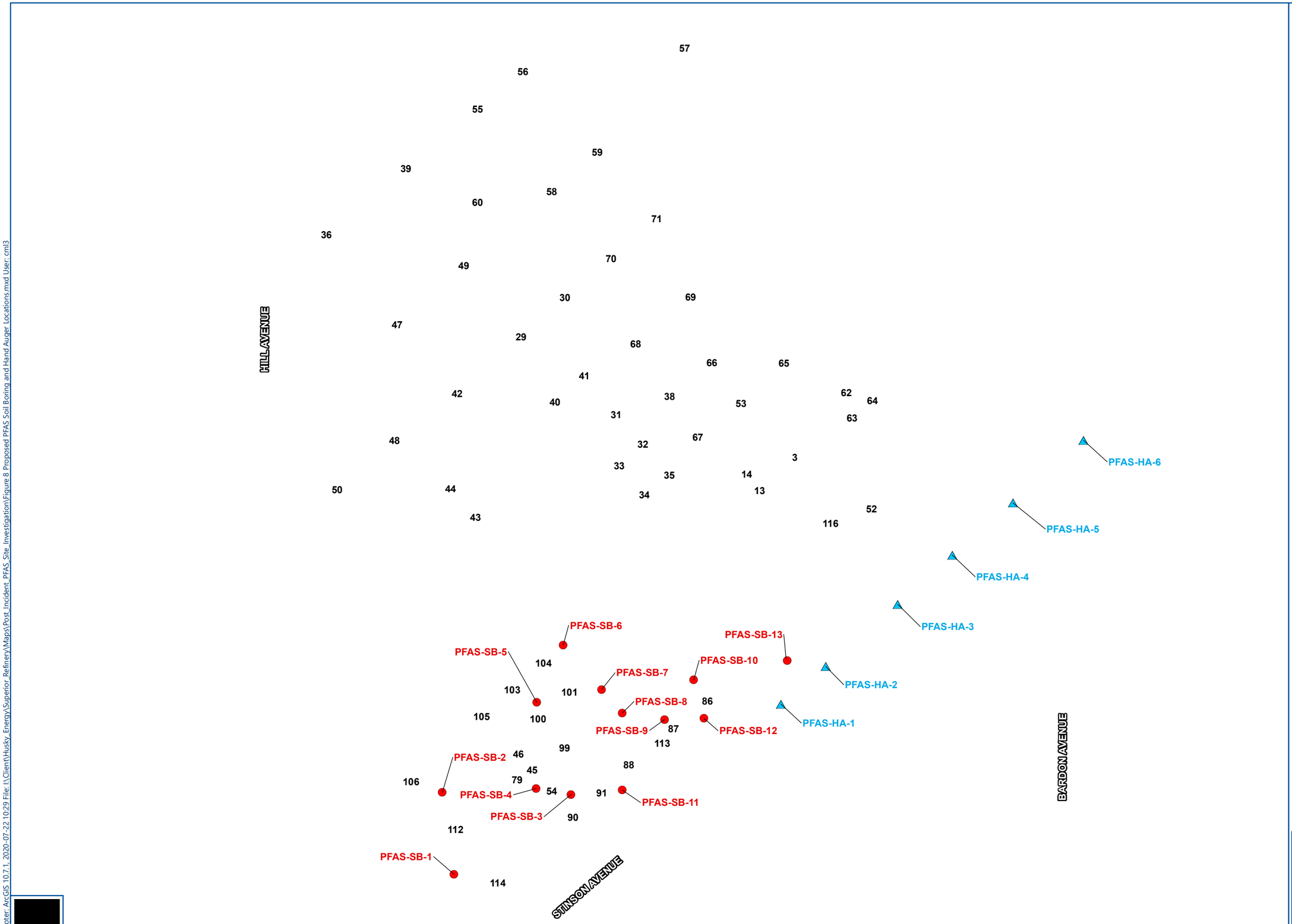
[redacted]

[redacted]

CONCEPTUAL SITE MODEL
Superior Refining Company LLC (SRC)
Superior, WI

FIGURE 7

Barr Footer: ArcGIS 10.7.1, 2020-07-22 10:37 File: I:\Client\Husky_Energy\Superior_Refinery\Maps\Post_Incident_PFAS_Site_Investigation\Figure 7 Conceptual Site Model.mxd User: cml3



PROPOSED PFAS
SOIL BORING AND
HAND AUGER LOCATIONS
Superior Refining
Company LLC (SRC)
Superior, WI

FIGURE 8

Barr Footer: ArcGIS 10.7.1, 2020-07-22 10:29 File: I:\Client\Husky_Energy\Superior_Refinery\Maps\Post_Incident_PFAS_Site_Investigation\Figure 8 Proposed PFAS Soil Boring and Hand Auger Locations.mxd User: cml3

Appendices

Appendix A

Area Well Construction Reports

1899

County Douglas Twp. 48 - Parkland Sec. 5
(Office Record—Do not fill in). Sections 5 T48N R13W

TO THE WISCONSIN STATE BOARD OF HEALTH, [redacted]
WELL DRILLING DIVISION, MADISON, WIS.

WELL LOG, PREMISES DIAGRAM, and REPORT

For Official Record of the Board.
(TO BE USED FOR THAT PURPOSE ONLY)

Owner City of Superior (If a joint ownership give names of responsible official. Also name of each individual holding an interest. Use a separate sheet and attach hereto.)
Address Superior Wisc (city, village, township, county)

Driller Maatsian Bros
Address Superior

Date of Report July 27 1936
Registration No. 232

Give below the location of the property on which well is drilled.
If incorporated village or city Superior — Name — Lot — Blk. — Kennedy St. and Winnan — Street and No.
If unincorporated hamlet — Name — County — Twp. — Highway
If Lake Shore Plat — Name of Plat — Lots — Lot — Blk. — Street
If Farm — County — Twp. 48 — Sec. 5 — Highway
If School — County — Twp. — Sec. — District
If other public building — Kind — County — Twp. — Sec.
Miscellaneous — Kind — County — Twp. — Sec.

WELL LOG and REPORT

Screens, Seals Grouts, etc.	Well Diagram (Each vertical line equals 1')	Kind of Casing, liner, shoe, etc. (Each horizontal line equals 5')	Formations State if dry or water bearing	Record of FINAL Pumping Test
Pipe shown in rock 3 ft	0 50 75 100 125 150 175 200 225 250 300 350 400 500 600 700	4in Driller's Spec Pipe Well 4in forged steel shoe 167 ft Drill hole 3 7/8 in sandstone 68 ft	Clay Red 140 ft Hard pan 24 ft sandstone 71 ft shell soft	Duration of test. Hours 12 Pumping Rate, G. P. M. 4 Depth of pump in well, Ft. 108 Standing water-level (from surface.) Ft. 50 Water level when pumping Ft. 75 Water, End of test. Check: Clear ✓ Cloudy Turbid Was well sterilized before test? Yes ✓ No Date July 25-36 To which Laboratory was sample sent? Date Was the well sealed on completion? Yes ✓ No How high did you leave casing above grade? 14 in Well was completed July 27 1936 Well Driller: Maatsian Signature. (Be sure to complete the report on the reverse side)

1899

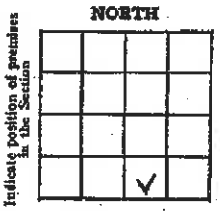
1899

PREMISES DIAGRAM

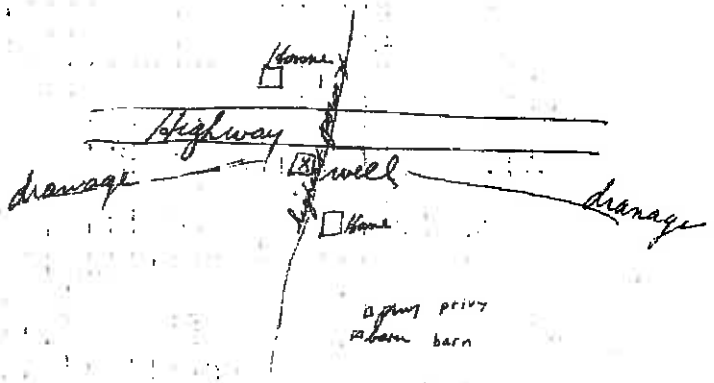
(See Rules)

Draw a representative sketch of the premises on which this well is located, showing the location of the well with reference to buildings and possible sources of pollution. Indicate the condition of the surroundings by printing descriptive words like high, low, level, slope, lake, river, swamp, forest meadow, barnyard, cesspool, privy, sewer, etc., at their respective locations and show distance from the well on the sketch. Also show direction of the compass. See Part III for specimen Diagram.

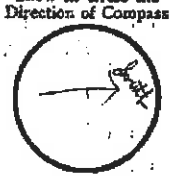
REMARKS:



Sec. 3 T. 45 R. 13 (E) (W) (Each division equals 10') (If more or less indicate: _____)



Show in circle the Direction of Compass



Note: Additional copies of this form may be obtained at 5c per copy in lots of 10 or more. Send remittance with order to State Board of Health, Well Drilling Division, Madison.

1899-2

1900

County Douglas City Twp. Superior 48 Sec. 6 1936 Bx 5

(Office Record—Do not fill in)
Section 6 T48N R13W

TO THE WISCONSIN STATE BOARD OF HEALTH, WELL DRILLING DIVISION, MADISON, WIS.

WELL LOG, PREMISES DIAGRAM, and REPORT

For Official Record of the Board.
(TO BE USED FOR THAT PURPOSE ONLY)

Owner City of Superior (If a joint partnership give name of responsible official. Also name of each individual holding an interest. Use separate sheet and attach hereto.)

Address Superior Wis (City, village, township, county)

Driller Madsen Bro

Address 1422 Ringsdell Superior

Date of Report Feb 1st 1937

Registration No. 232

Give below the location of the property on which well is drilled.

If incorporated village or city: Superior 34 E 5th St
Name | Lot | Blk. | Street and No.

If unincorporated hamlet ..... Name | County | Twp. | Highway

If Lake Shore Plat ..... Name of Plat | Lake | Lot | Blk. | Street

If Farm ..... County | Twp. 48 | Sec. 6 | Highway

If School ..... County | Twp. | Sec. | District

If other public building ..... Kind | County | Twp. | Sec.

Miscellaneous ..... Kind | County | Twp. | Sec.

WELL LOG and REPORT

Screens, Seals Grouts, etc.	Well Diagram (Each vertical line equals 1')	Kind of Casing, liner, shoe, etc. (Each horizontal line equals 5')	Formations State if dry or water bearing	Record of FINAL Pumping Test
	0 4 4 8 12 16 20 24 28	4 in special well pipe Drive shoe	Red clay 100 ft Hard pan 45 ft. sand Gravel 15 ft Coarse gravel 5 ft water bearing.	Duration of test. Hours 8 hr Pumping Rate. G. P. M. 10 gal Depth of pump in well. Ft. 90 ft Standing water-level (from surface.) Ft. 55 ft Water level when pumping Ft. 55 ft Water. End of test. Check: Clear ✓ Cloudy ____ Turbid ____ Was well sterilized before test? Yes ____ No ____ Date ____ To which Laboratory was sample sent? Superior Date ____ Was the well sealed on completion? Yes ✓ No ____ How high did you leave casing above grade? 14 in Well was completed Aug 6 1936 Well Driller's Signature. Madsen Bro (Be sure to complete the report on the reverse side)

1900

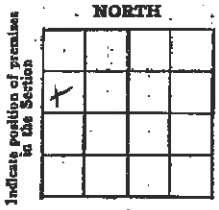
1900

PREMISES DIAGRAM

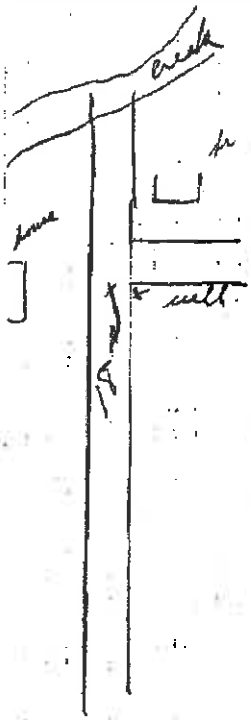
(See Rules)

Draw a representative sketch of the premises on which this well is located, showing the location of the well with reference to buildings and possible sources of pollution. Indicate the condition of the surroundings by printing descriptive words like high, low, level, slope, lake, river, swamp, forest meadow, barnyard, cesspool, privy, sewer, etc., at their respective locations and show distance from the well on the sketch. Also show direction of the compass. See Part III for specimen Diagram.

REMARKS:



Sec. 6 T. 10 R. 13 (E) (W) (Each division equals 10') (If more or less indicate: 1/2)



Show in circle the Direction of Compass

Note: Additional copies of this form may be obtained at 5c per copy in lots of 10 or more. Send remittance with order to State Board of Health, Well Drilling Division, Madison.

1900-2

DS-15-U 2065

WELL CONSTRUCTOR'S REPORT TO WISCONSIN STATE BOARD OF HEALTH

See Instructions on Reverse Side

NW, NE, Sec 1 T48N R14W

1. County Douglas (Town ☐ Village ☐ City ☑ Superior) Check one and give name

2. Location Barker ave and 58 st
Name of street and number of premise or Section, Town and Range numbers

3. Owner ☑ or Agent ☐ Lake Superior Fur Farms
Name of individual, partnership or firm

4. Mail Address 3732 E 7 st
Complete address required

5. From well to nearest: Building 4 ft; sewer ____ ft; drain ____ ft; septic tank ____ ft; dry well or filter bed ____ ft; abandoned well ____ ft.

6. Well is intended to supply water for: Fur Farm

7. DRILLHOLE:

Dia. (in.)	From (ft.)	To (ft.)	Dia. (in.)	From (ft.)	To (ft.)

8. CASING AND LINER PIPE OR CURBING:

Dia. (in.)	Kind	From (ft.)	To (ft.)
6"	steel	0	145

9. GROUT:

Kind	From (ft.)	To (ft.)

10. FORMATIONS:

Kind	From (ft.)	To (ft.)
Red clay	0	130
Muddy sand	130	135
Water sand	135	145
10 ft Johnson screen		

11. MISCELLANEOUS DATA:

Yield test: 50 Hrs. at 7 GPM.

Depth from surface to water-level: 70 ft.

Water-level when pumping: None ft.

Water sample was sent to the state laboratory at: Omaha City on ____ 19____

Construction of the well was completed on: Dec 1 19 55

The well is terminated 12 inches ☑ above, below ☐ the permanent ground surface.

Was the well disinfected upon completion? Yes ✓ No ____

Was the well sealed watertight upon completion? Yes ✓ No ____

Signature Theodore Pros Registered Well Driller

Great North Ave. Complete Mail Address

Please do not write in space below

Rec'd ____ No. ____

Ans'd ____

Interpretation ____

2065

	10 ml	10 ml	10 ml	10 ml	10 ml
Gas—24 hrs.					
48 hrs.					
Confirm					
B. Coli					

Examiner ____

DEC 8 1 1945

2066

WELL CONSTRUCTOR'S REPORT TO WISCONSIN STATE BOARD OF HEALTH

See Instructions on Reverse Side

1. County Douglas. {~~Town~~ ~~Village~~ City} Superior

2. Location NW-NE Sec 1-T48-R14W

3. Owner or Agent CAPALMI

4. Address Superior Wis

5. From well to nearest: Building 3 ft; sewer 35 ft; drain — ft; septic tank 50 ft; dry well or filter bed — ft; abandoned well — ft.

6. Well is intended to supply water for: Home

7. DRILLHOLE OR EXCAVATION:

Dia. (in.)	From (ft.)	To (ft.)
4"	0	145

8. CASING AND LINER PIPE OR CURBING:

Dia. (in.)	Kind	From (ft.)	To (ft.)
4"	Line Pipe	0	145
2x48	X 60 gauge screen + packer		

9. GROUT:

Kind	From (ft.)	To (ft.)
None		

10. FORMATIONS:

Kind	Thickness (ft.)	Total Depth (ft.)
Red CLAY	98	98
Hard pan	32	130
Dirty sand	10	140
CLEAN SAND	5	145

11. MISCELLANEOUS DATA:

Yield test: 10 Hrs. at 5 GPM.

Depth from surface to water: 57 ft.

Water-level when pumping: 65 ft.

Water sample sent to laboratory at Superior on ____ 19 45

Construction of the well was completed on April 27 19 45

The well is terminated 12 inches (above) ~~(below)~~ the permanent grade.

Was the well disinfected upon completion? Yes ✓ No ____

Was the well sealed watertight upon completion? Yes ✓ No ____

Signature Masterman Bros Wentworth Wis

Registered Well Driller — Complete Mail Address

20640

2067

RECEIVED JAN 6 1965 SANITARY ENGINEERING

WELL CONSTRUCTOR'S REPORT TO WISCONSIN STATE BOARD OF HEALTH

See Instructions on Reverse Side

1. County Douglas (Town ☒ Village ☒ City ☐) Superior — Check one and give

2. Location Section 2, T48N, R14W
Name of street and number of premise or Section, Town and Range numbers

3. Owner ☒ or Agent ☐ Elmer Craft
Name of individual, partnership or firm

4. Mail Address 214 N 58 Superior, Wis
Complete address required

5. From well to nearest: Building 4 ft; sewer 45 ft; drain None ft; septic tank None ft; dry well or filter bed — ft; abandoned well — ft.

6. Well is intended to supply water for: Home

7. DRILLHOLE:

Dia. (in.)	From (ft.)	To (ft.)	Dia. (in.)	From (ft.)	To (ft.)
8	0	20	4	20	172

8. CASING AND LINER PIPE OR CURBING:

Dia. (in.)	Kind and Weight	From (ft.)	To (ft.)
4	Steel 12#	0	172

9. GROUT:

Kind	From (ft.)	To (ft.)
Mud	0	20

10. FORMATIONS:

Kind	From (ft.)	To (ft.)
clay	0	130
hard pan	130	171
gravel	171	172

11. MISCELLANEOUS DATA:

Yield test: 16 Hrs. at 6 GPM.

Depth from surface to water-level: 65 ft.

Water-level when pumping: 80 ft.

Water sample was sent to the state laboratory at: Superior City on 8-26 1964

Construction of the well was completed on: 8-12- 1964

The well is terminated 10 inches ☒ above, below ☐ the permanent ground surface.

Was the well disinfected upon completion? Yes X No

Was the well sealed watertight upon completion? Yes X No

Signature Ivy L. Severin Registered Well Driller

Westerville Wis Complete Mail Address

Please do not write in space below

Rec'd No.

Ans'd

Interpretation

2067

	10 ml	10 ml	10 ml	10 ml	10 ml
Gas—24 hrs.					
48 hrs.					
Confirm					
B. Coli					

Examiner

Wel 6 2068

WELL CONSTRUCTOR'S REPORT TO WISCONSIN STATE BOARD OF HEALTH

See Instructions on Reverse Side

RECEIVED
JUN 25 1962
SANITARY ENGINEERING
RECEIVED
AUG 5 1962
SANITARY ENGINEERING

1. County Douglas (Town ☐ Village ☒ City ☐) Superior — Check one and give name

2. Location Section 2, T48N R14W — Name of street and number of premise or Section, Town and Range numbers

3. Owner ☒ or Agent ☐ Markus Fossnes — Name of individual, partnership or firm

4. Mail Address Superior Wis. — Complete address required

5. From well to nearest: Building 6 ft; sewer ____ ft; drain None ft; septic tank ____ ft; dry well or filter bed ____ ft; abandoned well ____ ft.

6. Well is intended to supply water for: Home

7. **DRILLHOLE:**

Dia. (in.)	From (ft.)	To (ft.)	Dia. (in.)	From (ft.)	To (ft.)
8	0	20	4	20	218

8. **CASING AND LINER PIPE OR CURBING:**

Dia. (in.)	Kind and Weight	From (ft.)	To (ft.)
4	Steel 12	0	218

9. **GROUT:**

Kind	From (ft.)	To (ft.)
Mud	0	20

10. **FORMATIONS:**

Kind	From (ft.)	To (ft.)
clay	0	130
hardpan	130	200
clay	200	216
Sand & gravel	216	218

Construction of the well was completed on: 8-25 1962

The well is terminated 12 inches ☒ above, below ☐ the permanent ground surface.

Was the well disinfected upon completion? Yes X No ____

Was the well sealed watertight upon completion? Yes X No ____

11. **MISCELLANEOUS DATA:**

Yield test: 12 Hrs. at 10 GPM.

Depth from surface to water-level: 65 ft.

Water-level when pumping: 60 ft.

Water sample was sent to the state laboratory at: Superior (City) on 8-29 1962

Signature Lyle Lercier — Registered Well Driller

Wentworth Wis. — Complete Mail Address

Please do not write in space below

Rec'd ____ No. ____

Ans'd ____

Interpretation ____

2068

	10 ml	10 ml	10 ml	10 ml	10 ml
Gas—24 hrs.					
48 hrs.					
Confirm					
B. Coli					

Examiner ____

2069

Wel 6

WELL CONSTRUCTOR'S REPORT TO WISCONSIN STATE BOARD OF HEALTH DS-14-U

See Instructions on Reverse Side

1. County Douglas — Town ☐ Village ☐ City ☑ Superior — Check one and give name

SW, SE, SE, Sec. 2 T48N R14W

2. Location East of Golf Course
Name of street and number of premise or Section, Town and Range numbers

3. Owner ☑ or Agent ☐ Harold Olson
Name of individual, partnership or firm

4. Mail Address Superior Sta B
Complete address required

5. From well to nearest: Building 18 ft; sewer none ft; drain ____ ft; septic tank none ft; dry well or filter bed ____ ft; abandoned well ____ ft. none

6. Well is intended to supply water for: Home

7. DRILLHOLE:

Dia. (in.)	From (ft.)	To (ft.)	Dia. (in.)	From (ft.)	To (ft.)

8. CASING AND LINER PIPE OR CURBING:

Dia. (in.)	Kind and Weight	From (ft.)	To (ft.)
4"	steel pipe	0	220

9. GROUT:

Kind	From (ft.)	To (ft.)

10. FORMATIONS:

Kind	From (ft.)	To (ft.)
Red Clay	0	120
Hardpan	120	220
Sandstone	220	240

RECEIVED
FEB 3 1958
ENVIRONMENTAL SANITATION

Construction of the well was completed on: May 5 19 57

The well is terminated 12 inches ☑ above, below ☐ the permanent ground surface.

Was the well disinfected upon completion? Yes ✓ No ____

Was the well sealed watertight upon completion? Yes ✓ No ____

11. MISCELLANEOUS DATA:

Yield test: 10 Hrs. at 7 GPM.

Depth from surface to water-level: 60 ft.

Water-level when pumping: None ft.

Water sample was sent to the state laboratory at:

City ____ on ____ 19____

Signature Mastran Bros
Registered Well Driller

Crentsworth Wis
Complete Mail Address

Please do not write in space below

Rec'd ____ No. ____

Ans'd ____

Interpretation ____

2069

	10 ml	10 ml	10 ml	10 ml	10 ml
Gas—24 hrs.					
48 hrs.					
Confirm					
B. Coli					

Examiner ____

2070

WELL CONSTRUCTOR'S REPORT TO WISCONSIN STATE BOARD OF HEALTH

See Instructions on Reverse Side

RECEIVED
JAN 22 1949
BUREAU SAN. ENG.

