NORTH SHORE GAS®
NATURAL GAS DELIVERY

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March 8, 2019

Mr. Ross Del Rosario
Project Manager
United States Environmental Protection Agency
77 Jackson Blvd.
Chicago, IL 60604

RE: Final Design Response to Comments and Final Design Addenda Submittal
Former South Plant Manufactured Gas Plant Site, Waukegan, Illinois
North Shore Gas Company
CERCLA Docket No. V-W-15-C-027 CERCLIS ID – ILD984809228

Dear Mr. Del Rosario:

The attachments to this letter comprise the Final Remedial Design for the North Shore Gas (NSG) Former South Plant Manufactured Gas Plant (MGP) Site. This Final Remedial Design is intended to represent 100 percent completion of the design process, with the goal of delivering a refined design based upon United States Environmental Protection Agency (USEPA) comments on the Final Remedial Design Report, provided on February 21, 2019.

The below sections of this letter provide responses to USEPA comments issued on February 21, 2019 regarding the Final Design for the NSG Former South Plant MGP Site. For ease of review, USEPA comments are formatted in italics, followed by the response.

GENERAL COMMENTS:

> ***Comment 1:*** *We recommend that the pilot study adopt rigorous quality control and assurance procedures, including thorough documentation of field measurements and observations, as well as effective communication with EPA & IEPA;*

Response: NSG agrees that quality control and assurance, particularly in documenting operational paramaters, field measurements, and observations will be critical in gaining the information necessary from the Phase 1 system to expand to full scale. NSG also agrees that communication with EPA and IEPA, particularly in the start up phase, will be useful and critical to sharing the knowledge and experience among the project team.

> ***Comment 2:*** *Adding a camera inspection schedule to the O & M schedule would be helpful and recommended;*

Response: As was stated in Section 2.4.2 of the Operations and Mainteanance Plan, the injection well will be inspected with a camera at the conclusion of Phase 1 operations to provide insights for use in specifying the full-scale system. Section 2.4.2 has been modified to state that based on observations, a schedule for additional camera work will be develop for inclusion in the full-scale design and submittal to USEPA in support of an adaptive management appraoch.

> ***Comment 3:*** *Please provide an update on the permitting/permit applications status. Some of the permitting tasks have a lead time of up to 120 days (Table 1). Consequently, permitting should be obtained as projected in the plan;*

Response: Development of permit applications is underway. Permit application for longer lead-time permits) water treatment plant construction, operations, and injection is anticipated to be completed by March 22, 2019.

> ***Comment 4:*** *We note that the final design drawings are still identified as preliminary. Given impending approval of this final report, either indicate these drawings as being final or suggest adding a note on the level of design (e.g., 90% vs. 100%) on the design drawings. Also, please confirm if the drawings need to be stamped by an Illinois Professional Engineer (P.E.). On a minor note, we also suggest doing a spell check through the drawings;*

Response: Preliminary note has been removed from each sheet and Issued for USEPA Approval has been noted in revision block. Regarding stamping drawings, the RD AOC does not require PE certified drawings. Section D of the RD AOC states the following requirements for drawings: *reproducable drawings and specifications suitable for bid