1. County Douglas — Town ☐ Village ☐ City ☐ South Superior — Check one and give name

2. Location NE ¼ of SE ¼ of Sec 2 T 48 N, R 14 W, R - 14 — Name of street and number of premise or Sec. Tn. and R. numbers

3. Owner ☑ or ☐ Fred Heim — Name of individual, partnership or firm

4. Mail Address South Superior — Complete address required

5. From well to nearest: Building 12 ft; sewer 60 ft; drain None ft; septic tank None ft; dry well or filter bed None ft; abandoned well None ft.

6. Well is intended to supply water for: Home

7. DRILLHOLE:

Dia. (in.)	From (ft.)	To (ft.)
5	0	184

8. CASING AND LINER PIPE OR CURBING:

Dia. (in.)	Kind	From (ft.)	To (ft.)
5	Std pipe	0	184
2	screen	184	187

9. GROUT:

Kind	From (ft.)	To (ft.)
puddled clay	0	184

10. FORMATIONS:

Kind	From (ft.)	To (ft.)
Red clay	0	140
Red hard pan	140	184
clean water sand	184	187

11. MISCELLANEOUS DATA:

Yield test: 10 Hrs. at 7 GPM

Depth from surface to water: 126 ft.

Water-level when pumping: 130 ft.

Water sample sent to laboratory at Superior on July 15 19 48

Signature M. R. Long
Registered Well Driller

Construction of the well was completed on June 30 19 48

The well is terminated 14 inches ☑ above, ~~below~~ ☐ the permanent ground surface.

Was the well disinfected upon completion?
Yes ✓ No ____

Was the well sealed watertight upon completion?
Yes ✓ No ____

Poplar Wis
Complete Mail Address

2070

Vol 6

2071

WELL CONSTRUCTOR'S REPORT TO WISCONSIN STATE BOARD OF HEALTH

See Instructions on Reverse Side

1. County Douglas (Town ☒ / Village ☐ / City ☐) Superior — check one and give name

2. Location N-E ¼ of S E ¼ of Sec. 2 T 48N R 14 W
Name of street and number of premise or Section, Town and Range numbers

3. Owner ☒ or Agent ☐ Edward Bak
Name of individual, partnership or firm

4. Mail Address Station Station R. Superior Wis
Complete address required

5. From well to nearest: Building 10 ft; sewer 12 ft; drain 25 ft; septic tank 80 ft; dry well or filter bed 100 ft; abandoned well not ft.

RECEIVED
AUG 1 1960

6. Well is intended to supply water for: Tavern

7. DRILLHOLE:

Dia. (in.)	From (ft.)	To (ft.)	Dia. (in.)	From (ft.)	To (ft.)
8	0	20	4	160	265
6	20	160			

8. CASING AND LINER PIPE OR CURBING:

Dia. (in.)	Kind and Weight	From (ft.)	To (ft.)
4	Std. pipe 11 lbs	0	251

9. GROUT:

Kind	From (ft.)	To (ft.)
puddled clay	0	20

10. FORMATIONS:

Kind	From (ft.)	To (ft.)
Red clay	0	140
Red Hardpan	140	245
sand rock	245	265

RECEIVED
JUL 15 1960
WISCONSIN STATE BOARD OF HEALTH
ENGINEERING

Construction of the well was completed on: June 25 19 60

The well is terminated 12 inches ☒ above, below ☐ the permanent ground surface.

Was the well disinfected upon completion? Yes ✓ No

Was the well sealed watertight upon completion? Yes ✓ No

11. MISCELLANEOUS DATA:

Yield test: 16 Hrs. at 10 GPM.

Depth from surface to water-level: 105 ft.

Water-level when pumping: 110 ft.

Water sample was sent to the state laboratory at: Madison City on July 5 1960

Signature M. R. Long
Registered Well Driller

Poplar Wis
Complete Mail Address

Please do not write in space below

Rec'd JUL 6 1960 No. 23813

Ans'd

Interpretation SAFE—BACTERIOLOGICALLY

2071

	10 ml	10 ml	10 ml	10 ml	10 ml
Gas—24 hrs.					
48 hrs.					
Confirm					
B. Coli					

Examiner

2226

County Douglas Twp. City Superior (Office Record—Do not fill in) Sec. 30 Rge. 13 W

T49 R13W SE¼ Sec 30 T44 R13 7 Fourth Principal

TO THE WISCONSIN STATE BOARD OF HEALTH, WELL DRILLING DIVISION, MADISON, WIS.

WELL LOG, PREMISES DIAGRAM, and REPORT

For Official Record of the Board.

(TO BE USED FOR THAT PURPOSE ONLY)

Owner Park Board of City of (If a joint ownership give name of responsible official. Also name of each individual holding an interest. Use a separate sheet and attach hereto.)

Address Superior Wis (City, village, township, county)

Driller Mastrian Bros

Address 714 Hughitt ave Superior Wis

Date of Report June 30 1937

Registration No. 232

Give below the location of the property on which well is drilled.

If incorporated village or city: City of Superior (Name) 4 (Lot) Blk. E 7th St (Street and No.)

If unincorporated hamlet (Name) County Twp. Highway

If Lake Shore Plat (Name of Plat) Lake Lot Blk. Street

If Farm County Twp. Sec. Highway

If School County Twp. Sec. District

If other public building (Kind) County Twp. Sec.

Miscellaneous (Kind) County Twp. Sec.

WELL LOG and REPORT

Screens, Seals Grouts, etc.	Well Diagram (Each vertical line equals 1')	Kind of Casing, liner, shoe, etc. (Each horizontal line equals 5')	Formations State if dry or water bearing	Record of FINAL Pumping Test
6 ft Johnson Reel Brass screen 25 Slot	8 6 4 2 0 2 4 6 8 — 25, 50, 75, 100, 125, 150, 175, 200, 225, 250, 300, 350, 400, 500, 600, 700	Drop forged Point shoe; 6 in Drilled Spiel Casing	Red Clay to 85 ft; Water Sand & gravel to 102 ft; gravel to 108 ft	Duration of test. Hours 10 hr; Pumping Rate. G. P. M. 60; Depth of pump in well. Ft. 25 ft; Standing water-level (from surface.) Ft. 9 ft; Water level when pumping Ft. 5 ft; Water. End of test. Check: Clear ✓; Cloudy; Turbid; Was well sterilized before test? Yes ✓ No; Date; To which Laboratory was sample sent? Superior Wis; Date June 29-37; Was the well sealed on completion? Yes ✓ No; How high did you leave casing above grade? Capped 1 ft below grade; Well was completed June 29 1937; Well Driller: Mastrian Bros Signature.

Flowing Well

flowing 8 gal per min

3 feet ~~Below grade~~ above grade at Well and 7 ft about Pump Level

Pump house to be built when pump to be installed

(Be sure to complete the report on the reverse side)

2226

PREMISES DIAGRAM

(See Rules)

Draw a representative sketch of the premises on which this well is located, showing the location of the well with reference to buildings and possible sources of pollution. Indicate the condition of the surroundings by printing descriptive words like high, low, level, slope, lake, river, swamp, forest meadow, barnyard, cesspool, privy, sewer, etc., at their respective locations and show distance from the well on the sketch. Also show direction of the compass. See Part III for specimen Diagram.

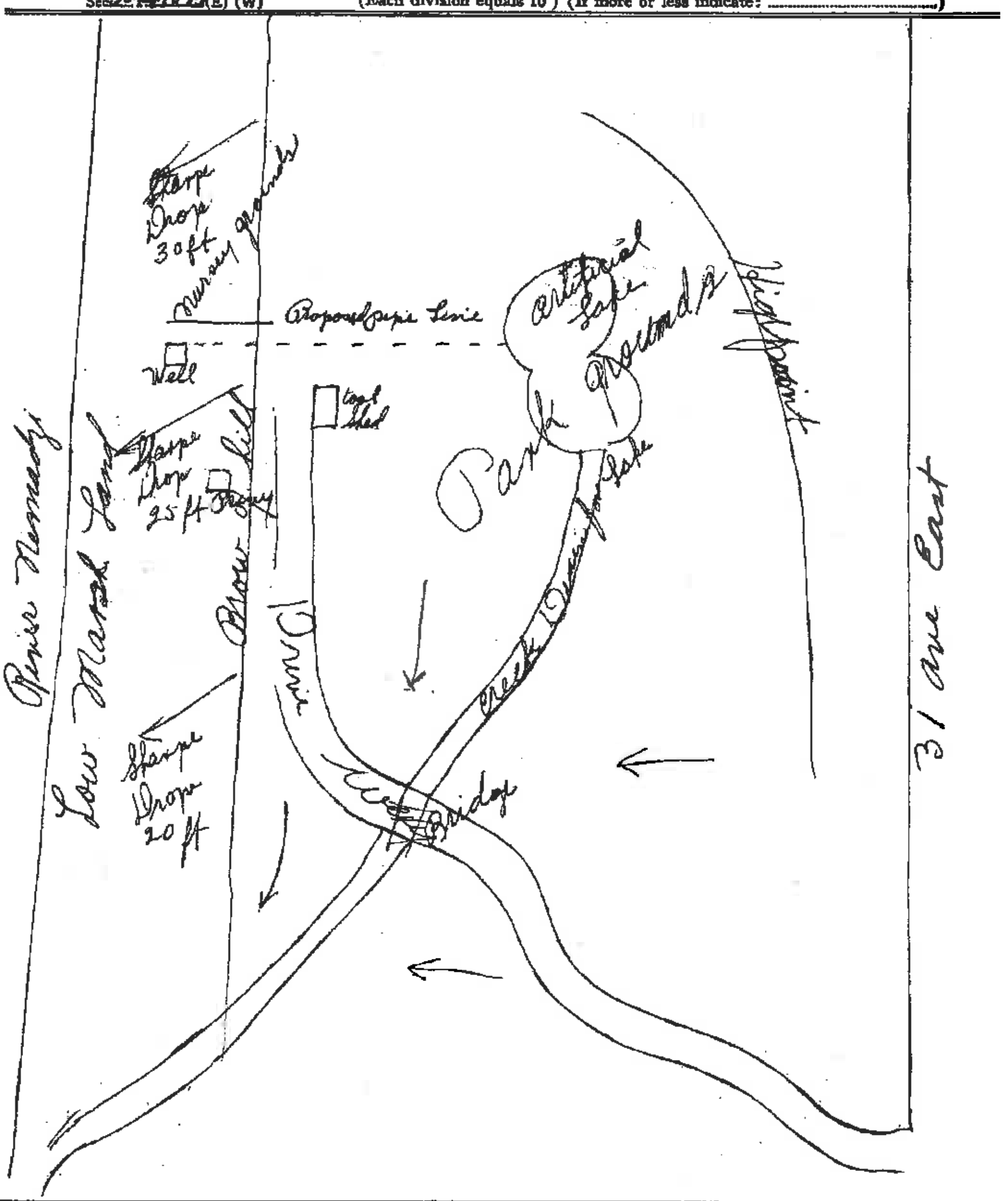
REMARKS:

NORTH

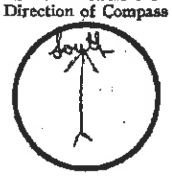
Indicate position of premises in the Section

30 ~~49N~~ R13W T49N

Sec. 30 T. 49 R. 13 (E) (W) (Each division equals 10') (If more or less indicate: ....)



Show in circle the Direction of Compass



Note: Additional copies of this form may be obtained at 5c per copy in lots of 10 or more. Send remittance with order to State Board of Health, Well Drilling Division, Madison.

DS 2226-2

2227

WELL CONSTRUCTION REPORT
WISCONSIN STATE BOARD OF HEALTH
WELL CONSTRUCTION DIVISION

JAN 28 1943

Note: Section 31 of the Wisconsin Well Construction Code, having the force and effect of law, provides that within thirty days after completion of every well the driller shall submit a report covering all essential details of construction to the State Board of Health on a form provided by the Board.

Owner Ray Logen — Driller Gilstrain Bros

Street or RFD 3924 E 17 st — Post Office Weatherwax Wis

Post Office Superior Wis — Date Jan 26-43 — Permit No. 2227

LOCATION OF PREMISES

Douglas (County) — City of Superior (Town)

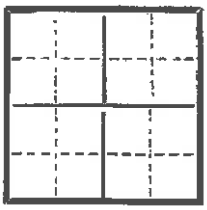
Describe further by subdivision, plat, district, lake, lot.

Known as Allouez Acres.

block, nearest principal highway, etc., whichever apply.

at Allouez

The square below represents a section of land divided into 40 acre tracts. Mark the position of the premises in the section.



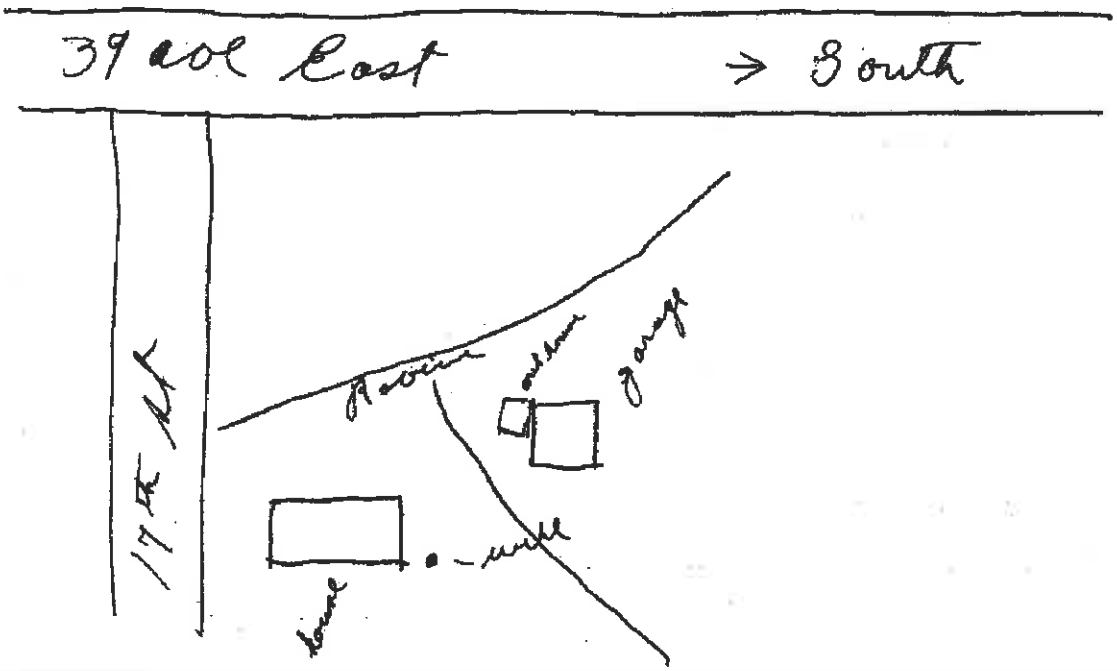
Sec. No. SE Sec 31

Twp. No. T49N

Range R13W E W

DIAGRAM OF PREMISES

See Well Construction Report bulletin. In making the diagram in the space below consider 10 ft. as the distance between lines. Be sure to indicate NORTH.



Additional copies of this form may be obtained in lots of 12 for 25c. Send remittance with order to State Board of Health, Well Construction Division, Madison, Wis.

2227

2227

WELL LOG *and* REPORT

For method of making report, refer to bulletin entitled "Well Construction Report," 7-5-39.

In this column indicate the kind of casing, liner, shoe and other accessories used.

6" old Well
Reduced to
3 in.
special
Well pipe

pipe end at
90 ft and
special packer
Installed →

Red line
denotes Rock

2227-2

WELL DIAGRAM
Use a red line to show casing or liner pipe. Use black for drill or borehole.

Inches Diameter
2 3 4 5 6 8 10 12 14 16 18

Depth

25
50
75
100
150
172
200
400
800
1200

Draw the diagram to show the right half only

In this column state the kind of formations penetrated, their thickness in feet and if water bearing.

Old Well
to 140 ft

Sand pan

6 ft Lake Superior
Sandstone

Record of FINAL Pumping test

Duration of test
Hours 10

Pumping rate
G.P.M. 6

Depth of pump in well. Ft. 90

Standing water-level (from surface) —
Ft. 45

Water-level when pumping Ft. Same

Water. End of test.
Clear ✓
Cloudy
Turbid

Was the well sterilized?
Yes ✓ No

To which laboratory was sample sent?
Superior
Date

Was the well sealed on completion?
Yes ✓ No

How high did you leave the casing-pipe above grade?
1 ft

Well was completed
Date Oct 20 42

Well Contractor
M. Meehan
Signature

2228

Vol 6

WELL CONSTRUCTOR'S REPORT TO WISCONSIN STATE BOARD OF HEALTH

See Instructions on Reverse Side

? SE Sec 31 T 49 N R 13 W

1. County Douglas — Town ☐ Village ☐ City ☑ Superior (Check one and give name)

2. Location Allouez Ave 3910 E 18 St
Name of street and number of premise or Section, Town and Range numbers

3. Owner ☑ or Agent ☐ John Murillo
Name of individual, partnership or firm

4. Mail Address Blasen Ste Superior Wis
Complete address required

5. From well to nearest: Building 10 ft; sewer — ft; drain — ft; septic tank — ft; dry well or filter bed — ft; abandoned well — ft.

6. Well is intended to supply water for: Home

7. DRILLHOLE:

Dia. (in.)	From (ft.)	To (ft.)	Dia. (in.)	From (ft.)	To (ft.)
4"	0	165'			

8. CASING AND LINER PIPE OR CURBING:

Dia. (in.)	Kind and Weight	From (ft.)	To (ft.)
4"	Steel	0	165'

9. GROUT:

Kind	From (ft.)	To (ft.)

10. FORMATIONS:

Kind	From (ft.)	To (ft.)
Red clay	0	135
Rudpch	135'	160'

RECEIVED
JAN 14 1959
ENVIRONMENTAL SANITATION

Construction of the well was completed on: Sept 1 19 58

The well is terminated 12 inches ☑ above, below ☐ the permanent ground surface.

Was the well disinfected upon completion? Yes ✓ No —

Was the well sealed watertight upon completion? Yes ✓ No —

11. MISCELLANEOUS DATA:

Yield test: 5 Hrs. at 5 GPM.

Depth from surface to water-level: 60 ft.

Water-level when pumping: Same ft.

Water sample was sent to the state laboratory at: by Owner City on — 19—

Signature Mastrian Bros Registered Well Driller

Westmoreland Wis Complete Mail Address

Please do not write in space below

	10 ml	10 ml	10 ml	10 ml	10 ml
Gas—24 hrs.					
48 hrs.					
Confirm					
B. Coli					

Rec'd — No.

Ans'd

Interpretation

2228

Examiner

2239

WELL CONSTRUCTION REPORT
WISCONSIN STATE BOARD OF HEALTH
WELL DRILLING DIVISION

AUG 28 1941

Note: Section 32 of the Wisconsin Well Drilling Sanitary Code, having the force and effect of law, provides that within thirty days after completion of every well the driller shall submit a report covering all essential details of construction to the State Board of Health on a form provided by the Board.

Owner William Kobb
Street or RFD Norman Road
Post Office Superior

Driller Martin Broo
Post Office Wentworth Wis.
Date Feb 27 1941 Permit No. 232

LOCATION OF PREMISES

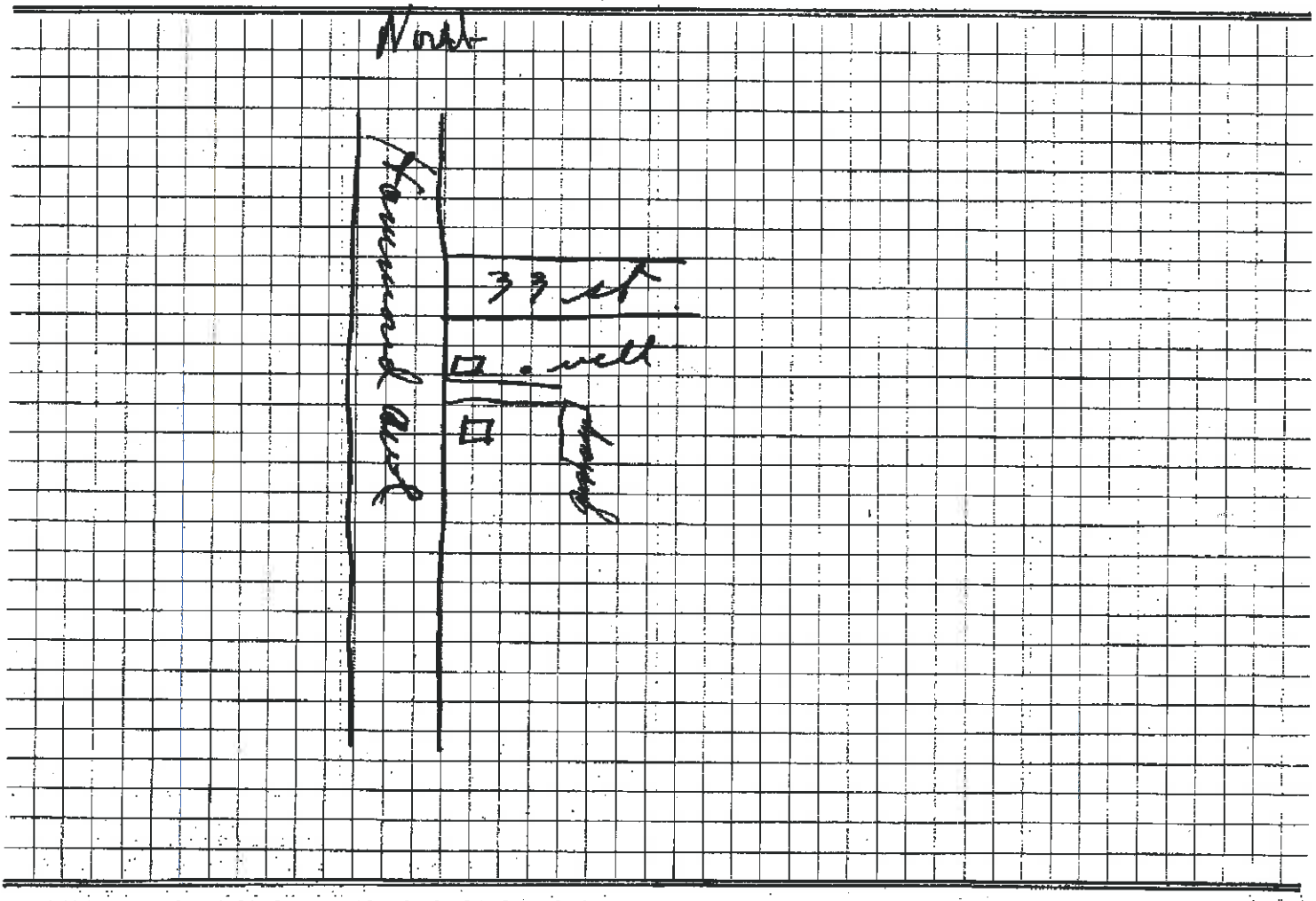
~~Bayfield~~ Douglas County City of Superior Town
Blk 12 Hammond Add Lot 27
Describe further by subdivision, plat, district, lake, lot, block, nearest principal highway, etc., whichever apply.
S ½ of sec 25 Sec 26?

The square below represents a section of land divided into 40 acre tracts. Mark the position of the premises in the section.

Sec. 25 26?
Twp. 49 N
Range 14 W

DIAGRAM OF PREMISES

See discussion and illustration in Part III Well Drilling Code. In making the diagram in the space below consider 10 ft. as the distance between lines. Be sure to indicate NORTH.



Additional copies of this form may be obtained in lots of 12 for 25¢. Send remittance with order to State Board of Health, Well Drilling Division, Madison, Wis.

2239

2239

WELL LOG *and* REPORT

In this column indicate the kind of casing, liner, shoe and other accessories used.	WELL DIAGRAM Use a red line to show casing or liner pipe. Use black for drill or borehole.	In this column state the kind of formations penetrated, their thickness in feet and if water bearing.	Record of FINAL Pumping test

4 in special Well pipe

Drive shoe steel

Inches Diameter 2 3 4 5 6 8 10 12 14 16 18

Depth: 25, 50, 75, 100, 150, 200, 260, 275, 400, 800, 1200

Red clay

150 ft

Hard pan Boulders

110 ft

Casing to 260 ft.

rock 15

sand stone 15 ft

Draw the diagram to show the right half only

Duration of test Hours 24 hr

Pumping rate G.P.M. 5

Depth of pump in well. Ft. 108

Standing water-level (from surface) Ft. 45

Water-level when pumping Ft. 100

Water. End of test.
Clear ✓
Cloudy
Turbid

Was the well sterilized?
Yes ✓ No

To which laboratory was sample sent?
Imperial
Date Feb 29 41

Was the well sealed on completion?
Yes ✓ No

How high did you leave the casing-pipe above grade?
1 ft

Well was completed
Date Feb 27-41

Well Driller
H H Masterson
Signature

2239-2

2244

RECEIVED
JAN 1 1954

WELL CONSTRUCTOR'S REPORT TO WISCONSIN STATE BOARD OF HEALTH

See Instructions on Reverse Side

See 36? T 49N R 14W

1. County Douglas (Town ☐ Village ☐ City ☑) Check one and give name

2. Location City of Superior Tower and Belknap Ave
Name of street and number of premise or Section, Town and Range numbers

3. Owner ☐ or Agent ☐ Lake Head Pipe Line Co
Name of individual, partnership or firm

4. Mail Address Lockland Superior Wis
Complete address required

5. From well to nearest: Building ← ft; sewer ← ft; drain ← ft; septic tank ← ft; dry well or filter bed ← ft; abandoned well ← ft.

6. Well is intended to supply water for: Drinking

7. DRILLHOLE:

Dia. (in.)	From (ft.)	To (ft.)	Dia. (in.)	From (ft.)	To (ft.)

8. CASING AND LINER PIPE OR CURBING:

Dia. (in.)	Kind and Weight	From (ft.)	To (ft.)
4	standard	0	179

9. GROUT:

Kind	From (ft.)	To (ft.)

10. FORMATIONS:

Kind	From (ft.)	To (ft.)
Red clay	0	135
Hardpan	135	175
water gravel	175	179

Construction of the well was completed on: Oct 9 19 53

The well is terminated 22 inches ☑ above, below ☐ the permanent ground surface.

Was the well disinfected upon completion? Yes ← No

Was the well sealed watertight upon completion? Yes ← No

11. MISCELLANEOUS DATA:

Yield test: 5 Hrs. at 7 GPM.

Depth from surface to water-level: ____ ft.

Water-level when pumping: Pumped ft.

Water sample was sent to the state laboratory at: Superior (City) on ____ 19____

Signature Hartman Bros
Registered Well Driller

[illegible] Wis
Complete Mail Address

Please do not write in space below

Rec'd ____ No. ____

Ans'd ____

Interpretation ____

2244

	10 ml	10 ml	10 ml	10 ml	10 ml
Gas—24 hrs.					
48 hrs.					
Confirm					
B. Coli					

Examiner ____

WISCONSIN UNIQUE WELL NUMBER
Source: WELL CONSTRUCTION

NK943

State of Wi-Private Water Systems-DG/2
Department Of Natural Resources, Box 7921
Madison, WI 53707

Form 33 (Rev 02/ NK943

Depth 212 FT

Property Owner: SMITH, KEN
Telephone Number: 715 -398 -5559
Mailing Address: 1811 42ND AVE E
City: SUPERIOR
State: WI
Zip Code: 54880
County of Well Location: 16 DOUGLAS
Co Well Permit No: NO W
Well Completion Date: May 27, 1999

1. Well Location
T=Town C=City V=Village: C of SUPERIOR
Fire#:
Street Address or Road Name and Number:
Subdivision Name:
Lot#:
Block #:

Well Constructor: THOMAS G BUTTERFIELD
License #: 555
Facility ID (Public):
Address: 14346W STATE RD 77
Public Well Plan Approval#:
City: HAYWARD
State: WI
Zip Code: 54843
Date Of Approval:
Hicap Permanent Well #:
Common Well #:
Specific Capacity: .2 gpm/ft

Gov't Lot: or NW 1/4 of NW 1/4 of
Section 6 T 48 N R 13 W

2. Well Type 1 (See item 12 below)
1=New 2=Replacement 3=Reconstruction
of previous unique well # _____ constructed in _____
Reason for replaced or reconstructed Well?

3. Well Serves: P (# of homes and or (eg: barn, restaurant, church, school, industry, etc.))
M=Munic O=OTM N=NonCom P=Private Z=Other X=NonPot A=Anode L=Loop H=Drillhole

High Capacity: Well? N
Property? N

1 1=Drilled 2=Driven Point 3=Jetted 4=Other

4. Is the well located upslope or sideslope and not downslope from any contamination sources, including those on neighboring properties? Y
Well located in floodplain? N
Distance in feet from well to nearest: (including proposed)

1. Landfill
8 2. Building Overhang
61 3. 1=Septic 2= Holding Tank
4. Sewage Absorption Unit
5. Nonconforming Pit
6. Buried Home Heating Oil Tank
7. Buried Petroleum Tank
8. 1=Shoreline 2= Swimming Pool
9. Downspout/ Yard Hydrant
10. Privy
11. Foundation Drain to Clearwater
12. Foundation Drain to Sewer
13. Building Drain 1=Cast Iron or Plastic 2=Other
14. Building Sewer 1=Gravity 2=Pressure 1=Cast Iron or Plastic 2=Other
15. Collector Sewer: ___ units ___ in . diam.
16. Clearwater Sump
17. Wastewater Sump
18. Paved Animal Barn Pen
19. Animal Yard or Shelter
20. Silo
21. Barn Gutter
22. Manure Pipe 1=Gravity 2=Pressure 1=Cast iron or Plastic 2=Other
23. Other manure Storage
24. Ditch
25. Other NR 812 Waste Source

5. Drillhole Dimensions and Construction Method

Dia.(in.)	From (ft)	To (ft)
4.0	surface	212

Upper Enlarged Drillhole
-- 1. Rotary - Mud Circulation
-- 2. Rotary - Air
-- 3. Rotary - Air and Foam
-- 4. Drill-Through Casing Hammer
-- 5. Reverse Rotary
-- 6. Cable-tool Bit _ n. dia
-- 7. Temp. Outer Casing _ in. dia. _____ depth ft. Removed ?
Other

Lower Open Bedrock

6. Casing Liner Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
4.0	NEW P&E BLK WELDED ASTMA-53B 10:79 LB/FT SAWHILL	surface	212

Dia.(in.)	Screen type, material & slot size	From	To

7. Grout or Other Sealing Material

Method: MOUNDED

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
BENTONITE	surface	20.0	2 S

Geology Codes	8. Geology Type, Caving/Noncaving, Color, Hardness, etc	From (ft.)	To (ft.)
T_C_	TAN CLAY	0	10
R_C_	RED CLAY	10	27
T_C_	MED BRN CLAY (HARD) W/ SOFT	27	77
G_C_	GREY CLAY	77	104
_HC_	MED BRN CLAY (HARD)	104	167
R_Y_	RED SAND & GRAVEL	167	212

9. Static Water Level
44.0 feet B ground surface
A=Above B=Below

10. Pump Test
Pumping level 85.0 ft. below surface
Pumping at 10.0 GP M 1.0 Hrs

11. Well Is: 14 in. A Grade (A=Above B=Below)
Developed? Y
Disinfected? Y
Capped? Y

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property? N
If no, explain: 2 HOMES WERE ON ONE WELL

13. Initials of Well Constructor or Supervisory Driller: TB
Date Signed: 6/2/99

Initials of Drill Rig Operator (Mandatory unless same as above): TB
Date Signed: 6/2/99

Additonal Comments?
Owner Sent Label? Y
Variance Issued?
More Geology?

Batch 604

WISCONSIN UNIQUE WELL NUMBER **TF532**

Source: WELL CONSTRUCTION

State of Wi-Private Water Systems-DG/2
Department Of Natural Resources, Box 7921
Madison, WI 53707

Form 3: TF532
(Rev 02

Depth **220** FT

Property Owner: **ASHLEY, PAUL**		Telephone Number: **715-398-6597**	
Mailing Address: **1521 E 4TH ST**			
City: **SUPERIOR**	State: **WI**	Zip Code: **54880**	
County of Well Location: **16 DOUGLAS**	Co Well Permit No: **NO W**	Well Completion Date: **October 17, 2005**	

1. Well Location

T=Town C=City V=Village: **C of SUPERIOR**

Fire#:

Street Address or Road Name and Number: **39TH AVE E**

Subdivision Name	Lot#	Block #

Gov't Lot: or **SE** 1/4 of **SE** 1/4 of

Section **31** T **49** N R **13 W**

Well Constructor: **MATT H LONG**	License #: **145**	Facility ID (Public):
Address: **LONG'S WELL DRILLING**		Public Well Plan Approval#:
City: **POPLAR**	State: **WI** Zip Code: **54864**	Date Of Approval:
Hicap Permanent Well #:	Common Well #:	Specific Capacity: **.3** gpm/ft

2. Well Type **1** (See item 12 below)

1=New 2=Replacement 3=Reconstruction

of previous unique well # _____ constructed in _____

Reason for replaced or reconstructed Well?

1 1=Drilled 2=Driven Point 3=Jetted 4=Other

3. Well Serves **P** # of homes and or (eg: barn, restaurant, church, school, industry, etc.)

M=Munic O=OTM N=NonCom P=Private Z=Other X=NonPot A=Anode L=Loop H=Drillhole

High Capacity: Well? N Property? N

4. Is the well located upslope or sideslope and not downslope from any contamination sources, including those on neighboring properties? **Y**

Well located in floodplain? **N**

Distance in feet from well to nearest: (including proposed)

1. Landfill
22 2. Building Overhang
3. 1=Septic 2= Holding Tank
4. Sewage Absorption Unit
5. Nonconforming Pit
6. Buried Home Heating Oil Tank
7. Buried Petroleum Tank
8. 1=Shoreline 2= Swimming Pool
9. Downspout/ Yard Hydrant
10. Privy
11. Foundation Drain to Clearwater
12. Foundation Drain to Sewer
13. Building Drain 1=Cast Iron or Plastic 2=Other
55 14. Building Sewer **1** 1=Gravity 2=Pressure **1** 1=Cast Iron or Plastic 2=Other
15. Collector Sewer: ___ units ___ in . diam.
16. Clearwater Sump
17. Wastewater Sump
18. Paved Animal Barn Pen
19. Animal Yard or Shelter
20. Silo
21. Barn Gutter
22. Manure Pipe 1=Gravity 2=Pressure 1=Cast iron or Plastic 2=Other
23. Other manure Storage
24. Ditch
25. Other NR 812 Waste Source

5. Drillhole Dimensions and Construction Method

Dia.(in.)	From (ft)	To (ft)	Upper Enlarged Drillhole / Lower Open Bedrock
8.5	surface	63	
6.0	163	220	

X -- 1. Rotary - Mud Circulation
-- 2. Rotary - Air X
-- 3. Rotary - Air and Foam
-- 4. Drill-Through Casing Hammer
-- 5. Reverse Rotary
-- 6. Cable-tool Bit _ n. dia
-- 7. Temp. Outer Casing _ in. dia. _____ depth ft. Removed ?
Other

6. Casing Liner Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6.0	WHEATLAND A53 SCHD 40 WELD	surface	163

Dia.(in.)	Screen type, material & slot size	From	To

7. Grout or Other Sealing Material

Method: DRILLING MUD

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
QUIK GEL	surface	163.0	

Geology Codes	8. Geology Type, Caving/Noncaving, Color, Hardness, etc	From (ft.)	To (ft.)
_C_	CLAY	0	144
_P_	HARDPAN	144	159
_PB	HARDPAN/SANDSTONE MIX	159	161
_HN_	SANDSTONE/HARD & CLEAN	161	220

9. Static Water Level

35.0 feet **B** ground surface (A=Above B=Below)

10. Pump Test

Pumping level **85.0** ft. below surface

Pumping at **15.0** GP M **4.0** Hrs

11. Well Is: 24 in. A Grade (A=Above B=Below)

Developed? Y

Disinfected? Y

Capped? Y

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property?

If no, explain: NONE

13. Initials of Well Constructor or Supervisory Driller: MHL Date Signed: 10/20/05

Initials of Drill Rig Operator (Mandatory unless same as above) Date Signed

Additonal Comments? TF
Owner Sent Label? Y
Variance Issued?
More Geology?

21015615

Batch 1003

WISCONSIN UNIQUE WELL NUMBER **TJ253**

Source: WELL CONSTRUCTION

State of Wi-Private Water Systems-DG/2
Department Of Natural Resources, Box 7921
Madison, WI 53707

Form 3 (Rev 02) TJ253

Depth **260** FT

Property Owner: NEMADJI PUBLIC GOLF		Telephone Number: - -	
Mailing Address: 5 N 58TH ST E			
City: SUPERIOR	State: WI	Zip Code: 54880	
County of Well Location: 16 DOUGLAS	Co Well Permit No: NO W	Well Completion Date: July 19, 2006	

1. Well Location

T=Town C=City V=Village: C of SUPERIOR

Fire#: 5 N

Street Address or Road Name and Number: 58TH ST

Subdivision Name | Lot# | Block #

Gov't Lot or **NW** 1/4 of **NW** 1/4 of

Section **1** T **48** N R **14 W**

Well Constructor: KEITH R LIND	License #: 4684	Facility ID (Public)	
Address: KEITH LIND WELL DRLG INC		Public Well Plan Approval#	
City: MAPLE	State: WI	Zip Code: 54854	Date Of Approval
Hicap Permanent Well #	Common Well #		Specific Capacity: .2 gpm/ft

2. Well Type **1** (See item 12 below)

1=New 2=Replacement 3=Reconstruction

of previous unique well # _____ constructed in _____

Reason for replaced or reconstructed Well?

1 1=Drilled 2=Driven Point 3=Jetted 4=Other

3. Well Serves **X** # of homes and or **POND** (eg: barn, restaurant, church, school, industry, etc.)

M=Munic O=OTM N=NonCom P=Private Z=Other X=NonPot A=Anode L=Loop H=Drillhole

High Capacity: Well? N Property? N

4. Is the well located upslope or sideslope and not downslope from any contamination sources, including those on neighboring properties? **Y**

Well located in floodplain? **N**

Distance in feet from well to nearest: (including proposed)

1. Landfill
2. Building Overhang
3. 1=Septic 2= Holding Tank
4. Sewage Absorption Unit
5. Nonconforming Pit
6. Buried Home Heating Oil Tank
7. Buried Petroleum Tank
100 8. 1=Shoreline 2= Swimming Pool
9. Downspout/ Yard Hydrant
10. Privy
11. Foundation Drain to Clearwater
12. Foundation Drain to Sewer
13. Building Drain 1=Cast Iron or Plastic 2=Other
63 14. Building Sewer 1 1=Gravity 2=Pressure
1 1=Cast Iron or Plastic 2=Other
15. Collector Sewer: ___ units ___ in . diam.
16. Clearwater Sump
17. Wastewater Sump
18. Paved Animal Barn Pen
19. Animal Yard or Shelter
20. Silo
21. Barn Gutter
22. Manure Pipe 1=Gravity 2=Pressure 1=Cast iron or Plastic 2=Other
23. Other manure Storage
24. Ditch
25. Other NR 812 Waste Source

5. Drillhole Dimensions and Construction Method

Dia.(in.)	From (ft)	To (ft)
6.0	surface	231
6.0	231	260

Upper Enlarged Drillhole — Lower Open Bedrock

-- 1. Rotary - Mud Circulation
-- 2. Rotary - Air
-- 3. Rotary - Air and Foam
X -- 4. Drill-Through Casing Hammer
-- 5. Reverse Rotary
-- 6. Cable-tool Bit _ in. dia
-- 7. Temp. Outer Casing _ in. dia. _____ depth ft. Removed ?

Other

6. Casing Liner Screen Material, Weight, Specification

Dia. (in.)	Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6.0	PLAIN END WHEATLAND ASTM A53B .280 18.97	surface	231

Dia.(in.)	Screen type, material & slot size	From	To

7. Grout or Other Sealing Material

Method MOUNDED

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
BENTONITE GRAN	surface	231.0	6 S

Geology Codes	8. Geology Type, Caving/Noncaving, Color, Hardness, etc	From (ft.)	To (ft.)
_C_	CLAY	0	130
_P_	HARDPAN	130	150
T_SU	DIRTY SAND-BROWN	150	156
_P_	HARDPAN	156	171
T_SU	DIRTY SAND-BROWN	171	175
G_C_	GRAY CLAY	175	229
_G_	GRAVEL	229	231
_N_	SANDSTONE	231	260

9. Static Water Level

44.0 feet **B** ground surface (A=Above B=Below)

10. Pump Test

Pumping level **200.0** ft. below surface

Pumping at **35.0** GP M **3.0** Hrs

11. Well Is: 24 in. A Grade (A=Above B=Below)

Developed? Y

Disinfected? Y

Capped? Y

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property?

If no, explain NA

13. Initials of Well Constructor or Supervisory Driller KL Date Signed 7/30/06

Initials of Drill Rig Operator (Mandatory unless same as above) Date Signed

Additonal Comments? TJ2

Owner Sent Label? Y

Variance Issued?

More Geology?

23349713

Batch 1040

WISCONSIN UNIQUE WELL NUMBER **VE161**

Source: WELL CONSTRUCTION

State of Wi-Private Water Systems-DG/2
Department Of Natural Resources, Box 7921
Madison, WI 53707

Form 3 (Rev 02) VE161

Depth **260** FT

Property Owner: ENBRIDGE ENERGY US		Telephone Number: - -	
Mailing Address: 10 BARDON AVE			
City: SUPERIOR	State: WI	Zip Code: 54880	
County of Well Location: 16 DOUGLAS	Co Well Permit No: NO W	Well Completion Date: July 29, 2010	

1. Well Location

T=Town C=City V=Village: C of SUPERIOR

Fire#:

Street Address or Road Name and Number: 10 BARDON AVE

Subdivision Name | Lot# | Block #

Gov't Lot or NW 1/4 of SE 1/4 of

Section 36 T 49 N R 14 W

Well Constructor: KEITH R LIND		License #: 4684	Facility ID (Public):
Address: KEITH LIND WELL DRLG INC			Public Well Plan Approval#:
City: MAPLE	State: WI	Zip Code: 54854	Date Of Approval:
Hicap Permanent Well #	Common Well #		Specific Capacity: .2 gpm/ft

2. Well Type 1 (See item 12 below)

1=New 2=Replacement 3=Reconstruction

of previous unique well # _____ constructed in _____

Reason for replaced or reconstructed Well?

3. Well Serves: N # of homes and or SHOP (eg: barn, restaurant, church, school, industry, etc.)

M=Munic O=OTM N=NonCom P=Private Z=Other X=NonPot A=Anode L=Loop H=Drillhole

High Capacity: Well? N Property? N

1 1=Drilled 2=Driven Point 3=Jetted 4=Other

4. Is the well located upslope or sideslope and not downslope from any contamination sources, including those on neighboring properties?

Well located in floodplain? N

Distance in feet from well to nearest: (including proposed)

1. Landfill
2. Building Overhang
101 3. 1=Septic 2= Holding Tank
4. Sewage Absorption Unit
5. Nonconforming Pit
6. Buried Home Heating Oil Tank
7. Buried Petroleum Tank
8. 2 1=Shoreline 2= Swimming Pool
9. Downspout/ Yard Hydrant
10. Privy
11. Foundation Drain to Clearwater
12. Foundation Drain to Sewer
13. Building Drain 1=Cast Iron or Plastic 2=Other
14. Building Sewer 1=Gravity 2=Pressure 1=Cast Iron or Plastic 2=Other
15. Collector Sewer: ___ units ___ in . diam.
16. Clearwater Sump
17. Wastewater Sump
18. Paved Animal Barn Pen
19. Animal Yard or Shelter
20. Silo
21. Barn Gutter
22. Manure Pipe 1=Gravity 2=Pressure 1=Cast iron or Plastic 2=Other
23. Other manure Storage
24. Ditch
25. Other NR 812 Waste Source

5. Drillhole Dimensions and Construction Method

Dia.(in.)	From (ft)	To (ft)
8.8	surface	256
6.0	256	260

Upper Enlarged Drillhole

X – 1. Rotary - Mud Circulation

– 2. Rotary - Air

– 3. Rotary - Air and Foam

– 4. Drill-Through Casing Hammer

– 5. Reverse Rotary

– 6. Cable-tool Bit _ n. dia

– 7. Temp. Outer Casing _ in. dia. _____ depth ft. Removed ?

Other

Lower Open Bedrock

6. Casing Liner Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6.0	PLAINEND EXELL ASTM A53B .280 18.97	surface	256

Dia.(in.)	Screen type, material & slot size	From	To
3.0	10 SLOT STAINLESS STEEL	256	260

7. Grout or Other Sealing Material

Method PUMPING

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
BENTONITE CUTTINGS	surface	256.0	S
CAVING FORMATION	256.0	260.0	S

8. Geology

Geology Codes	Type, Caving/Noncaving, Color, Hardness, etc	From (ft.)	To (ft.)
_C_	CLAY	0	141
_SU	DIRTY MUDDY SAND	141	145
_PG	HARD PAN & BOULDERS	145	171
_SU	MUDDY SAND	171	173
_PG	HARD PAN & BOULDERS	173	253
_SM	SILTY SAND	253	256
_NS_	FINE SAND	256	260

9. Static Water Level

49.0 feet B ground surface A=Above B=Below

10. Pump Test

Pumping level 94.0 ft. below surface

Pumping at 8.0 GP M 4.0 Hrs

11. Well Is: 28 in. A Grade A=Above B=Below

Developed? Y

Disinfected? Y

Capped? Y

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property?

If no, explain NA

13. Initials of Well Constructor or Supervisory Driller KL Date Signed 7/29/10

Initials of Drill Rig Operator (Mandatory unless same as above) Date Signed

Additonal Comments? VE Variance Issued?

Owner Sent Label? Y More Geology?

37602062

Batch 1199

WISCONSIN UNIQUE WELL NUMBER **VH933**

Source: WELL CONSTRUCTION

State of Wi-Private Water Systems-DG/2
Department Of Natural Resources, Box 7921
Madison, WI 53707

Form 33 (Rev 02/ VH933

Depth **163** FT

Property Owner: **ENBRIDE US ENERGY** Telephone Number: - -

Mailing Address: 10 BARDON AVE

City: SUPERIOR | State: WI | Zip Code: 54880

County of Well Location: 16 DOUGLAS | NO | Co Well Permit No W | Well Completion Date: October 7, 2010

Well Constructor: BUTTERFIELD, TIM DRILLING INC | License #: 6900

Address: 395 REED ST

City: SOMERSET | State: WI | Zip Code: 54025

Hicap Permanent Well # | Common Well #

Facility ID (Public)

Public Well Plan Approval#

Date Of Approval

Specific Capacity: gpm/ft

1. Well Location

T=Town C=City V=Village: **C** of SUPERIOR

Fire#

Street Address or Road Name and Number: BARDON AVE

Subdivision Name | Lot# | Block #

Gov't Lot or **NW** 1/4 of **SE** 1/4 of

Section **36** T **49** N R **14 W**

2. Well Type **1** (See item 12 below)

1=New 2=Replacement 3=Reconstruction

of previous unique well # _____ constructed in _____

Reason for replaced or reconstructed Well?

1 1=Drilled 2=Driven Point 3=Jetted 4=Other

3. Well Serves **N** # of homes and or **BUILDING** (eg: barn, restaurant, church, school, industry, etc.)

M=Munic O=OTM N=NonCom P=Private Z=Other X=NonPot A=Anode L=Loop H=Drillhole

High Capacity: Well? N Property? N

4. Is the well located upslope or sideslope and not downslope from any contamination sources, including those on neighboring properties?

Well located in floodplain? **N**

Distance in feet from well to nearest: (including proposed)

1. Landfill
100 2. Building Overhang
100 3. 1=Septic 2= Holding Tank
4. Sewage Absorption Unit
5. Nonconforming Pit
6. Buried Home Heating Oil Tank
7. Buried Petroleum Tank
8. **2** 1=Shoreline 2= Swimming Pool
9. Downspout/ Yard Hydrant
10. Privy
11. Foundation Drain to Clearwater
12. Foundation Drain to Sewer
13. Building Drain 1=Cast Iron or Plastic 2=Other
14. Building Sewer 1=Gravity 2=Pressure 1=Cast Iron or Plastic 2=Other
15. Collector Sewer: ___ units ___ in . diam.
16. Clearwater Sump
17. Wastewater Sump
18. Paved Animal Barn Pen
19. Animal Yard or Shelter
20. Silo
21. Barn Gutter
22. Manure Pipe 1=Gravity 2=Pressure 1=Cast iron or Plastic 2=Other
23. Other manure Storage
24. Ditch
250 25. Other NR 812 Waste Source **FUEL TANK**

5. Drillhole Dimensions and Construction Method

Dia.(in.)	From (ft)	To (ft)
6.0	surface	163

Upper Enlarged Drillhole
-- 1. Rotary - Mud Circulation
-- 2. Rotary - Air
-- 3. Rotary - Air and Foam
X – 4. Drill-Through Casing Hammer
– 5. Reverse Rotary
– 6. Cable-tool Bit _ n. dia
-- 7. Temp. Outer Casing _ in. dia. _____ depth ft. Removed ?
Other

Lower Open Bedrock

Geology Codes	8. Geology Type, Caving/Noncaving, Color, Hardness, etc	From (ft.)	To (ft.)
R_C_	RED CLAY	0	140
__S_	SAND	140	163

6. Casing Liner Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6.0	NEW P&E BLK WELDED 18.97 LB/FT ASTM-A53B IPSCO	surface	155

Dia.(in.)	Screen type, material & slot size	From	To
3.0	JOHNSON STAINLESS V-WIRE 10 SLOT	155	163

7. Grout or Other Sealing Material

Method MOUNDED

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
BENTONITE	surface	20.0	2 S

9. Static Water Level
50.0 feet **B** ground surface
A=Above B=Below

10. Pump Test
Pumping level **100.0** ft. below surface
Pumping at **20.0** GP M **1.0** Hrs

11. Well Is: 24 in. A Grade (A=Above B=Below)
Developed? Y
Disinfected? Y
Capped? Y

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property? **N**
If no, explain N/A

13. Initials of Well Constructor or Supervisory Driller: TB Date Signed: 10/25/10

Initials of Drill Rig Operator (Mandatory unless same as above) Date Signed

Additonal Comments? Owner Sent Label? Y Variance Issued? More Geology?

38456106

Batch 1203

County Douglas Twp. City Superior (Office Record—Do not fill in) Sec. 30 Rge. 13 W

T49 R13W SE Sec 30 T44 R13 7 Wards Island

TO THE WISCONSIN STATE BOARD OF HEALTH, WELL DRILLING DIVISION, MADISON, WIS.

WELL LOG, PREMISES DIAGRAM, and REPORT

For Official Record of the Board.

(TO BE USED FOR THAT PURPOSE ONLY)

Owner Park Board of Superior (If a joint ownership give name of responsible official. Also name of each individual holding an interest. Use a separate sheet and attach hereto.)

Address Superior Wis (City, village, township, county)

Driller Mastricin Bros

Address 714 Hughitt ave Superior Wis

Date of Report June 30 1937

Registration No. 232

Give below the location of the property on which well is drilled.

If incorporated village or city: City of Superior (Name) 4 (Lot) (Blk.) E 7th St (Street and No.)

If unincorporated hamlet (Name) (County) (Twp.) (Highway)

If Lake Shore Plat (Name of Plat) (Lake) (Lot) (Blk.) (Street)

If Farm (County) (Twp.) (Sec.) (Highway)

If School (County) (Twp.) (Sec.) (District)

If other public building (Kind) (County) (Twp.) (Sec.)

Miscellaneous (Kind) (County) (Twp.) (Sec.)

WELL LOG and REPORT

Screens, Seals Grouts, etc.	Well Diagram (Each vertical line equals 1')	Kind of Casing, liner, shoe, etc. (Each horizontal line equals 5')	Formations State if dry or water bearing	Record of FINAL Pumping Test
6 ft Johnson Reel Brass screen 95 ~~Slot~~	8 6 4 2 0 2 4 6 8 25 50 75 100 125 150 175 200 225 250 300 350 400 500 600 700	Drop forged Drive shoe 6 in Drillers Spiel Casing	Dry Red Clay to 85 ft Water Bearing White Sand & gravel to 102 ft gravel to 108 ft	Duration of test. Hours 10 hr Pumping Rate. G. P. M. 60 Depth of pump in well. Ft. 25 ft Standing water-level (from surface.) Ft. 3 ft Water level when pumping Ft. 5 ft Water. End of test. Check: Clear ✓ Cloudy Turbid Was well sterilized before test? Yes ✓ No Date To which Laboratory was sample sent? Superior Wis Date June 29-37 Was the well sealed on completion? Yes ✓ No ✗ How high did you leave casing above grade? Capped 1 ft below grade Well was completed June 28 1937 Well Driller: Mastricin Bros Signature. (Be sure to complete the report on the reverse side)

Flowing Well

flowing 8 gal per min

3 feet ~~Pumping Level~~ Below grade at Well and 7 ft about Pump Level

Pump house to be built Wilson pumps to be installed

2226

Appendix B

Barr Standard Operating Procedures (SOPs)

Appendix B

Index of Standard Operating Procedures (SOP)

Site Investigation Work Plan
Superior Refinery April 2018 Explosion and Fire
Superior, Wisconsin

Contents:

Standard Operating Procedure

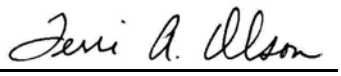
Field Screening Soil Samples

Revision 8

April 9, 2019

Approved By:

John W. Juntilla		04/09/19
Print Technical Reviewer	Signature	Date

Terri A. Olson		04/09/19
Print QA Manager	Signature	Date

Review of the SOP has been performed and the SOP still reflects current practice.

Initials:	_____	Date:	_____
Initials:	_____	Date:	_____
Initials:	_____	Date:	_____
Initials:	_____	Date:	_____

Field Screening of Soil Samples

1.0 Scope and Applicability

The purpose of this Standard Operating Procedure (SOP) is to describe the procedure for properly screening soil or sediment samples in the field. This procedure applies to field technicians responsible for field screening soil or sediment samples.

The recommended procedures in this SOP should be followed unless conditions make it impractical or inappropriate to do so. Modifications should be noted in the applicable documentation and communicated to appropriate personnel. Significant changes may result in a revision or newly created SOP.

2.0 Limitations

- Screening techniques can vary by project. If not specified in the project scope of work and/or documentation (e.g., Work Plan, Sampling Analysis Plan (SAP), or Quality Assurance Project Plan (QAPP)), consult with the appropriate regulatory agency for guidance, if applicable.
- Interferences on the test can be caused by any contaminant that can cause an oil sheen on water. The samples will be carefully observed for characteristic appearance or odors which may indicate a possible contaminant other than coal tar or petroleum substances.
- Sunlight and low temperatures may interfere with headspace development.
- Water and soil particles may interfere with PID and FID measurements.
- Decontamination of screening equipment is required to prevent cross-contamination.
- Contact the local one call system prior to digging to have public utilities identified at sampling locations. Privately owned underground utilities, if present, typically will not be identified by the one call system and contracting with a private utility locater may be necessary.

3.0 Responsibilities

The Project Manager, in conjunction with the client, develops the site specific scope of work (e.g., Work Plan, SAP, etc.).

Experienced Field Technicians are responsible for the proper sample identification, field screening procedures, field equipment and calibration, quality control procedures, and documentation.

Equipment Technicians are responsible for maintaining equipment in working order and aiding in troubleshooting equipment issues.

The role of the Field Safety Representative is to oversee on-site safety activities.

4.0 Safety

Barr staff is responsible for conducting the aspects of the job safely. When applicable, refer to the appropriate Project Health and Safety Plan (PHASP) to understand the hazards associated with suspected contamination, symptoms of exposure, methods to minimize exposure, personal protective equipment (PPE), and personal air monitoring required when using this SOP. Minimum protection of one pair of chemical resistant gloves (e.g., nitrile) and safety glasses with side shields should be worn to prevent

sample contact with the skin and eyes. When screening soils contaminated with corrosive materials, emergency eye flushing facilities should be available.

Consult the applicable Safety Data Sheet to review hazards and appropriate PPE to minimize exposure.

5.0 Equipment, Reagents, and Supplies

- Photoionization detector (PID)
- Flame ionization detector (FID)
- Squirt bottle with tap water
- Waterproof ink pen or pencil
- Polyethylene bags
- Chemical resistant gloves (e.g., nitrile)
- Stainless steel spoon
- Items listed in Section 8.0 Records
- Decontamination supplies (see Decon SOP)

6.0 Procedure

The field screening techniques for soils are as follows: visual examination, odor, headspace organic vapor screening, and oil sheen. The results of these four screening procedures may be used to screen soil samples for possible contamination.

6.1 Calibration

The PID or FID shall be calibrated or checked against a known concentration of a calibration gas standard prior to collection of field measurements. Calibration of the PID or FID shall follow the recommended procedures as described in the manufacturer's operation manual or as per the applicable Barr SOP.

Regular calibration checks (bump tests) are expected to be performed by the field technician a minimum of once per day of use in the field. It is recommended that bump tests be conducted around mid-day and at the end of the day. More frequent bump testing may be completed if warranted by field conditions. The bump testing results should be recorded in the field log book or field log data sheets.

If problems occur during calibration, during bump tests, or if the unit will not stay calibrated, the field technician should document the issue in the field notes then contact the equipment technician or project manager for assistance.

6.2 Screening Techniques

The field screening techniques for soils are as follows: visual examination, odor, headspace organic vapor screening, and oil sheen. The results of these four screening procedures may be used to screen soil samples for possible contamination. To prevent sample cross-contamination, the screening equipment is carefully cleaned before and after working with each sample per Barr's SOP 'Decontamination of Sampling Equipment'.

6.2.1 Visual Examination

A visual examination of the soil sample will include noting any discoloration of the soil or visible oiliness or tar.

6.2.2 Odor

The field technician will note odor only if noticed incidentally while handling the soil sample. Field technicians will not unduly expose themselves to sample odors. Odor will be described as trace, light, moderate, or strong, and appropriate description of the type of odor, if evident.

6.2.3 Headspace Organic Vapor Screening

The polyethylene bag headspace method recommended by the Minnesota Pollution Control Agency will be used in the field to screen soils suspected to contain volatile organic compounds. The screening method is intended to be used in conjunction with other "real time" observations.

The following equipment is required to conduct headspace organic vapor screening: PID or FID, polyethylene bag, log book or record sheet, and appropriate PPE. Soil samples collected from a split-barrel sampler or a direct-push (i.e., Geoprobe) sample liner will be collected immediately after opening the barrel or liner. If the sample is collected from an excavation wall, soil pile, or backhoe bucket, it will be collected from a freshly exposed surface.

- Half-fill the bag with the sample to be analyzed using a stainless-steel spoon or a gloved hand and immediately seal it. Agitate the bag for 15 seconds and manually break up any soil clumps within the bag.
- Allow headspace development for approximately 10 minutes. The sample should be kept in a shaded area out of direct sunlight. Ambient temperatures during headspace development should be recorded. When ambient temperatures are below 50°F, headspace development should be conducted inside a heated vehicle or building. After completing the headspace development, agitate the bag for an additional 15 seconds.
- Quickly puncture the bag with the sampling probe of the PID or FID at a point about one-half of the headspace depth. Exercise care to avoid uptake of water droplets or soil particles.
- Record the highest PID or FID meter response as the headspace concentration. The maximum response will likely occur between 0 to 5 seconds.
- When using a FID, it may be necessary to correct for methane. In this case, take a reading first with the carbon filter, then without. This will require two duplicate bag samples. The second reading less the first is the headspace adjusted for methane. Adjusted readings less than zero are considered zero. Methane correction is not necessary if a PID is used.

6.2.4 Oil Sheen Test

The oil sheen or hydrocarbon test is a method used to immediately determine the approximate magnitude of coal tar or petroleum contamination in soil by observation of the sample in the field. The test is useful in soils which do not have a high binding capacity with petroleum compounds or polycyclic aromatic hydrocarbons (PAHs) (i.e., petroleum compounds or PAHs are free on the surface of the soil particles and can be released by a stream of water).

The equipment required to conduct the oil sheen test includes: a stainless-steel spoon, a squirt bottle filled with tap water, a log book or field log data sheet, and the appropriate personal protective equipment necessary for collection and handling of soil samples as described in the Project Health and Safety Plan.

The procedure for conducting the oil sheen test consists of obtaining approximately 50 grams (about 30 cc) of representative soil with the spoon and then directing a stream of water onto the soil in the spoon with the squirt bottle until the soil is saturated and water begins to collect around the soil. The amount of oil sheen present on the water is determined by observation and the results of the test are reported as a magnitude of oil sheen observed: none, trace, light, moderate, heavy or rainbow. The test results, sample location, and observations of the sample's appearance and odor are recorded in the log book or field log data sheet.

The specific soil types at the area of investigation should be accounted for when performing the oil sheen test. The best results are obtained in silts, sands, and/or gravels with low organic content. The results obtained from clay soils may appear deceptively low. Typical descriptions of each test result are provided in the table below.

Oil Sheen Test Result	Description
None	No sheen detected.
Trace	Possible or faint oil sheen observed (may not continue to generate sheen as additional water is added).
Light	Obvious sheen that may not cover entire water surface
Moderate	Definite oil sheen that covers entire surface, but "rainbow colors" not distinguishable.
Heavy	Definite oil film or product that does not display rainbow colors.
Rainbow	Definite oil sheen, film or product that displays rainbow colors.

6.3 Data Reduction/Calculations

No data reduction or calculations are associated with this procedure.

6.4 Disposal

Waste generated by this process will be disposed of in accordance with Federal, State and Local regulations and Barr's SOP 'Investigative Derived Waste'. Where reasonably feasible, technological changes have been implemented to minimize the potential for environmental pollution.

7.0 Quality Control and Quality Assurance (QA/QC)

Field background readings are measured for the headspace organic vapor screening. PID and FID readings should be duplicated every 20 field samples.

8.0 Records

The field technician(s) will document the field screening activities and measurements in a project dedicated field logbook or on field log data sheets.

Examples of common field documentation are available in Barr's "Compendium of Field Documentation". Field documentation specific to this SOP are listed below:

- Field Sampling Report
- Field Log Data Sheet

Field documentation are provided to a Barr Data Management Administrator for storage on the internal Barr network.

Additional records information can be found in Barr's "Records Management System Manual."

Other Barr SOP subjects referenced within this SOP: PID and FID equipment, decontamination of sampling equipment, and investigative derived waste.

9.0 References

PID and FID operation manuals.

STANDARD OPERATING PROCEDURE

MiniRAE 3000
Photoionization Detector

Revision 1

February 15, 2013

Approved By:

Dana Baker	Dana Baker	2-15-2013
Print	QA Manager(s) Signature	Date

John W. Juntilla	John W. Juntilla	2-15-2013
Print	Field Technician(s) Signature	Date

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Annual Review of the SOP has been performed
and the SOP still reflects current practice.

Initials:	_____	Date:	_____
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Initials:	_____	Date:	_____

Standard Operating Procedures for
MiniRAE 3000 – Photoionization Detector

Purpose

The purpose of this SOP is to define the calibration, operating and maintenance procedures for the MiniRAE 3000 – Photoionization Detector.

Applicability

This procedure applies to the detection and measurement of hazardous-organic vapors and gases for the gas survey industry.

Definitions

PID Photoionization Detector (PID)

Equipment

Ambient Air Thermometer
MiniRAE 3000
Field Logbook
Indelible ink pen
Calibration Standard – Isobutylene for PID
Charcoal capsule for zeroing the instrument

References

MiniRAE 3000 – Photoionization Detector Instruction Manual

Responsibilities

The environmental technician(s) are responsible for the measurement of hazardous-organic vapors and gases in the field. The environmental technician is responsible for proper equipment calibration, calibration verification, operation, quality control procedures and documentation. Regular calibration checks (bump tests) are expected to be performed by the environmental technician a minimum of once per day of use in the field. If problems occur during calibration, during bump tests, or if the unit will not stay calibrated, then contact the equipment technician and project manager for assistance.

Procedure

a. Calibration Check: The analyzer's calibration must be checked prior to use. If the calibration check does not pass, then the instrument must be recalibrated using the following procedure:
b. Calibration procedures: See Instruction Manual
c. Calibration Criteria: See Instruction Manual
d. Corrective Action for Calibration/Field Equipment Failure: See Instruction Manual or Equipment Manager

Preventative Maintenance Procedures

Charge the equipment battery for at least 8 hours prior to use, to ensure a complete charge.

Preventative Maintenance Schedule

The MiniRAE 3000 Photoionization Detector is an advanced-design, portable, organic vapor meter for the gas survey industry. This analyzer uses a photoionization detector (PID)
The vapor concentration may be read immediately on the display. Vapor concentration is displayed in parts per million (ppm). The data displayed may also be collected and saved in the unit's memory and downloaded to a personal computer for analysis.

MiniRAE 3000 Photoionization Detector Specifications

Measurement range & resolution Lamp	Range	Resolution
10.6 eV	0.1 ppm to 15,000 ppm	0.1 ppm
9.8 eV	0.1 ppm to 5,000 ppm	0.1 ppm
11.7 eV	0.1 ppm to 2,000 ppm	0.1 ppm

Response time (T90): 2 seconds

Accuracy: 10 to 2000 ppm: ±3% at calibration point. (Isobutylene):

PID Detector: Easy access to lamp and sensor for cleaning and replacement
Correction Factors: Over 200 VOC gases built in (based on RAE Systems Technical Note TN-106)

Calibration: Two-point field calibration of zero and standard reference gases

Calibration Reference: Store up to 8 sets of calibration data, alarm limits and span values

Inlet Probe: Flexible 5" tubing

Radio module: Bluetooth (2.4GHz), RF module (433MHz, 868MHz , 915MHz, or 2.4GHz)

Keypad: 1 operation key and 2 programming keys; 1 flashlight switch

Direct Readout: Instantaneous, average, STEL, TWA and peak value, and battery voltage

Intrinsic Safety: US and Canada: Class I, Division 1, Groups A, B, C, D Europe: ATEX (0575 Ex II 2G Ex ia IIC/IIB T4 Gb) KEMA 07 ATEX 0127 Complies with EN60079-0:2009, EN60079-11:2007 IECEx CSA 10.0005 Ex ia IIC/IIB T4 Gb Complies with IEC 60079-0:2007, IEC 60079-11:2006 (IIC: 059-3051-000 Li-ion bat pack or 059-3054-000 NiMH bat pack; IIB: 059-3052-000 alkaline bat pack)

EM Interference: Highly resistant to EMI/RFI. Compliant with EMC R&TTE (RF Modules)

Alarm Setting: Separate alarm limit settings for Low, High, STEL and TWA alarm

Operating Mode: Hygiene or Search mode

Alarm: Buzzer 95dB at 30cm and flashing red LEDs to indicate exceeded preset limits, low battery voltage or sensor failure

Alarm Type: Latching or automatic reset

Real-time Clock: Automatic date and time stamps on datalogged information

Datalogging: 260,000 points with time stamp, serial number, user ID, site ID, etc.

Communication: Upload data to PC and download instrument setup from PC via USB on charging station.

Sampling Pump: Internally integrated. Flow rate: 450 to 550 cc/min.

Temperature: -20º C to 50º C (-4º to 122º F)

Humidity: 0% to 95% relative humidity (non-condensing)

Housing (including) Polycarbonate, splash proof and dustproof

Rubber boot: Battery can be changed without removing rubber boot

Turning the Instrument On

1. With the instrument turned off, press and hold [MODE].
2. When the display turns on, release the [MODE] key.

The RAE Systems logo should appear first. (If the logo does not appear, there is likely a problem and you should contact your distributor or RAE Systems Technical Support.) The instrument is now operating and performs self tests. If any tests (including sensor and memory tests fail), refer to the Troubleshooting section of this guide.

Once the startup procedure is complete, the instrument shows a numerical reading screen with icons. This indicates that the instrument is fully functional and ready to use.

Turning the Instrument Off

1. Press and hold the Mode key for 3 seconds. A 5-second countdown to shutoff begins.
2. Once the countdown stops, the instrument is off. Release the Mode key.
3. When you see "Unit off..." release your finger from the [MODE] key. The instrument is now off.

Note: You must hold your finger on the key for the entire shutoff process. If you remove your finger from the key during the countdown, the shutoff operation is canceled and the instrument continues normal operation.

Operating the Built-In Flashlight

The instrument has a built-in flashlight that helps you point the probe in dark places. Press the flashlight key to turn it on. Press it again to turn it off.

Note: Using the flashlight for extended periods shortens the battery's operating time before it needs recharging.

Pump Status

IMPORTANT!

During operation, make sure the probe inlet and the gas outlet are free of obstructions. Obstructions can cause premature wear on the pump, false readings, or pump stalling. During normal operation, the pump icon alternately shows inflow and outflow as shown here:

MiniRAE 3000 User's Guide During duty cycling (PID lamp cleaning), the display shows these icons in alternation:

If there is a pump failure or obstruction that disrupts the pump, you will see this icon blinking on and off:

If you see this blinking icon, consult the Troubleshooting section of this guide.

Calibration Status

The instrument displays this icon if it requires calibration:

Calibration is required (and indicated by this icon) if:

- The lamp type has been changed (for example, from 10.6 eV to 9.8 eV).
- The sensor has been replaced.
- It has been 30 days or more since the instrument was last calibrated.
- If you have changed the calibration gas type without recalibrating the instrument.

After the instrument is turned on, it runs through the start-up menu. Then the messages "Please apply **zero gas…**" is displayed.

At this point, you can perform a zero air (fresh air) calibration. If the ambient air is clean, you can use that. Otherwise, use a charcoal scrubbing tube included with the instrument kit.

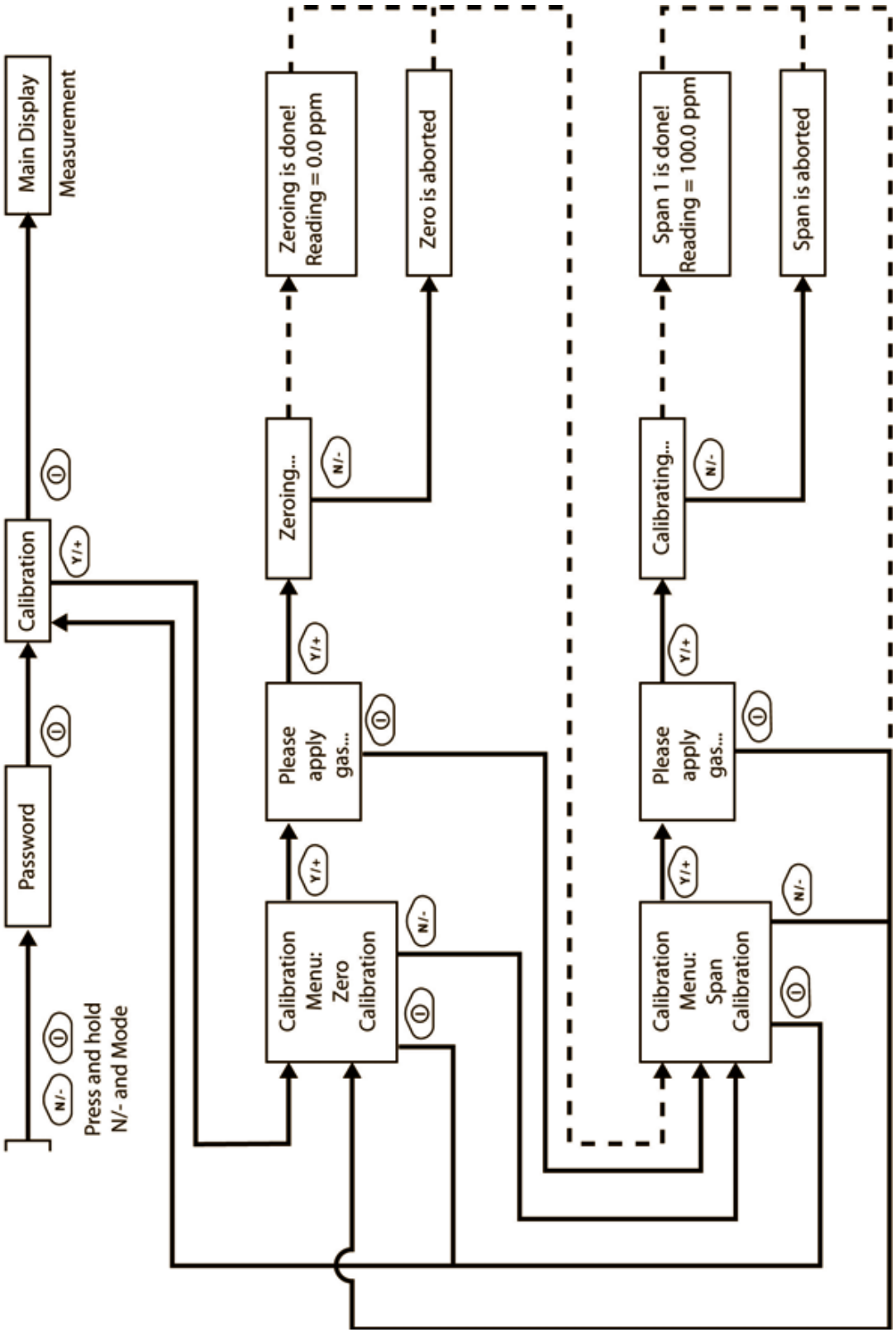
Start zero calibration by pressing Start. You see the message Zeroing…" followed by a 30-second countdown. **Note:** You can press [MODE] to quit, bypassing the zero air calibration. When zero calibration is complete, you see the message:

Zeroing is done!

Reading = 0.0 ppm

The instrument is now sampling and collecting data.

Note: At the Average & Peak, Date & Time & Temperature, Calibration Gas & Measurement Gas & Correction Factor, and PC Communications screens, the instrument automatically goes to the main display after 60 seconds if you do not push a key to make a selection.


Main Display
Measurement
Calibration
Password
Press and hold
N/- and Mode
N/-
Y/+
Zeroing is done!
Reading = 0.0 ppm
Zero is aborted
Zeroing...
Please
apply
gas...
Calibration
Menu:
Zero
Calibration
Span 1 is done!
Reading = 100.0 ppm
Span is aborted
Calibrating...
Calibration
Menu:
Span
Calibration

Operating guidelines:

- Check calibration daily or before use. If calibration check is ± 5% of true value, recalibrate the instrument using the calibration gas located in a separate equipment case by following the directions written in the operating manual. If the calibration fails, contact the Equipment Technician.
- Avoid use at temperatures below 32°F.
- Allow instrument to "warm up" 5 to 10 minutes after ignition before checking calibration or monitoring.

* See MiniRAE 3000 manual for specific operating instructions.

The following procedure will be used for conducting headspace organic vapor screening:

1. Soil samples collected from, split-barrel sampler or a direct-push (i.e., Geoprobe®) sample liner will be collected immediately after opening the barrel or liner. If the sample is collected from an excavation wall, soil pile, or backhoe bucket, it will be collected from a freshly exposed surface.
2. Half-fill the bag with the sample to be analyzed using a stainless-steel spoon or a gloved hand and immediately seal it.
3. Agitate the bag for 15 seconds. Manually break up any soil clumps within the bag.
4. Allow headspace development for approximately 10 minutes. The sample should be kept in a shaded area out of direct sunlight. Ambient temperatures during headspace development should be recorded. When ambient temperatures are below 50°F, headspace development should be conducted inside a heated vehicle or building.
5. Agitate the bag for an additional 15 seconds.
6. Quickly puncture the bag with the sampling probe to a point about one-half of the headspace depth. Exercise care to avoid uptake of water droplets or soil particles.

Interferences/Discussion

May not function properly if used in temperatures below 32°F and must be slowed to warm up for a minimum of 5-10 minutes prior to operation.

Quality Control Samples

Replicate sample measurements should be taken a minimum of one of twenty project samples. Method Blanks must be one for every batch of samples analyzed.

Preventative Maintenance Procedure

Charge the battery for a minimum of 8 hours prior to use, to ensure a complete charge. If calibration gas canister pressure readings are below 40 psi, contact the Equipment Manager for replacements.

Sample Storage

The samples should be bubble wrapped or bagged immediately after collection, stored in a sample cooler, packed on double bagged wet ice and accompanied with the proper chain of custody documentation. Samples will be kept cold (approximately 4°C) until receipt at the laboratory, where they are to be stored in a refrigerated area. Custody seals may be present, but at minimum, the coolers must be taped shut with three straps of fiberglass tape. All samples will be kept secured to prevent tampering. If sample coolers are left in a vehicle or field office for temporary storage, the area will be locked and secured. The coolers

must be delivered to the laboratory via hand or overnight delivery courier in accordance with all Federal, State and Local shipping regulations.

Note: Samples may have to be stored indoors in winter to prevent freezing.

Disposal

All waste generated by this process will be disposed of in accordance with Federal, State and Local regulations. Where reasonably feasible, technological changes have been implemented to minimize the potential for environmental pollution.

Documentation

The field technician is responsible for documenting the proper calibration and operation of the MiniRAE 3000 and the proper documentation of the data on the Field Log Book and/or Site Specific Field Sheets.

Attachments

Attachment 1: Field Sampling Report
Attachment 2: Field Log Cover Sheet
Attachment 3: Meter Calibration Summary Form

Attachment 1
Field Sampling Report

BARR

FIELD SAMPLING REPORT

Date:

Project:

Contact:

Barr Engineering Company
4700 W. 77th Street
Minneapolis, MN 55435-4803

Field Sampling

Field Report

Attachments:

-
-
-
-
-
-
-

Laboratory Analysis Status

<Name inserts here>
Environmental Technician

Document1

Barr Engineering Company ' 4700 W. 77th Street ' Minneapolis, MN 55435-4803 ' 952/832-2600

Attachment 2
Field Log Cover Sheet

BARR

FIELD LOG COVER SHEET
WATER SAMPLING

Client: **Project No.:**

Technician: **Sampling Period:**

Date	Temperature	Wind Speed	Wind Direction	Cloud Cover

Summary of Field Activities

Document1

Attachment 3
Meter Calibration Summary Form

MCS-1

BARR ENGINEERING COMPANY
METER CALIBRATION SUMMARY

PROJECT _____

TECHNICIAN _____

Meter type and number	Date	Time	Temperature C	Standard Used	Meter Reading	Slope	Conductivity Redline
Conductivity	Date	Solution Used	Cell Result				
Cell Check							
ORP Probe	Date	Temp.	ORP Reading	Calculation Result			
Check							
231+,- 10mV @ 25C							
231mV = Display Value + [(Display Temp. - 25 C) x (1.3 mV)]							

WEATHER CONDITIONS

Date	Wind Direction	Wind Speed	Temperature F	Cloud Cover	Comments

Comments: _____

Standard Operating Procedure

Collection of Soil Samples

Revision 9

March 20, 2019

Approved By:

Kevin McGilp		03/20/19
Print Technical Reviewer	Signature	Date

Terri Olson		03/20/19
Print QA Manager	Signature	Date

Review of the SOP has been performed and the SOP still reflects current practice.

Initials:		Date:	
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Initials:		Date:	
Initials:		Date:	

Collection of Soil Samples

1.0 Scope and Applicability

The purpose of this Standard Operating Procedure (SOP) is to describe the collection of a representative soil sample using a variety of methods (including compositing of discrete samples) and equipment depending on the depth and type of sample required. This procedure applies to the collection of soil samples for volatiles (VOC), semivolatiles (SVOC), general chemistry, and metals analyses.

The recommended procedures in this SOP should be followed unless conditions make it impractical or inappropriate to do so. Modifications should be noted in the applicable documentation and communicated to appropriate personnel. Significant changes may result in a revision or newly created SOP.

2.0 Limitations

- Sample collection methods can vary by project. If not specified in the project scope of work and/or documentation (e.g., Work Plan, Sampling Analysis Plan (SAP), or Quality Assurance Project Plan (QAPP)), consult with the appropriate regulatory agency for guidance.
- Inadequate homogenization of the samples, where applicable, can result in non-representative samples and results.
- Decontamination of sampling equipment is required to prevent cross-contamination.
- Contact the local one call system prior to digging to have public utilities identified at sampling locations. Privately owned underground utilities, if present, typically will not be identified by the one call system and contracting with a private utility locater may be necessary.
- If sampling for per- and polyfluorinated alkyl substances (PFAS), special consideration must be taken to avoid accidental contamination of environmental samples - see Barr's SOP 'Collection of Per- and Polyfluorinated Alkyl Substances (PFAS) Samples'.

3.0 Responsibilities

The Project Manager, in conjunction with the client, develops the site specific scope of work (e.g., Work Plan, SAP, etc.).

Experienced Field Technicians are responsible for the proper sample identification, collection of samples, field screening procedures, field equipment and calibration, quality control procedures, and documentation.

Equipment Technicians are responsible for maintaining equipment in working order and aiding in troubleshooting equipment issues.

The role of the Field Safety Representative is to oversee on-site safety activities.

Project staff are responsible for ordering sample containers prior to the sampling event.

4.0 Safety

Barr staff is responsible for conducting the aspects of the job safely. When applicable, refer to the appropriate Project Health and Safety Plan (PHASP) to understand the hazards associated with suspected

contamination, symptoms of exposure, methods to minimize exposure, personal protective equipment (PPE), and personal air monitoring required when using this SOP. Minimum protection of one pair of chemical resistant gloves (e.g., nitrile) and safety glasses with side shields should be worn to prevent sample contact with the skin and eyes. When sampling soils contaminated with corrosive materials, emergency eye flushing facilities should be available.

Some of the sample containers may require the use of preservatives. Consult the applicable Safety Data Sheet to review hazards and appropriate PPE to minimize exposure.

5.0 Equipment, Reagents, and Supplies*

- Sampling devices/tools
- Stainless steel mixing bowl and spoon
- Sample containers (method specific)
- Balance
- Coolers
- Plastic bags
- Chemical resistant gloves (e.g., nitrile)
- Paper towels/laboratory tissues
- Waterproof ink pen or pencil
- Ice
- Items listed in Section 8.0 Records
- Decontamination supplies (see Decon SOP)

* See Barr's PFAS SOP for a list of prohibited and acceptable items.

6.0 Procedure

This section describes the procedure(s) for the sampling, handling, and delivery of soil samples.

6.1 Calibration

No specific calibration procedures are required for the actual sampling equipment; however, the calibration of the balance should be verified prior to use. Refer to the applicable Barr SOP.

6.2 Sampling

General considerations to be taken into account when planning and conducting sampling operations are the required sample weight, sample holding times, sample handling, and special precautions for trace contaminant sampling.

To prevent sample cross-contamination, the soil sampling equipment is carefully cleaned before initially sampling and after working at each sampling point per Barr's SOP 'Decontamination of Sampling Equipment'. A new, clean outer pair of disposable gloves will be worn for each sample location and sample containers are placed in separate plastic bags after collecting, preserving and tagging. Sample collection activities will typically proceed progressively from the least contaminated area to the most contaminated area (when known).

Depending on the project work to be done, soil samples will be collected for analysis by either a drilling apparatus (equipped with a split spoon or core barrel sampler), hand excavation (hand auger, trowel, or shovel), or direct-push (Geoprobe®) technology

- If a drilling apparatus was used, retrieve the split spoon or core barrel sampler from the desired sampling interval and open. If a liner (sleeve) is present and will not be sampled in the field, wrap the ends of the liner with heavy-duty aluminum foil, taking care to not pierce the foil. Tape the foil to the liner with duct tape to seal. Cover the ends of the liner with plastic caps or duct tape to

fully protect the foil and package for shipment to the laboratory. If a liner is being sampled in the field, open the liner to sample the soil.

- If hand excavating, dig with a trowel or shovel to the desired sampling interval and expose a fresh soil surface to sample. Collect a large sample on a shovel and bring it to the surface or collect the sample directly from the fresh soil surface. The hand excavation technique may be done from the bucket of a backhoe also.
- If direct-push (Geoprobe®) technology is used, soils are typically sampled following the subcontractor's soil sampling procedures. This method generally utilizes a direct-push soil boring rig, steel drive rods and a 2-inch outside diameter (O.D.) soil core sampler with a dedicated 1.75-inch inside diameter (I.D) removable acetate plastic sampler liner. The probe rods and sampling unit are driven to the desired sampling depth by the static weight of the carrier vehicle and hydraulic hammer percussion. Two, four, or five-foot sample cores are typically collected. The assembly is brought to the surface and the soil sample is exposed by cutting open the sampler liner.

In most investigations, the soil samples are field screened for moisture, odor, oil sheen, discoloration and the presence of organic soil vapors and classified in accordance with ASTM D-2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Refer to Barr's SOP 'Screening Soil Samples'.

The form 'Soil Sampling Guidelines' lists the analyses (in order of collection) and describes the preservation, container, and holding time for the most common sampling media (information can vary depending on the laboratory used). The container size, type, preservative, and holding time are important considerations in sample collection. Sample and container size must be adequate to meet laboratory requirements for quality control, split samples, or repeat analyses. The container type varies with the analysis required. Typically, the analytical laboratory will preserve the container before shipment, where applicable. Preservation and shelf life vary; contact the laboratory to determine if an on-hand container is still useful.

Both discrete and composite samples can be used for environmental investigations. A discrete sample is a sample that originated from a specific area at a specific time. The sample may be transferred directly from the sampler or sampling location to the sample container.

A composite sample is a collection of multiple temporary or discrete samples of the same medium that are combined, thoroughly homogenized, and treated as a single sample. Composite samples are valuable in characterizing a large area or volume of soil.

Note: Samples collected for analysis of volatile organic compounds (VOC) should not be homogenized or composited, due to aeration of the sample during mixing which may result in loss of VOC.

6.2.1 Volatile Organic Compounds (VOC)

If VOC or similar analyses (e.g., GRO, TPH as Gasoline) are being analyzed, these samples should be collected as soon as possible after the soil is removed from the ground from a representative area of the most undisturbed soil possible. Please refer to Barr's SOP 'Screening Soil Samples'. It is important to note that there are different containers and sampling media available for collecting a soil sample for VOC. Typically, the VOC sample is collected at a 1:1 weight ratio with a preservative. A coring device, such as a

Terra Core® or En Core® sampler, is the first choice for sampling. After VOC samples are collected, mix the remaining soil from the sampling locations/intervals prior to filling the rest of the sample containers.

Note: Analytical samples should not be collected from polyethylene bags used for field screening purposes.

6.2.1.1 Terra Core® Sampler

The Terra Core® Sampler is a single use device that is typically supplied with a 40 mL VOA (volatile organic analysis) vial containing preservative (e.g., methanol) and an unpreserved container for % moisture/% solids determination. To use the Terra Core®, make certain the plunger is aligned with, and seated in, the handle. Push the Terra Core® into freshly exposed soil until the sample chamber is filled. Depending on the Terra Core® sampler size, a filled chamber will deliver approximately 5 or 10 g of soil. If a 1:1 ratio of soil to preservative is needed, verify the correct size sampler is being used.

Wipe the outside of the sampler, check that the soil plug is flush with the mouth of the sampler, and remove any excess soil. Rotate the plunger 90° until it is aligned with the slots in the body. Extrude the sample into the appropriate container by pushing the plunger down. To provide a good sealing surface, wipe the container lip and screw threads to remove soil and immediately screw on the lid. If preservative is present in the container, swirl to immerse the sample. Record the sample ID on the container and package for shipment to the laboratory.

6.2.1.2 En Core® Sampler

The disposable En Core® sampler is a single use device that is pushed into the soil using a reusable En Core® T-handle. Two, 5 g samplers are typically supplied with an unpreserved container for percent moisture/percent solids determination. Hold the En Core® coring body and push plunger down until the small O-ring rests against the tabs so the plunger moves freely.

Depress the locking lever on the T-handle. Place coring body plunger end first into the open end of the T-Handle, aligning the slots on the coring body with the locking pins in the T-Handle. Twist coring body clockwise to lock pins in slots. Make certain that the sampler is locked in place.

Turn T-handle with T-up and coring body down. This will position the plunger bottom flush with bottom of coring body. Using T-handle, push sampler into soil until coring body is completely full. When full the small O-ring will be centered in the T-handle viewing hole. Remove excess soil from the coring body exterior.

Cap the coring body while it is still on the T-handle by pushing and twisting the cap over the bottom until grooves on locking arms seat over ridge on coring body. Remove the coring body from the T-handle and lock plunger by rotating extended plunger rod fully counterclockwise until wings rest firmly against tabs.

Attach the accompanying label and package for shipment to the laboratory.

6.2.1.3 Other

If no coring device is available, an estimate of the amount of soil needed to provide the desired weight can be determined. Place an extra laboratory container, disposable weigh boat, paper towel, or laboratory tissue on a balance pan. Using a stainless steel spoon, add the desired weight (10 g or 25 g) of a representative soil sample on the balance. Once the amount has been established, discard the soil used in the estimation and collect the sample as per form 'Soil Sampling Guidelines' or laboratory instructions.

If allowed by applicable regulations for VOC sample collection, the VOC aliquot may be weighed directly into the sample container by placing the pre-weighed sample container on the balance, taring the balance, then adding the appropriate amount of soil to the container to reach the desired aliquot weight. This should be done quickly to reduce the possible loss of VOCs.

6.2.2 Compositing Discrete Samples

Discrete samples, to be used for compositing, are stored at ≤ 6 °C until each individual sample is obtained. A minimum volume of soil obtained during discrete sampling will be dependent on the final analytical requirements for the composite sample and the laboratory requirements.

After discrete samples have been obtained, record the locations to be included in a final composited sample in the field documentation. Appropriate laboratory containers should be labeled with this final sample identifier and the date of collection.

Retrieve the samples selected for compositing from storage. One container from each discrete sample location should remain in storage in case individual sample confirmations are necessary. Empty the entire contents of each container into a stainless steel mixing bowl, removing any large debris or rocks, and mix thoroughly.

6.2.3 SVOC / General Chemistry / Metals

Using either a composited sample or a homogenized, discrete sample, fill the remaining containers in the order listed on form 'Soil Sampling Guidelines'. To reduce potential contamination, samples for PFAS should be collected first. See Barr's SOP 'Collection of Per- and Polyfluorinated Alkyl Substances (PFAS) Samples'. Typically, the soil is packed into the sample jars leaving no headspace. If allowed by applicable regulations, the WIDRO sample may be weighed directly into the sample container by placing the pre-weighed sample container on the balance, taring the balance, then adding the appropriate amount of soil to the container to reach the desired sample weight (~25 g).

Wipe the container lip and screw threads to remove soil and provide a good sealing surface, and immediately screw on the lid.

6.2.4 Handling

After collection, the samples should be handled as few times as possible. Samplers should use extreme care to ensure that samples are not contaminated. Immediately after samples are collected, they are bubble wrap or bagged and placed in a cooler containing bagged ice. Samples will be kept cold (≤ 6 °C, but not frozen) until receipt at the laboratory, where they are to be stored in a refrigerated area.

Note: Samples may need to be stored indoors in winter to prevent freezing.

6.2.5 Shipment/Delivery

Once the cooler is packed to prevent breaking of containers, the proper COC documentation is relinquished by the sampler, placed into a plastic bag, and included in the cooler.

Samples will be kept secured to prevent tampering. If sample coolers are left in a vehicle or field office for temporary storage, the area will be locked and secured.

Custody seals may be present, but at a minimum, the coolers must be taped shut to prevent the lid from opening during shipment.

The coolers must be delivered to the laboratory via hand or overnight delivery courier in accordance with Federal, State and Local transportation regulations and Barr's SOP 'Domestic Transport of Samples to the Laboratory'.

6.3 Data Reduction/Calculations

No data reduction or calculations are associated with this procedure.

6.4 Disposal

Waste generated by this process will be disposed of in accordance with Federal, State and Local regulations and Barr's SOP 'Investigative Derived Waste'. Where reasonably feasible, technological changes have been implemented to minimize the potential for environmental pollution.

7.0 Quality Control and Quality Assurance (QA/QC)

The QC activities described below allow the self-verification of the quality and consistency of the work.

7.1 QA/QC Samples

QA/QC samples are defined in Barr's SOP 'Collection of Quality Control Samples'. The sampling frequency should be performed as written in the project scope of work and/or documentation (e.g., Work Plan, SAP, or QAPP).

7.2 Measurement Criteria

No specific criteria apply to the implementation of this SOP.

8.0 Records

The field technician will document the soil sampling event in a project dedicated field logbook or on field log data sheets. The analysis for each container, the number of bottles, and the laboratory used will be documented on the chain-of-custody record. Refer to Barr's SOP 'Documentation on a Chain-of-Custody (COC)' for further information.

Examples of common field documentation are available in Barr's "Compendium of Field Documentation". Field documentation specific to this SOP are listed below:

- COC
- Sample label
- Custody seal (if applicable)
- Field Sampling Report
- Field Log Data Sheet
- Soil Sampling Guidelines (includes sampling order, container, preservation, and holding time)

Field documentation and COC are provided to a Barr Data Management Administrator for storage on the internal Barr network.

Additional records information can be found in Barr's "Records Management System Manual."

Other Barr SOP subjects referenced within this SOP: screening soil samples, balance calibration, collection of QC samples, collection of PFAS samples, decontamination of sampling equipment, investigative derived waste, domestic transport of samples, and documentation on a COC.

9.0 References

USEPA Environmental Response Team. 2000. *SOP for Soil Sampling*.

Standard Operating Procedure

Collection of Per- and Polyfluorinated Alkyl Substances (PFAS) Samples

Revision 0

March 12, 2019

Approved By:

Kevin McGilp		03/12/19
Print Technical Reviewer	Signature	Date

Terri Olson		03/12/19
Print QA Manager	Signature	Date

Review of the SOP has been performed and the SOP still reflects current practice.

Initials: _____ Date: _____

Initials: _____ Date: _____

Initials: _____ Date: _____

Initials: _____ Date: _____

Collection of Per- and Polyfluorinated Alkyl Substances (PFAS) Samples

1.0 Scope and Applicability

The purpose of this Standard Operating Procedure (SOP) is to describe the methods used when collecting liquid (e.g., drinking water, groundwater, surface water, wastewater) and solid (e.g., soil, sediment, wipe) samples for per- and polyfluorinated alkyl substances (PFAS) analysis.

The recommended procedures in this SOP should be followed unless conditions make it impractical or inappropriate to do so. Modifications should be noted in the applicable documentation and communicated to appropriate personnel. Significant changes may result in a revision or newly created SOP.

2.0 Limitations

- Sample collection methods can vary by project. If not specified in the project scope of work and/or documentation (e.g., Work Plan, Sampling Analysis Plan (SAP), or Quality Assurance Project Plan (QAPP)), consult with the appropriate regulatory agency for guidance.
- PFAS samples are susceptible to contamination from many sources. Special consideration must be taken to avoid accidental contamination of environmental samples due to the presence of fluoropolymers, such as polytetrafluoroethylene (PTFE, e.g., Teflon®), in many consumer products and sampling materials.
- Dedicated or disposable sampling equipment and/or decontamination of sampling equipment should be used to prevent cross-contamination, where applicable.
- Since there are many individual PFAS, the substances of concern can vary by project. If a PFAS project list is not specified in the project scope of work and/or documentation (e.g., Work Plan, Sampling Analysis Plan (SAP), or Quality Assurance Project Plan (QAPP)), consult with the appropriate regulatory agency for guidance to develop an appropriate PFAS project list.

3.0 Responsibilities

Equipment Technicians are responsible for maintaining equipment in working order and aiding in troubleshooting equipment issues.

The role of the Field Safety Representative is to oversee on-site safety activities.

The Project Manager, in conjunction with the client, develops the site specific scope of work (e.g., Work Plan, SAP, etc.).

Experienced Field Technician(s) are responsible for the proper sample identification, collection of samples, quality control procedures, and documentation.

Project staff are responsible for ordering sample bottles prior to the sampling event.

4.0 Safety

Barr staff is responsible for conducting the aspects of the job safely. When applicable, refer to the appropriate Project Health and Safety Plan (PHASP) to understand the hazards associated with suspected

contamination, symptoms of exposure, methods to minimize exposure, personal protective equipment (PPE), and personal air monitoring required when using this SOP. Minimum protection of one pair of chemical resistant gloves (e.g., nitrile) and safety glasses with side shields should be worn to prevent sample contact with the skin and eyes. When sampling waters contaminated with corrosive materials, emergency eye flushing facilities should be available.

Some of the sample containers may require the use of preservatives. Consult the applicable Safety Data Sheet to review hazards and appropriate PPE to minimize exposure.

5.0 Equipment, Reagents, and Supplies

A summary of prohibited and acceptable materials is provided in Table 1. The list represents best practices when sampling but is subject to change as new information becomes available. Equipment and/or materials listed in other referenced SOPs may be used if known to be PFAS-free. If presence is unknown, it is highly recommended that rinsate blanks, or the materials themselves, be collected and submitted to the laboratory prior to use for analysis of the PFAS project list.

6.0 Procedure

This section describes the procedure(s) for the sampling, handling, and delivery of liquid and solid PFAS samples.

6.1 Calibration

Please refer to the individual field equipment SOP to be used during sampling.

6.2 Sampling

PFAS are man-made fluorinated and environmentally persistent compounds that do not occur naturally in the environment. Due to the presence of PFAS in common consumer products, the environment, and in equipment typically used to collect samples, care must be taken during sampling operations to minimize exposure of the sample to human, atmospheric, and other potential sources of contamination. A conservative approach is to exclude materials know to contain PFAS. When PFAS-containing equipment or supplies cannot be eliminated (e.g., fire retardant clothing at a refinery), consider collecting a sample of the material or a rinsate blank sample to show the extent of possible PFAS contamination. Use appropriate SOPs for sampling according to the matrix being collected.

6.2.1 Source/Import Materials

Since PFAS is commonly found in many products, including equipment typically used to collect samples, materials being brought onto a project site should be screened for the project list of PFAS prior to use. Source/import materials may include, but are not limited to:

- Water used for drilling and decontamination
- Pumps, and drilling equipment that contacts the soil or water being sampled (e.g., drill augers, drill rods, direct-push sample liners, and well casing and screens)
- Personal protective equipment (PPE), including Tyvek®, leather gloves and boots (treated or not)
- Food wrappers and containers
- Additional items listed in Table 1

Depending on the item, sample a portion of the material or collect a rinsate blank by rinsing the material with PFAS-free water (typically supplied by the selected laboratory) and send to the laboratory for PFAS analysis. Best practice for a project is to define what is considered PFAS-free prior to beginning sampling operations. The material is considered acceptable for use if the PFAS results reported as nondetections, or less than the reporting limit, meet project requirements. As the current trends regarding acceptable and prohibited materials is evolving with respect to this emerging contaminant, it is recommended that the project team is consulted prior to sampling to determine if any changes have been made to the acceptable substances list.

6.2.2 Water and Soil Samples

Put on new sampling gloves at each sampling site to reduce the risk of sample cross-contamination and exposure to skin. Never reuse gloves. Use the sampling SOP that is appropriate for the type of sample being collected. **Collect PFAS samples first at each sampling location to minimize contact with other types of sample containers that may contain PFAS.** Avoid contact with the prohibited materials listed in Table 1 if possible.

Field blanks are typically collected with PFAS samples. Due to the possible areas of contamination, as well as the demand for increasingly lower reporting limits, the water used for the field blank is typically supplied by the lab. When collecting the field blank, pour the field blank water into the sample bottle and label this bottle as the field blank. Trip blanks, if required by the project, are supplied by the laboratory. They should accompany each cooler of PFAS samples and field blanks collected. Document the field and trip blank samples on the chain-of-custody (COC).

Turn off any equipment, disassemble the sampling apparatus, dispose of one-time use (disposable) equipment, and decontaminate reusable equipment per Barr's SOP 'Decontamination of Sampling Equipment'. Whenever possible, materials used for decontamination will need to be PFAS-free.

6.2.3 Preservation

Sample container size, type, and preservative are important considerations in sample collection. Container volume must be adequate to meet laboratory requirements for quality control, split samples, or repeat analyses. The container type varies with the matrix and analysis required. If preservation is required, the analytical laboratory will preserve the container before shipment. Barr's 'Water Sampling Guidelines' and 'Soil Sampling Guidelines' forms list the container type, container size, and preservative.

6.2.4 Handling

Prepare sample bottles/jars by filling out the label, using an indelible marker (e.g., fine point Sharpie®) with the following information at a minimum.

- Sample ID
- Date and time of sample collection
- Preservative
- Sample analysis (if required by the lab)

If placed into a bag, samples can be labeled directly on the bag, minimizing potential for contaminating sample. The bagged samples and blanks will be stored in a separate sample cooler (other sampling

containers may contain PFAS) and packed on bagged wet ice (not chemical ice packs – see Table 1). Samples will be kept cold (≤ 6 °C, but not frozen), until receipt at the laboratory.

Note: Samples may need to be stored indoors in winter to prevent freezing.

6.2.5 Shipment/Delivery

Once the cooler is packed to reduce bottle shifting during transport, the proper COC documentation is signed and placed inside a plastic bag then added to the cooler.

Samples will be kept secured to prevent tampering. If sample coolers are left in a vehicle or field office for temporary storage, the area will be locked and secured.

Custody seals may be present, but at a minimum, the coolers must be taped shut to prevent the lid from opening during shipment.

The coolers must be delivered to the laboratory via hand or overnight delivery courier, if possible, in accordance with Federal, State and Local transportation regulations and Barr's SOP 'Domestic Transport of Samples to the Laboratory'.

6.3 Data Reduction/Calculations

No data reduction or calculations are associated with this procedure.

6.4 Disposal

Project-specific protocols for disposal of PFAS-contaminated investigation derived waste (IDW) should be established before sampling begins. Project IDW disposal plans should be adhered to in order to ensure that materials are stored and disposed of properly. Waste generated by this process will be disposed of in accordance with the project requirements, Federal, State and Local regulations, and Barr's SOP 'Investigative Derived Waste'. Where reasonably feasible, technological changes have been implemented to minimize the potential for environmental pollution.

7.0 Quality Control and Quality Assurance (QA/QC)

The QC activities allow the self-verification of the quality and consistency of the work.

7.1 QA/QC Samples

QA/QC samples are defined in Barr's SOP 'Collection of Quality Control Samples'. The sampling frequency should be performed at the frequency noted in the project scope of work and/or documentation (e.g., Work Plan, SAP, or QAPP). To demonstrate that sample contamination has not occurred during field sampling, one field blank should be processed per day or per project requirements. If a trip blank was provided, it should be included with each PFAS cooler or per project requirements. The PFAS concentrations in the field and trip blank samples should not be detected at the level required for the project.

8.0 Records

The field technician will document the order in which the wells were sampled, any potential sources of contamination (e.g., changes in weather, wind direction, activity in the area), and any field test measurements on the field log data sheet and/or field notebook. They will also document the type and

number of bottles on the chain-of-custody record, as appropriate. The analysis for each bottle and the laboratory used will be documented on the chain-of-custody record. Refer to Barr's SOP 'Documentation on a Chain-of-Custody (COC)' for further information.

Examples of common field documentation are available in Barr's "Compendium of Field Documentation". Field documentation is specific to the sampling SOP being used.

The field documents and COCs are provided to a Barr Data Management Administrator for storage on the internal Barr network.

Additional records information can be found in Barr's "Records Management System Manual".

Other Barr SOP subjects referenced within this SOP: collection of various matrices (e.g., groundwater, surface water, soil), low-flow sampling, field equipment, collection of QC samples, decontamination of sampling equipment, investigative derived waste, domestic transport of samples, and documentation on a COC.

9.0 References

Interstate Technology and Regulatory Council. 2018. *Site Characterization Considerations, Sampling Precautions, and Laboratory Analytical Methods for Per- and Polyfluoroalkyl Substances (PFAS)*.

Michigan Department of Environmental Quality. 2018. *General PFAS Sampling Guidance*.

Michigan Department of Environmental Quality. 2018. *MDEQ PFAS Sampling Quick reference Field Guide*.

New Hampshire Department of Environmental Services. 2016. *Perfluorinated Compound (PFC) Sample Collection Guidance*.

USEPA. 2018. *Method 537.1: Determination of Selected Per- and Polyfluorinated Alkyl Substances in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)*.

Table 1
Prohibited and Acceptable Items for PFAS Sampling

Prohibited Items	Acceptable Items
Field Equipment	
Teflon® containing materials	High-density polyethylene (HDPE)
Storage of samples in containers made of LDPE materials	Acetate liners
Teflon® tubing	Silicon tubing
Waterproof field books	Loose paper (non-waterproof)
Plastic clipboards, binders, or spiral hard cover notebooks	Aluminum field clipboards or with Masonite
Post-It Notes	Sharpies®, pens
Chemical (blue or black) ice packs	Regular ice
Field Clothing and Personal Protective Equipment (PPE)	
New clothing or water resistant, waterproof, or stain- treated clothing, clothing containing Gore-Tex®. Avoid any sort of synthetic "performance" fabrics	Well-laundered clothing, defined as clothing that has been washed 6 or more times after purchase, made of synthetic or natural fibers (preferable cotton)
Clothing laundered using fabric softener	No fabric softener
Boots containing Gore-Tex® Leather boots and gloves may require pre-screening	Boots made with polyurethane and polyvinyl chloride (PVC) Disposable PFAS-free over-boots PFAS-free leather boots and gloves
Tyvek® (coated variety)	Cotton Clothing Plain, uncoated Tyvek® (must verify prior to use)
No cosmetics, moisturizers, hand cream, or other related products as part of personal cleaning/showering routine on the morning of sampling	**Sunscreens** Alba Organics Natural Sunscreen, Yes To Cucumbers, Aubrey Organics, Jason Natural Sun Block, Kiss my face, Baby sunscreens that are "free" or "natural" **Insect Repellents** Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Insect repellant, Herbal Armor, California Baby Natural Bug Spray, BabyGanics **Sunscreen and insect repellant** Avon Skin So Soft Bug Guard Plus – SPF 30 Lotion
Sample Containers	
LDPE or glass containers	HDPE or polypropylene
Teflon®-lined caps	Lined or unlined HDPE or polypropylene caps
Rain Events	
Waterproof or water resistant rain gear	Gazebo tent that is only touched or moved prior to and following sampling activities
Equipment Decontamination	
Decon 90	Alconox® and/or Liquinox®
Water from an on-site well	PFAS-free water
Food Considerations	
All food and drink, with exceptions as noted for acceptable items	Bottled water and hydration drinks (i.e. Gatorade® and Powerade®) to be brought and consumed only in the staging area
General *Prohibited includes materials or equipment containing:*	
Teflon®, polytetrafluoroethylene (PTFE) Food containers with waterproof coatings Anything with fluoro in the name Fluorinated ethylene propylene (FEP) Ethylene tetrafluoroethylene (ETFE) Low density polyethylene (LDPE) Polyvinylidene fluoride (PVDF)	Anything including the trademarks Teflon® and Hostaflon® Anything including the trademark Kynar® Anything including Polychlorotrifluoroethylene (PCTFE), that includes the trademark Neoflon ® Anything including the trademark Tefzel® Anything including the trademarks Teflon® FEP and Hostaflon® FEP

Standard Operating Procedure

Decontamination of Sampling Equipment

Revision 1

March 15, 2018

Approved By:

John W. Juntilla		03/15/18
Print Technical Reviewer	Signature	Date

Terri Olson		03/15/18
Print QA Manager	Signature	Date

Review of the SOP has been performed and the SOP still reflects current practice.

Initials:		Date:	
Initials:		Date:	
Initials:		Date:	
Initials:		Date:	

Decontamination of Sampling Equipment

1.0 Scope and Applicability

The purpose of this Standard Operating Procedure (SOP) is to define the process used for decontaminating environmental sampling-related equipment including pumps, meters, and materials coming into contact with actual sampling equipment or with sampling personnel. This procedure is applicable to all personnel who are collecting samples and/or decontaminating sampling and field equipment.

The recommended procedures in this SOP should be followed unless conditions make it impractical or inappropriate to do so. Modifications should be noted in the applicable documentation and communicated to appropriate personnel. Significant changes may result in a revision or newly created SOP.

2.0 Limitations

- Equipment used once and discarded such as bailers, protective gear, and filtration devices are not part of this SOP.

3.0 Responsibilities

The equipment technician is responsible for ensuring field equipment has been thoroughly decontaminated and prepared for use out in the field. The field technician(s) are responsible for decontamination in the field at each individual sampling point and for ensuring adherence to any investigative derived waste (IDW) project-specific requirements set forth in a QAPP or SAP (if applicable).

The role of the Field Safety Representative is to oversee on-site safety activities.

4.0 Safety

Barr staff is responsible for implementing aspects of the job safely. Where available, refer to the appropriate Project Health and Safety Plan (PHASP) to determine the proper personal protection equipment (PPE) required when using this SOP. Barr staff is responsible for conducting all aspects of the job safely. When applicable, refer to the appropriate Project Health and Safety Plan (PHASP) to understand the hazards associated with suspected contamination, symptoms of exposure, methods to minimize exposure, personal protection equipment (PPE), and personal air monitoring required when using this SOP. Minimum protection of one pair of chemical resistant gloves (e.g., nitrile) and safety glasses with side shields should be worn to prevent sample contact with the skin and eyes. When sampling soils contaminated with corrosive materials, emergency eye flushing facilities should be available.

Some of the sample containers may require the use of preservatives. Consult the applicable Safety Data Sheet to review hazards and appropriate PPE to minimize exposure.

5.0 Equipment, Reagents, and Supplies

- Non-phosphorus detergent (e.g., Liquinox™)
- Scrub brush made of inert materials
- Oven
- Bucket
- Tap water
- Analyte-free water (e.g., distilled or deionized (DI) water, or equivalent)
- Kimwipes®, or equivalent
- Chemical resistant gloves (e.g., nitrile)
- Spray bottle
- Organic solvent (e.g. methanol)

6.0 Procedure

This section describes the procedure(s) for the decontamination of equipment used to sample water, soil, or air.

6.1 Calibration

Calibration is not applicable to this SOP.

6.2 Operation

Decontamination of sampling equipment will be performed before sampling and after working at each sampling point, if applicable.

6.2.1 Water Sampling Equipment

Equipment that does not contact sample water or the inside of the well should be rinsed with analyte-free water and inspected for remaining particles or surface film. If these are noted, repeat cleaning and rinse procedures.

Equipment that contacts sample water or the inside of the well should be cleaned (inside and outside where possible) with a non-phosphorus detergent solution applied with a spray bottle and/or scrub brush (if needed). Rinse with analyte-free water and containerize with other IDW if required by the SAP or QAPP and inspect for remaining particles or surface film. If these are noted, repeat cleaning and rinse procedures. Shake off remaining water and allow to air dry.

The internal surfaces of pumps and tubing that cannot be adequately cleaned by the above methods alone will also be cleaned by first circulating a non-phosphorus detergent solution through them followed by circulating analyte-free water. Special care will be exercised to ensure that the "rinse" fluids will be circulated in sufficient quantities to completely flush out contaminants and detergents.

When transporting or storing equipment after cleaning, the equipment will be stored in a manner that minimizes the potential for contamination.

6.2.2 Soil/Sediment Sampling Equipment

A variety of samplers (split-barrel, split-barrel with brass liners, piston sampler, backhoe, hand-auger, or shovel) may be used to retrieve soil from sampling locations. The soil sample will either be sealed within the sampler (e.g., collecting volatile samples) or the soil sample will be transferred to laboratory-supplied containers depending on the analysis to be conducted on the soil sample. The equipment required to transfer the soil from the sampler to the laboratory-supplied sample containers includes: stainless-steel

spoons or scoops and the appropriate personal protective equipment necessary for collection and handling of soil samples as described in the PHASP.

All soil sampling equipment, including split-barrels, stainless-steel spoons and scoops, will be carefully cleaned before and during sampling with a tap water and non-phosphorus detergent solution, using a brush if necessary to remove particulate matter and films. The equipment is then rinsed three times with tap water and/or three times with analyte-free water. Inspect equipment and repeat procedure if any residual soil or visible contaminants are present. Dry sampler with a Kimwipes®. Organic solvents (e.g., methanol) may be used to aid with desorbing organic material but should be kept to a minimum and must be collected and containerized if used.

At the completion of the work day, the samplers should be decontaminated following the procedure above and stored in a manner that minimizes the potential for contamination.

6.2.3 Air Sampling Equipment

For non-laboratory manifold equipment, methanol soak manifold components for a minimum of two hours. Remove from the methanol bath and place in an oven pre-heated to 90 °C and continue to heat manifold components for at least 3 hours or until interior and exterior surface inspections of the manifold components indicate that they are free of liquid methanol.

6.2.4 Handling

All equipment will be handled in a manner that minimizes cross-contamination between points. After cleaning, the equipment will be visibly inspected to detect any residues or other substances that may exist after normal cleaning. If inspection reveals that decontamination was insufficient, the decontamination procedures will be repeated.

6.3 Data Reduction/Calculations

No data reduction or calculations are associated with this procedure.

6.4 Disposal

IDW generated by this process will be disposed of in accordance with Federal, State and Local regulations and/or as required by project-specific SAP or Work Plan. Where reasonably feasible, technological changes have been implemented to minimize the potential for environmental pollution.

7.0 Quality Control and Quality Assurance (QA/QC)

The QC activities described below allow the self-verification of the quality and consistency of the work.

7.1 QA/QC Samples

Decontamination procedures may be monitored through the use of an equipment blank which consists of analyte-free water processed through non-disposable or non-dedicated aqueous or solid sampling equipment after equipment decontamination and before field sample collection. The equipment blank is analyzed for the same parameters as the samples at a project specific frequency (e.g., one per twenty samples).

7.2 Measurement Criteria

Equipment blank results should be below the laboratory's method detection limit or reporting limit (depending on the data quality objectives).

8.0 Records

When required, the field technician(s) will document the field equipment decontamination procedures in a project dedicated field logbook or on field log data sheets.

Examples of common field documentation are available in Barr's "Compendium of Field Documentation". Field documentation is listed in the applicable sample collection SOP.

Field documentation and COC are provided to a Barr Data Management Administrator for storage on the internal Barr network.

Additional records information can be found in Barr's "Records Management System Manual."

Other Barr SOP subjects referenced within this SOP: collection of samples and investigative derived waste.

9.0 References

ASTM. 2015. Standard Practice for Decontamination of Field Equipment Used at Waste Sites.

Standard Operating Procedure

Collection and Disposal of Investigative Derived Waste

Revision 6

March 15, 2018

Approved By:

John Juntilla		03/15/18
Print Technical Reviewer	Signature	Date

Terri Olson		03/15/18
Print QA Manager	Signature	Date

Review of the SOP has been performed and the SOP still reflects current practice.

Initials: _____ Date: _____

Initials: _____ Date: _____

Initials: _____ Date: _____

Initials: _____ Date: _____

Collection and Disposal of Investigative Derived Waste

1.0 Scope and Applicability

The purpose of this Standard Operating Procedure (SOP) is to define the procedures for the collection and disposal of investigative derived waste (IDW) generated during field investigation activities. This procedure is applicable to sampling IDW which are materials containing pollutants derived during investigation activities including drill cuttings, drilling fluids, cleaning liquids, waste water, DNAPL, soil and rock samples, protective clothing and equipment, or any other items or materials which are exposed to, or may contain pollutants that must be characterized for off-site disposal.

The recommended procedures in this SOP should be followed unless conditions make it impractical or inappropriate to do so. Modifications should be noted in the applicable documentation and communicated to appropriate personnel. Significant changes may result in a revision or newly created SOP.

2.0 Limitations

- IDW can be contaminated with various hazardous substances, characterization may be necessary.

3.0 Responsibilities

The Barr Project Manager is responsible for determining whether any solid or liquid-phase product needs to be containerized and characterized for off-site disposal.

Experienced Field Technicians are responsible for the proper sample identification, collection and management of samples, documentation and sample transport to the laboratory.

The role of the Field Safety Representative is to oversee on-site safety activities.

Project staff are responsible for ordering sample containers prior to the sampling event.

4.0 Safety

Barr staff is responsible for conducting aspects of the job safely. When applicable, refer to the appropriate Project Health and Safety Plan (PHASP) to understand the hazards associated with suspected contamination, symptoms of exposure, methods to minimize exposure, personal protection equipment (PPE), and personal air monitoring required when using this SOP. Minimum protection of one pair of chemical resistant gloves (e.g., nitrile) and safety glasses with side shields should be worn to prevent sample contact with the skin and eyes. When sampling material contaminated with corrosive materials, emergency eye flushing facilities should be available.

Some of the sample containers may require the use of preservatives. Consult the applicable Safety Data Sheet to review hazards and appropriate PPE to minimize exposure.

5.0 Equipment, Reagents, and Supplies

- Applicable sampling equipment
- Weatherproof container labels
- Plastic garbage bags
- Chemical resistant gloves (e.g., nitrile)
- IDW containers
- Permanent markers
- Plastic covering

6.0 Procedure

The Barr Project Manager is responsible for determining if IDW can be left on-site or if it must be disposed of off-site. Two general objectives that will be considered when managing IDW are the minimization of IDW generation and managing the IDW consistent with the final remedy for the site. The extent to which the objectives can be met is dependent on the site-specific circumstances.

Any IDW that is required to be containerized will be containerized separately by media until laboratory data are received to determine the appropriate disposition of the materials. Containerization and disposal of personal protective equipment and/or other materials, if necessary, will be determined on a project by project basis and discussed in the project Sampling and Analysis Plan (SAP).

6.1 Calibration

Calibration is not applicable to this SOP.

6.2 Sampling

Representative samples will be collected, and/or composited, preserved, and handled following Barr's matrix specific sampling SOP. Sampling equipment will be cleaned following Barr's 'Decontamination of Sampling Equipment' SOP.

The samples must be delivered to the laboratory via hand or overnight delivery courier in accordance with all Federal, State and Local transportation regulations and Barr's 'Domestic Transport of Samples to the Laboratory' SOP.

6.3 Data Reduction/Calculations

Data reduction or calculations are not applicable to this SOP.

6.4 Disposal

Waste generated by this process will be disposed of in accordance with Federal, State and Local regulations. Where reasonably feasible, technological changes have been implemented to minimize the potential for environmental pollution.

7.0 Quality Control and Quality Assurance (QA/QC)

The QC activities described below allow the self-verification of the quality and consistency of the work.

7.1 QA/QC Samples

QA/QC samples are defined in Barr's SOP 'Collection of Quality Control Samples'. The sampling frequency should be performed as written in the project scope of work and/or documentation (e.g., Work Plan, SAP, or Quality Assurance Project Plan).

7.2 Measurement Criteria

Measurement criteria are not applicable to this SOP.

8.0 Records

The field technician will document the IDW sampling event on the field log data sheet and/or field notebook. They will also document the type and number of bottles on the chain-of-custody record, as appropriate. The analysis for each container and the laboratory used will be documented on the chain-of-custody record. Refer to Barr's SOP 'Documentation on a Chain-of-Custody (COC)' for further information.

Examples of common field documentation are available in Barr's "Compendium of Field Documentation". Field documentation is listed in the SOPs referenced in this procedure.

The field documents and COCs are provided to a Barr Data Management Administrator for storage on the internal Barr network.

Additional records information can be found in Barr's "Records Management System Manual".

Other Barr SOP subjects referenced within this SOP: collection of samples, collection of QC samples, decontamination of sampling equipment, domestic transport of samples, and documentation on a COC.

9.0 References

Environmental Protection Agency, 9345.3-03FS. January 1992. *Guide to Management of Investigation-Derived Wastes*

Standard Operating Procedure

Documentation on a Chain-of-Custody (COC)

Revision 6

February 26, 2020

Approved By:

Print	Technical Reviewer	Signature	Date
Andrea Nord			02/26/20

Print	QA Manager	Signature	Date
Terri Olson			02/26/20

Review of the SOP has been performed and the SOP still reflects current practice.

Initials:		Date:	
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Initials:		Date:	

Documentation on a Chain-of-Custody (COC)

1.0 Scope and Applicability

The purpose of this procedure is to describe how to properly document information on a Chain-of-Custody (COC). A COC is a legally binding document that identifies sample identification, analyses required, and shows traceable possession of samples from the time they are obtained until they are introduced as evidence in legal proceedings. A Field Technician completes the information on the COC at the time he/she collects samples and the COC accompanies the samples during transport to a storage facility or to the laboratory for analysis.

The recommended procedures in this SOP should be followed unless conditions make it impractical or inappropriate to do so. Modifications should be noted in the applicable documentation and communicated to appropriate personnel. Significant changes may result in a revision or newly created SOP.

2.0 Limitations

- The SOP does not apply to sample aliquots that are only collected for field screening purposes.
- The SOP does not apply to samples remaining on-site.

3.0 Responsibilities

Experienced Field Technicians are responsible for the proper sample identification and for accurate and complete documentation on the COC.

4.0 Procedure

The COC is the most important sampling document; it must be filled out accurately and completely every time a sample is collected. The instructions below are specific to Barr's COC for air canisters and Barr's COC typically used for solid and liquid samples. The COC for air canisters is typically used when collecting soil gas, soil vapor, emissions, or indoor and outdoor air samples in an evacuated canister. The COC for solid and liquid samples is typically used when collecting matrices such as groundwater, surface water, drinking water, waste water, storm water, soil, sediment, oil, paint chips, bulk materials, etc. Information common to both COCs and specific to each COC are detailed below.

Some of the information on a COC may be filled out ahead of time (e.g., report and invoice recipient details, project number, project name, project manager, purchase order number, etc.) while other information should be completed during sampling. Complete one COC or more, as needed, for each set of project samples. The COC should be completed prior to leaving the sampling location.

Laboratory supplied COCs may be used but may differ in the information captured. The use of a Barr COC is recommended as it allows for more efficient data processing within Barr's systems. If there are any questions, please contact a member of Barr's Data Quality team.

The laboratory receiving the samples will sign the COC, record the date and time of sample receipt, assign a laboratory work order number, document sample condition, and document whether custody seals were used and if they were intact.

4.1 Common Chain-of-Custody Information

- Barr office location managing the work.
- Two digit identification for the state or province the samples originated from/sampled in.
- COC numbered pages (e.g., 1 of 1).
- Report and invoice recipient information.
- Purchase order number (if applicable).
- Barr project name and number.
- Sample location.
- Sample collection date and time.
- Sample matrix abbreviation (see "Matrix Code" on COC).
- Analysis requested.
- Field Technician (i.e. sampler) name.
- Barr Project Manager and project Data Quality (DQ) Manager names.
- Laboratory name and location in which samples are to be relinquished.
- Requested due date.
- Signature of Field Technician (i.e. sampler) under the first 'relinquished by'.
- Signature of sample transferee.
- Date and time of sample transfers.
- Method of transport (ground courier, air carrier, sampler, etc.).
- Air Bill number (if applicable).

4.2 Completing a Chain-of-Custody for Air Canisters

Lab deliverable contents (based on project needs).

- Canister serial # and size.
- Flow controller serial #.
- Initial and final vacuum measurement (in inches of mercury).
- Start and stop times that the canister was drawing sample.
- Total time calculated from the start and stop times.
- Matrix code.
- PID reading (indicate if ppm or ppb).
- Sample comments (if any).
- Identify the report deliverable contents and electronic data deliverable contents requested.

4.3 Completing a Chain-of Custody for Solid and Liquid Samples

- Sample start and stop depth (if applicable) and unit of measurement (meter, feet, inches, etc.).
- Information regarding whether to perform sample Matrix Spike (MS) and MS duplicate (MSD).
- Container preservative type (see "Preservative Code" on COC).
- Information regarding whether the sample was field filtered.
- Number of each container type and the total number of containers for the sample.
- Presence or absence of ice.

4.4 Distribution of the COC Pages

Page one (white copy) accompanies the sample shipment to the laboratory and page two (yellow copy) is the Field Document copy. The Field Technician must scan and email a copy to the Barr Data Management Administrator for filing on Barr's internal network project files. Alternatively, the yellow hardcopy may be routed to the Barr Data Management Administrator for electronic filing. This read-only electronic copy will be distributed to and available for use by the project team via Barr's internal network project file access.

5.0 Quality Control and Quality Assurance (QA/QC)

The Field Technician should review the COC for accurate and complete documentation.

6.0 Records

Examples of common field documentation are available in Barr's "Compendium of Field Documentation". Field documentation specific to this SOP are listed below:

- Chain-of-Custody for Air Canisters
- Chain-of-Custody

A copy of the COC is provided to a Barr Data Management Administrator for storage on the internal Barr network files.

Additional records information can be found in Barr's "Records Management System Manual".

7.0 References

United States Environmental Protection Agency. 2002. *Guidance for Quality Assurance Project Plans*. EPA QA/G-5.

Standard Operating Procedure

Domestic Transport of Samples to Laboratories within the United States of America – States and Territories

Revision 3

February 27, 2020

Approved By:

Andrea Nord		02/27/20
Print QA Manager	Signature	Date

Review of the SOP has been performed and the SOP still reflects current practice.

Initials: _____	Date: _____
Initials: _____	Date: _____
Initials: _____	Date: _____
Initials: _____	Date: _____

Standard Operating Procedures for the Domestic Transport of Samples to the Laboratories within the United States of America – States and Territories

1.0 Scope and Applicability

The purpose of this Standard Operating Procedure (SOP) is to describe the procedures necessary for personal delivery or shipment of samples from locations within the United States of America (USA) and its territories to analytical laboratories located within the USA and its territories. This procedure applies to the transportation of ground and surface water, soil, wipe, sediment, paint chip, debris, air samples and their corresponding quality control samples to the appropriate laboratory. This SOP applies to samples that are classified as non-regulated, non-hazardous, or "Dangerous Goods in Excepted Quantities" samples prior to shipment.

Soil samples that are preserved with flammable chemicals (methanol) and unused sample vials containing flammable or corrosive chemical preservatives are examples of materials that are classified as "Dangerous Goods in Excepted Quantities". Materials classified as Dangerous Goods in Excepted Quantities have limitations on the volume/weight of the material allowed in each shipment, and have additional packaging, labeling, and shipping requirements than non-regulated and non-hazardous samples and sampling media.

The recommended procedures in this SOP should be followed unless conditions make it impractical or inappropriate to do so. Modifications should be noted in the applicable documentation and communicated to appropriate personnel. Significant changes may result in a revision or newly created SOP.

2.0 Limitations

- Maintaining proper sample temperatures (<6°C or ambient air temperature in accordance with the analytical method requirements) and delivering samples to the laboratory within 24 to 48 hours from collection are primary concerns.
- This procedure does not apply to the transportation of samples to laboratories outside of the USA and its territories.
- This procedure does not apply to samples that are classified as "hazardous" according to USDOT, PHMSA, and/or RCRA and must be packaged, labeled, and/or transported in accordance with USDOT's hazardous materials regulations (49 CFR Parts 100-180).
- This procedure does not apply to samples that are classified as "dangerous goods" and must follow the International Air Transportation Association's (IATA) dangerous goods regulations (DGR) for packaging, labeling, and/or air transport.

3.0 Responsibilities

The field technician(s) shall ensure the security, temperature, and packaging of environmental samples during transport and shipment.

4.0 Safety

Barr staff is responsible for conducting the aspects of the job safely. When applicable, refer to the appropriate Project Health and Safety Plan (PHASP) to understand the hazards associated with suspected contamination, symptoms of exposure, methods to minimize exposure, personal protective equipment (PPE), and personal air monitoring required when using this SOP. Minimum protection of one pair of chemical resistant gloves (e.g., nitrile) and safety glasses with side shields should be worn to prevent sample contact with the skin and eyes. When samples may be contaminated with corrosive materials, emergency eye flushing facilities should be available.

Some of the sample containers may require the use of chemical preservatives. Consult the applicable Safety Data Sheet to review hazards and appropriate PPE to minimize exposure.

5.0 Equipment, Reagents, and Supplies

- Rigid cooler
- Heavy bag for containing ice and preventing leakage of melted water
- Ice
- Packing tape
- Dangerous Goods in Excepted Quantities Label with the number "8" added indicating the hazard class. This label must be used for coolers containing unused sample containers with corrosive preservative.
- Absorbent padding
- Bubble-wrap/bubble bags (inner packing material)
- Ziploc® baggies
- Shipping Airbill – if shipping via overnight commercial courier service
- Dangerous Goods in Excepted Quantities Label with the number "3" added indicating the hazard class. This label must be used for coolers containing methanol preservative
- Items listed in Section 8.0 Records

6.0 Procedure

6.1 Packaging of non-regulated or non-hazardous samples requiring ambient air temperature per the analytical method of analysis

Sample matrices that do not require thermal preservation (ice) typically include wipe, paint chip, debris, and air samples. These samples may or may not require chemical preservatives depending upon the analytical method of analysis. The classification of "non-regulated" or "non-hazardous" in this context is based upon the nature of the sample prior to chemical preservation/fixation.

For samples that are stored at ambient air temperature, the samples will be placed in a jar, baggie or shipping carton (i.e. cooler, cardboard box, envelope) and accompanied with the proper COC.

Place the samples in a shipping carton in a manner that will avoid breakage. Fill out the chain-of-custody (COC) completely and include required copies with the samples. Refer to Barr's SOP 'Documentation on a Chain-of-Custody (COC)' for further information.

Once the shipping carton is packed to prevent samples breaking, the COC is signed off and placed in the cooler or box. Adhere two to three strips of packaging tape from top to bottom on the cooler or box.

Custody seals must be adhered over the shipping carton lid or enclosure if project quality assurance plan or sampling and analysis plan require them. The custody seal must be adhered to the crack of the lid on two opposing sides of the cooler or over the flap(s) of the box or envelope to ensure the carton remained shut and the contents have not been tampered with during transit.

6.2 Packaging of non-regulated or non-hazardous samples requiring thermal preservation per the analytical method of analysis

Samples matrices that require thermal preservation (ice) typically include water, soil and sediment samples. Glass containers should be packed in bubble wrap or other cushioning material to avoid breakage.

Note: Bubble-wrap is the preferred packing material.

Line a rigid plastic cooler (i.e. shipping container) with a strong plastic bag. This bag will serve as an outer liner and contain the wet ice, absorbent materials and sample containers.

Place samples and cushioning absorbent material inside the plastic bag and add enough absorbent padding to absorb the sample liquid within the package. Package ice in double-lined Ziploc® bags to ensure sample labels will not be compromised, and the cooler(s) will not leak melt water. Add enough ice to the cooler to maintain a constant temperature at ≤ 6 °C, (but not frozen) until the samples arrive at the laboratory. Zip tie the plastic bag shut.

Before sealing cooler, fill out the COC completely and include required copies with the samples. Refer to Barr's SOP 'Documentation on a Chain-of-Custody (COC)' for further information.

Adhere two to three strips of packaging tape on the cooler from top to bottom, and adhere an additional strip of tape covering the gap between the lid and sides of cooler to seal the cooler to avoid leakage. Custody seals must be adhered on the cooler if project quality assurance plan or sampling and analysis plan require them. The custody seal must be adhered to the crack of the lid on two opposing sides of the cooler to ensure the contents have not been tampered with during transit.

Follow the labelling instructions in Section 6.4 of this SOP.

6.3 Packaging of samples classified as "Dangerous Goods in Excepted Quantities"

6.3.1 Soil Samples Preserved with Methanol (Flammable) – Hazard Class 3

Soil samples that are preserved with flammable chemicals (methanol) are an example of materials that are classified as hazard class "3" "Dangerous Goods in Excepted Quantities".

Follow the packaging instructions listed in Section 6.2 of this SOP with the following addition: *Methanol sample containers must be placed in a Ziploc® Baggie to meet shipping requirements for preventing leakage.*

Each cooler shall not exceed 500 mL of methanol (50 vials, 10 mL of methanol per vial) and each vial shall not have more than 10 mL of methanol to meet the requirements of a Dangerous Goods in Excepted Quantities. A label with the hazard class number "3" indicates the cooler contains flammable (or reactive/oxidizer) materials (in this case a flammable methanol sample preservative). Additional labeling instructions are found in Section 6.4.2 of this SOP.

6.3.2 Unused Sample Jars – Hazard Class 3 (Flammable) and Hazard Class 8 (Corrosive) Chemicals

Unused sample vials containing flammable or corrosive chemical preservatives are examples of materials that are classified as "Dangerous Goods in Excepted Quantities".

Follow the packaging instructions listed in Section 6.2 of this SOP with the following additions:

Each chemical, may have a limitation as to the volume or weight of the chemical and the number of inner containers (sample containers) allowed within each outer shipping container (cooler) to meet the requirements of a Dangerous Goods in Excepted Quantities. A label with the hazard class number "3" indicates the cooler contains flammable (or reactive/oxidizer) materials (in this case a flammable methanol sample preservative). A label with the hazard class number "8" indicates the cooler contains a corrosive material (in this case an acid or base sample preservative). Additional labeling instructions are found in Section 6.4.2 of this SOP.

6.4 Labeling of Outer Shipping Container or Carton

6.4.1 Shipping Label

Attach the shipping address label to the top of the cooler or to the cooler handle tag. Attach a second label with the same information should also be attached with packaging tape to the cooler in event that the original label is damaged or destroyed during sample shipment.

Directional arrow labels (Figure 1) must also be attached to the outside of the cooler according to the hazardous materials shipping regulations. Directional arrow labels indicate the upright position during sample shipment.

Figure 1 - Directional Arrows Label

6.4.2 Dangerous Goods in Excepted Quantities Label

When shipping materials classified as Dangerous Goods in Excepted Quantities, the cooler must have a Dangerous Goods in Excepted Quantities Label (Figure 2). This label is placed on two opposing sides of the cooler. The label indicates the hazard class number and the name and address of the shipper or consignee. In cases where the package contents have more than one hazard class assigned, the primary (most hazardous) hazard class is listed on the label. Table 1 includes a Summary of United Nations Hazard Classes.

Figure 2 - Dangerous Goods in Excepted Quantities Label

Footnotes:

(1) The "*" must be replaced by the primary hazard class, or when assigned, the division of each of the hazardous materials contained in the package.

(2) The "**" must be replaced by the name of the shipper or consignee if not shown elsewhere on the package.

Table 1 – Summary of United Nations Hazard Classes

Class 1	Explosives
Class 2	Gases
Class 3	Flammable Liquids
Class 4	Flammable Solids; Substances Liable to Spontaneous Combustion; Substances Which, in Contact with Water, Emit Flammable Gases (e.g., soil sample contaminated with high concentrations of gasoline released from an underground storage tank)
Class 5	Oxidizing Substances and Organic Peroxide
Class 6	Toxic and Infectious Substances (e.g., samples of refuse collected from a solid waste landfill)
Class 7	Radioactive Material
Class 8	Corrosives (e.g., nitric acid used for preservation of some groundwater samples) (see Note)
Class 9	Miscellaneous Dangerous Goods

6.4.2.1 Dangerous Goods Air Waybill Statement and Shippers Declaration

A shipping paper (i.e. bill of lading) is not required when offering the cooler for air transport via a commercial courier service (e.g. Federal Express or United Parcel Service).

A document such as an air waybill accompanies a shipment that is transported by aircraft. The air waybill must include the statement "Dangerous Goods in Excepted Quantities" and indicate the number of packages associated with each air waybill. This phrase is typically written behind the Barr project number in the PO or comments section on the air waybill.

A shipper's declaration for dangerous goods is also required. Some air waybills also have a box you must also check off that says "Dangerous Goods no Shipper's Declaration Required".

6.5 Transport/Delivery Options

Account for the samples before shipping and compare to the COC. Refer to Barr's SOP 'Documentation on a Chain-of-Custody (COC) for further information. Ship samples during times when the laboratory will be able to accept and quickly analyze them. Whenever possible, select mode of transport/delivery to ensure delivery to the laboratory will occur with ample holding time remaining for the specified analytical methods required for the samples. Avoid sending samples during holidays and weekends. All Federal, State and Local shipping regulations must be met.

Personal Delivery. The samples are delivered to the laboratory by the field technician(s). The COC is signed and dated by the laboratory representative.

Ground Transport. The same procedures are followed as above; i.e., the COC is signed and dated and the top copy is sent with the samples. The cooler or box is then secured with packaging tape and a courier form is filled out for the designated laboratory. The cooler or box is then left in the services area for pickup via ground transport and delivery.

Air Transport. Follow the procedures above, replacing the courier form with the overnight courier air bill via Federal Express or United Parcel Service, for example. Include the date, project number, type of

delivery service desired, parcel weight, number of coolers or boxes on the air bill. Also include the phrase "Dangerous Goods in Excepted Quantities", when applicable.

7.0 Quality Control and Quality Assurance (QA/QC)

Not Applicable.

8.0 Records

Examples of common field documentation are available in Barr's "Compendium of Field Documentation".

Field documentation specific to this SOP are listed below:

- Chain-of-custody (COC)
- Custody seal (if applicable)
- Dangerous Goods in Excepted Quantities Label
- Directional Arrow Label

COCs are provided to a Barr Data Management Administrator for storage on the internal Barr network.

Additional records information can be found in Barr's "Records Management System Manual".

Other Barr SOP subjects referenced within this SOP: documentation on a COC.

9.0 References

49 CFR Part 173.4a – Excepted Quantities October 1, 2011 Online
https://www.govinfo.gov/app/details/CFR-2011-title49-vol2/CFR-2011-title49-vol2-sec173-4

ASTM International. 2015. *ASTM Method D6911 – 15 Standard Guide for Packaging and Shipping Environmental Samples for Laboratory Analysis*[1]. ASTM January 15, 2015.

Site Location

Newton Creek

Site Location

Nemadji River

Approximate SRC Property Boundaries for Contiguous Operations

Approximate Fenceline Boundaries for Refining-Related Activities

0 750 1,500

Feet

SITE LOCATION
Superior Refining Company LLC (SRC)
Superior, WI

FIGURE 1

Approximate Fenceline Boundaries for Refining-Related Activities

Surficial Water

Private Water Supply Well (Historical)

Private Water Supply Well (Post-1989)

Note: Private water supply well locations were obtained from WDNR (post-1989) and the Wisconsin Geological Survey database (pre-1989). Creek/River data from USGS.

N

0 750 1,500

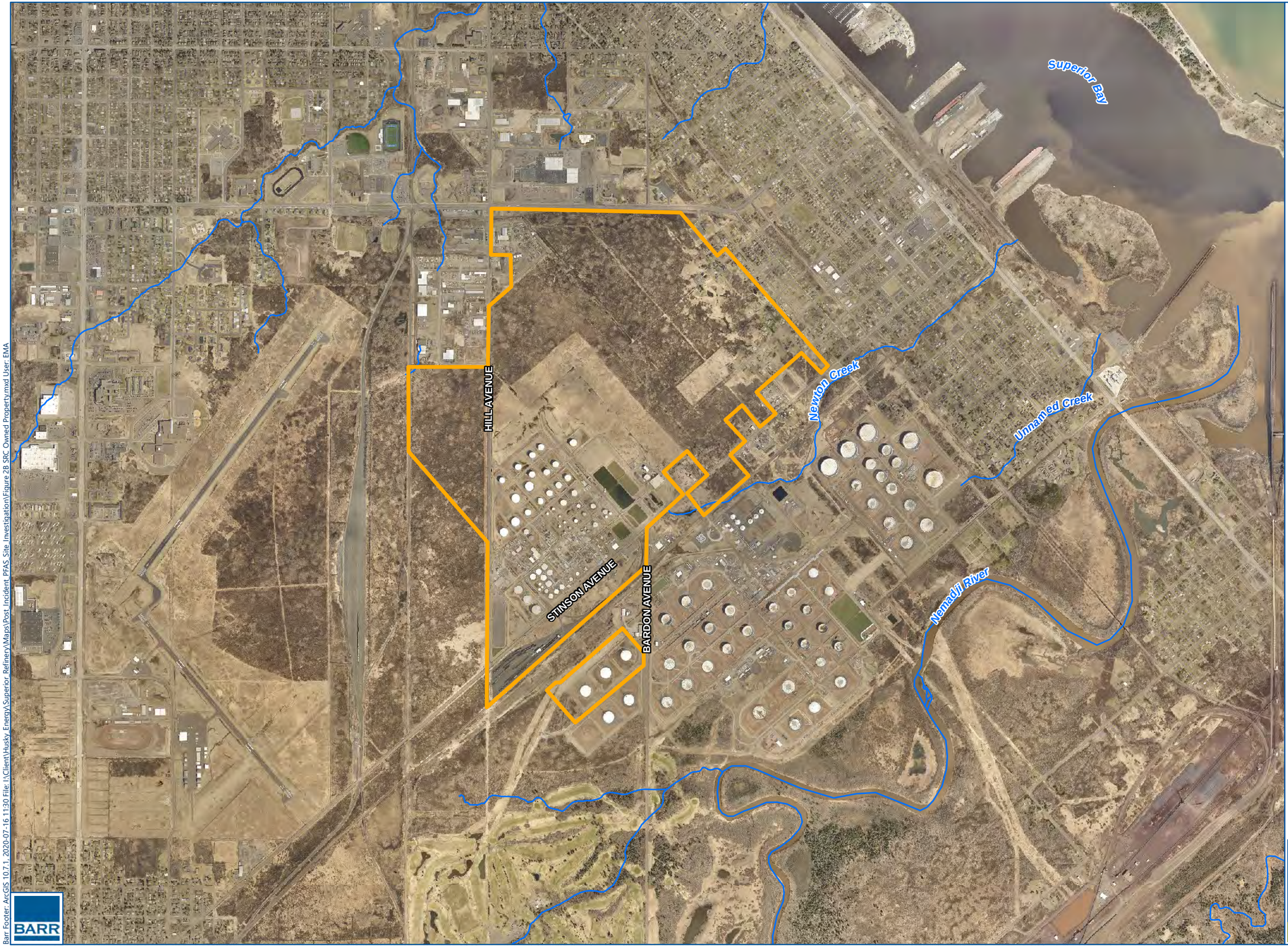
Feet

PROPERTY BOUNDARY
Superior Refining Company LLC (SRC)
Superior, WI

FIGURE 2A

BARR

Barr Footer: ArcGIS 10.7.1, 2020-06-23 14:07 File: I:\Client\Husky_Energy\Superior_Refinery\Maps\Post_Incident_PFAS_Site_Investigation\Figure 2 Facility Boundary.mxd User: EMA



Approximate SRC Property Boundaries for Contiguous Operations

Surficial Water

N

0 750 1,500

Feet

SRC OWNED PROPERTY
Superior Refining Company LLC (SRC)
Superior, WI

FIGURE 2B

BARR

Barr Footer: ArcGIS 10.7.1, 2020-07-16 11:30 File: I:\Client\Husky_Energy\Superior_Refinery\Maps\Post_Incident_PFAS_Site_Investigation\Figure 2B SRC Owned Property.mxd User: EMA

Approximate Fenceline Boundaries for Refining-Related Activities

Process Unit Battery Limits

HILL AVENUE

STINSON AVENUE

BARDON AVENUE

Former Ponds 1 & 6

WWTP Recirculation Pond 7

WWTP

Fire Water Pond 2

WWTP Recirculation Pond 8

Propane

Pump House

Fire Water Pond 3

Constructed Wetlands for WWTP

Storm Water Pond 4

Diversion Box No. 2

Newton Creek Impoundment/ Headwaters

4 Bay Stormwater Pond

Fire Water Pond 5

LPG Building

Pump House

Fire House

Fuel Loading Area

Boiler House

Marketing

Guard House

Main Office

Locker Room

Lab

Crude Control Room

Asphalt Loading

Polymer Building

Asphalt Loading

Asphalt Rail Loading

Tank Farm Area

Response Center

Warehouse Facility

Maintenance

Caustic Scrubber

Flare

Spare Hose House

Foam Storage Building

Ethanol Loading

Contractor Shop

Loaders Shack

Asbestos Storage

Hazardous Waste Storage

Contaminated Soil

Contractor Trailer Area

Wick Building

No. 1 Cooling Tower

GGU

Alky

Alky Maintenance

#2 Duff

#1 Duff

Hydros

ISOM

Crude

FCCU

Plat

Tail Gas Unit

Sulfur Plant & Sour Water Stripper

Benzout Unit

S2

S1

No. 2 Cooling Tower

116

52

3

14

13

34

35

33

31

32

67

38

53

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41

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66

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62

64

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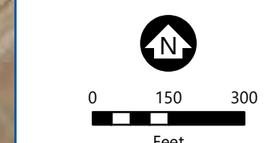
90

87

113

86



SITE FEATURES
REFINING-RELATED ACTIVITIES
Superior Refining Company LLC (SRC)
Superior, WI

FIGURE 3A

BARR

SITE FEATURES
PROCESS AREA DETAIL
Superior Refining
Company LLC (SRC)
Superior, WI

FIGURE 3B

Barr Footer: ArcGIS 10.7.1, 2020-07-15 16:04 File: I:\Client\Husky_Energy\Superior_Refinery\Maps\Post_Incident_PFAS_Site_Investigation\Figure 3B Site Features - Process Area Detail.mxd User: EMA

MW-16\PZ-16
MW-15
MW-2
MW-1
MW-3D\PZ-3D
MW-9B
MW-5/T70
MW-17\PZ-17
MW-2/T66\PZ-2/T66
MW-5/T40
MW-1/T67
MW-18
MW-3/T50
MW-7
MW-11\PZ-11
MW-12
MW-13\PZ-13
MW-8R\PZ-8R
MW-14
MW-20
MW-19
MW-21\PZ-21
MW-22

Approximate Fenceline Boundaries for Refining-Related Activities

Existing Monitoring Well

Existing Monitoring Well & Piezometer Pair

N

0 250 500

Feet

SITE MONITORING WELL LOCATIONS
Superior Refining Company LLC (SRC)
Superior, WI

FIGURE 4

BARR

Barr Footer: ArcGIS 10.7.1, 2020-06-23 14:15 File: I:\Client\Husky_Energy\Superior_Refinery\Maps\Post_Incident_PFAS_Site_Investigation\Figure 4 Monitoring Well Location Map.mxd User: EMA

MW-2
MW-1
MW-3D\PZ-3D
MW-9B
MW-17\PZ-17
MW-5/T70
MW-2/T66\PZ-2/T66
MW-18
MW-5/T40
MW-1/T67
MW-3/T50
MW-7
MW-11\PZ-11
MW-12
MW-13\PZ-13
MW-8R\PZ-8R
MW-14
57
56
55
39
59
58
60
36
71
49
70
30
69
47
29
68
66
65
41
42
40
38
53
62
64
63
31
48
67
32
3
33
35
14
34
13
52
116
50
44
43
104
103
101
105
100
86
87
113
99
46
45
88
79
54
91
106
90
112
114

Existing Monitoring Well

Existing Monitoring Well & Piezometer Pair

Potential Incident Impacted Pervious Surface

Stinson Ave Ditch

Culvert

Approximate Fenceline Boundaries for Refining-Related Activities

Incident Impacted Unpaved (Pervious) Surface- Firefighting Water Storage

Incident Impacted Paved (Impervious) Surface

Incident Impacted Unpaved (Pervious) Surface

PFAS Impacted Surface Water Storage and Treatment System

Note: Release extent based on information provided to Barr by SRC.

N

0 150 300

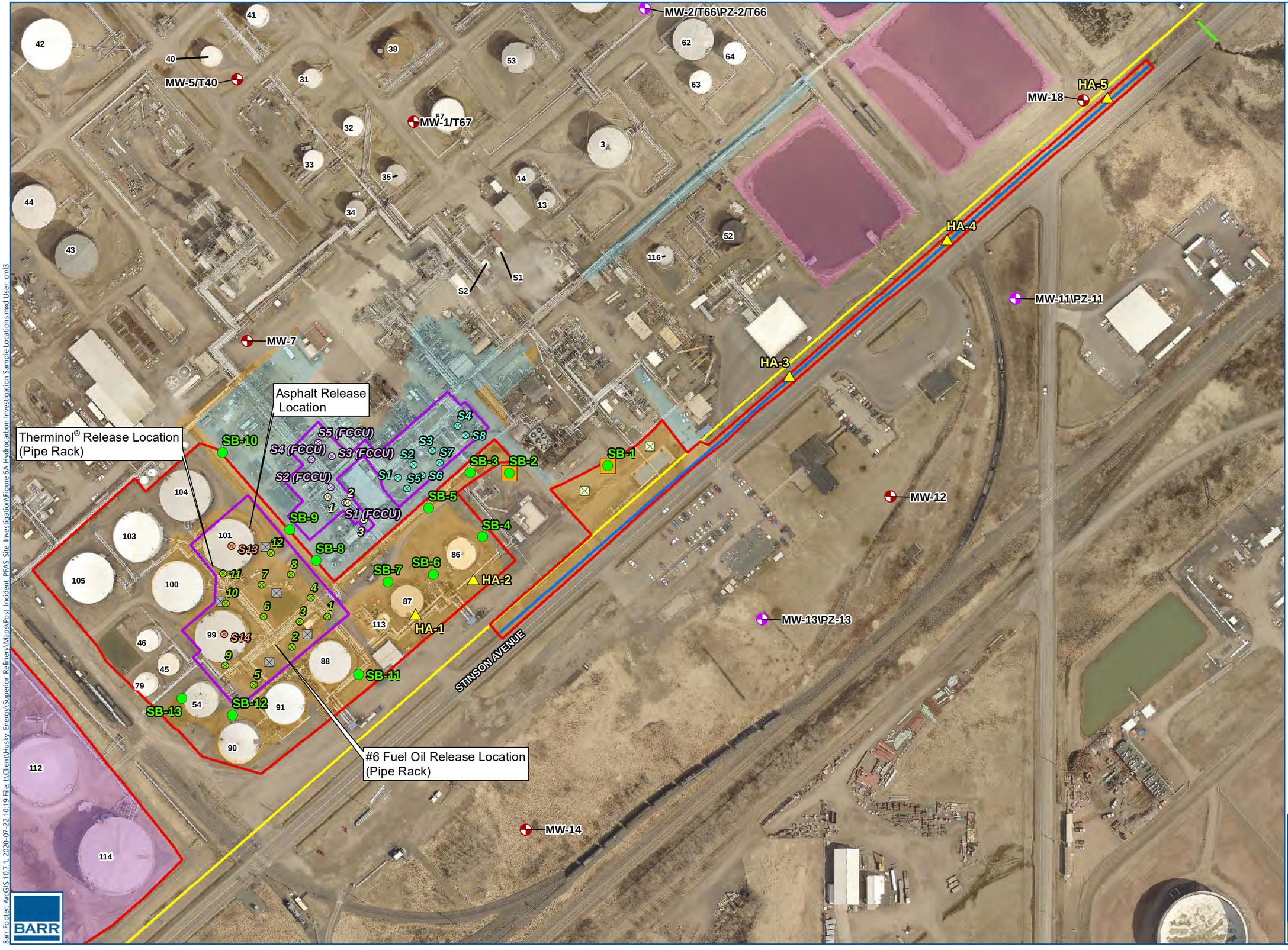
Feet

INCIDENT IMPACTED AREAS
Superior Refining Company LLC (SRC)
Superior, WI

FIGURE 5

BARR

Barr Footer: ArcGIS 10.7.1, 2020-07-22 10:11 File: I:\Client\Husky_Energy\Superior_Refinery\Maps\Post_Incident_PFAS_Site_Investigation\Figure 5 Affected Areas.mxd User: cml3



Approximate Fenceline Boundaries for Refining-Related Activities

Potential Incident Impacted Pervious Surface

Incident Impacted Paved (Impervious) Surface

Incident Impacted Unpaved (Pervious) Surface

Incident Impacted Unpaved (Pervious) Surface- Firefighting Water Storage

PFAS Impacted Surface Water Storage and Treatment System

Existing Monitoring Well

Existing Monitoring Well & Piezometer Pair

Stinson Ave Ditch

Culvert

Approximate Location of Refinery Rebuild Construction Excavation (7 to 8.5 ft bgs)

Soil Boring Location

Hand Auger Location

Test Pit Location

Previously Proposed Boring Locations (Removed)

Previously Proposed Boring Location (Moved)

Insight Soil Characterization Sample Locations

- Crude Unit, 5/5/2019
- FCCU Unit, 6/13/2019
- Tank Farm Unit, 6/13/2019
- Tank Farm Unit, 8/1/2019
- FCCU Unit, 11/19/2019

Note:
- Release extent based on information provided to Barr by SRC.
- Bathtub excavation limits are based on information provided to Barr by SRC.

N

0 90 180

Feet

HYDROCARBON INVESTIGATION SAMPLE LOCATIONS

Superior Refining Company LLC (SRC)
Superior, WI

FIGURE 6A

BARR

Barr Footer: ArcGIS 10.7.1, 2020-07-22 10:19 File: I:\Client\Husky_Energy\Superior_Refinery\Maps\Post_Incident_PFAS_Site_Investigation\Figure 6A Hydrocarbon Investigation Sample Locations.mxd User: cml3

Current Surface Water and Treatment System Sample Location

Initial Emergency Response Sample Location (subsequently discontinued)

Approximate Fenceline Boundaries for Refining-Related Activities

N

0 300 600

Feet

PFAS SURFACE WATER AND TREATMENT SYSTEM SAMPLE LOCATIONS

Superior Refining Company LLC (SRC)

Superior, WI

FIGURE 6B

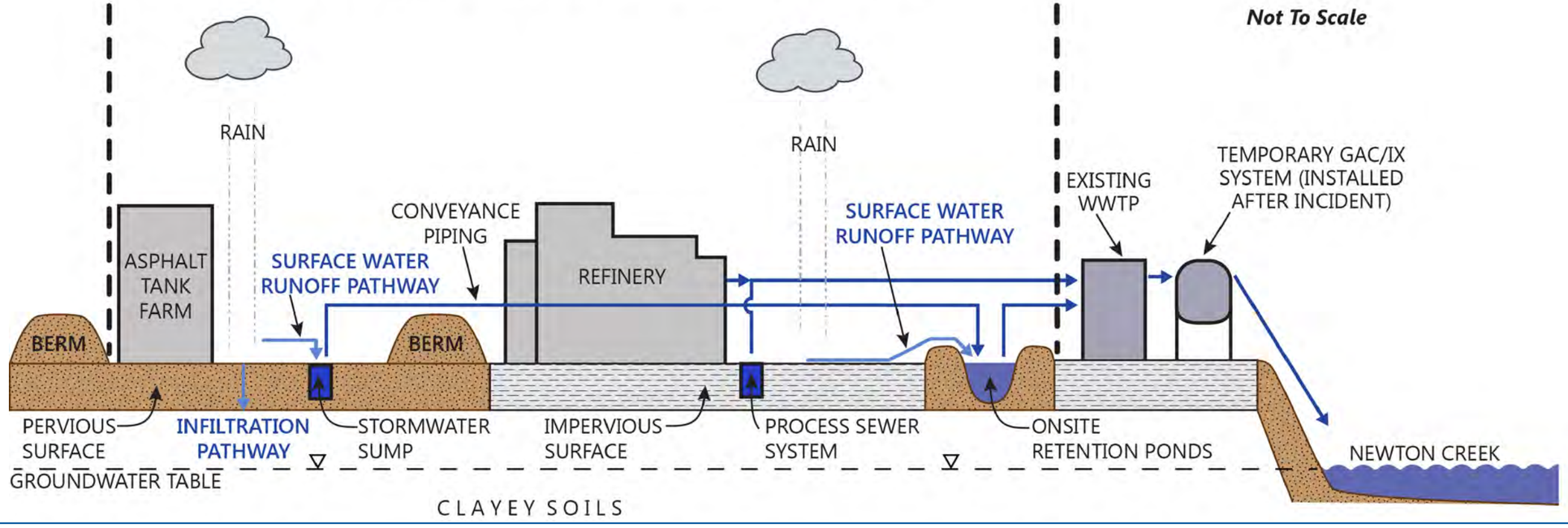
BARR

Barr Footer: ArcGIS 10.7.1, 2020-07-22 10:14 File: i:\Client\Husky_Energy\Superior_Refinery\Maps\Post_Incident_PFAS_Site_Investigation\Figure 6B PFAS Surface Water and Treatment System Sample Locations.mxd User: cml3

Area in contact with AFFF and/or firefighting water

AREAS OF AFFF AND FIRE FIGHTING WATER INCIDENT IMPACTS

Not To Scale

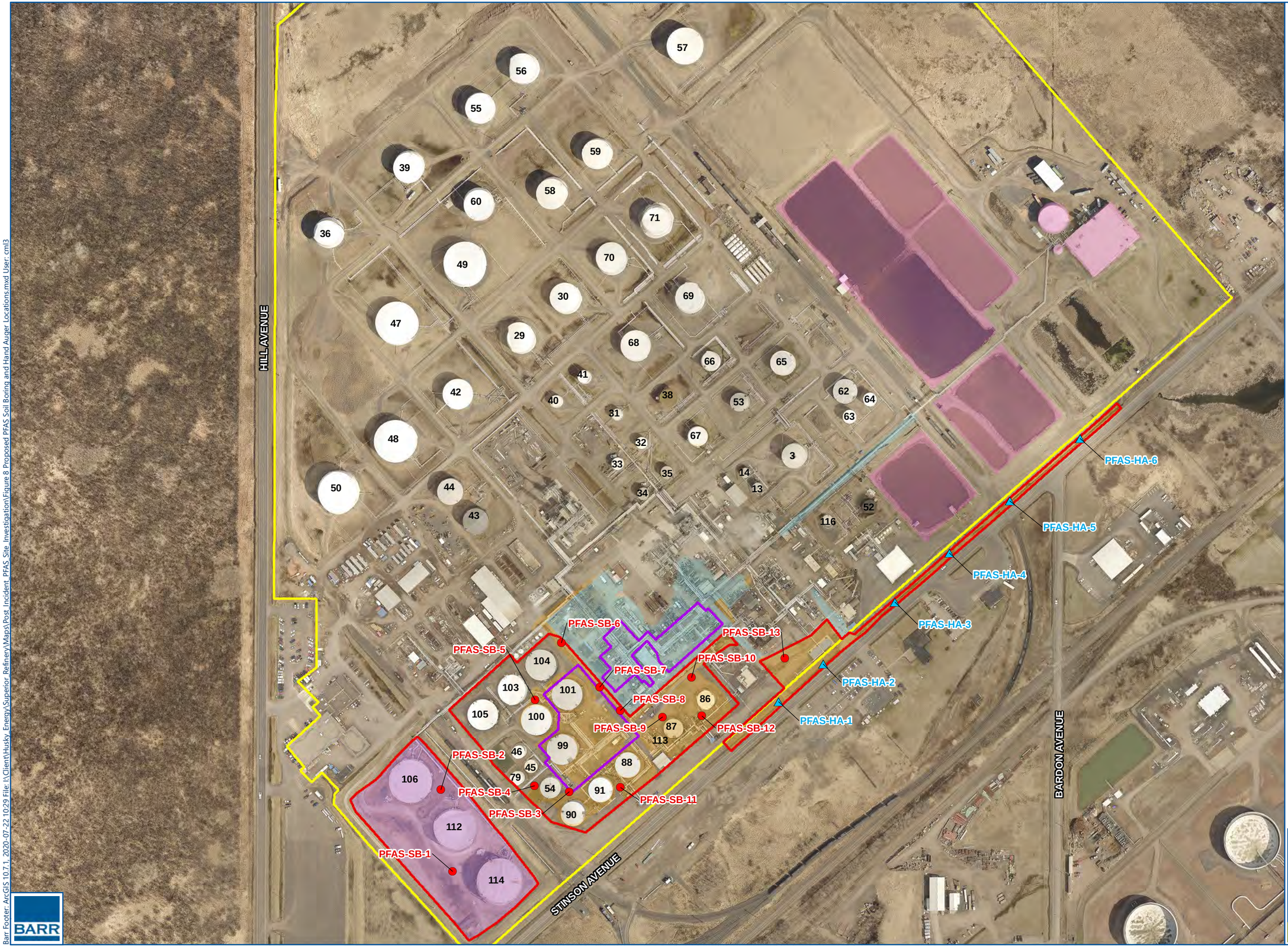


CONCEPTUAL SITE MODEL
Superior Refining Company LLC (SRC)
Superior, WI

FIGURE 7

BARR

Barr Footer: ArcGIS 10.7.1, 2020-07-22 10:37 File: I:\Client\Husky_Energy\Superior_Refinery\Maps\Post_Incident_PFAS_Site_Investigation\Figure 7 Conceptual Site Model.mxd User: cml3



Approximate Fenceline Boundaries for Refining-Related Activities

Potential Incident Impacted Pervious Surface

Approximate Location of Refinery Rebuild Construction Excavation (7.5 to 8 ft bgs)

Incident Impacted Paved (Impervious) Surface

Incident Impacted Unpaved (Pervious) Surface

Incident Impacted Unpaved (Pervious) Surface- Firefighting Water Storage

PFAS Impacted Surface Water Storage and Treatment System

Proposed PFAS Soil Boring Location

Proposed PFAS Hand Auger Location

N

0 150 300

Feet

PROPOSED PFAS SOIL BORING AND HAND AUGER LOCATIONS

Superior Refining Company LLC (SRC)
Superior, WI

FIGURE 8

BARR

Barr Footer: ArcGIS 10.7.1, 2020-07-22 10:29 File: I:\Client\Husky_Energy\Superior_Refinery\Maps\Post_Incident_PFAS_Site_Investigation\Figure 8 Proposed PFAS Soil Boring and Hand Auger Locations.mxd User: cml3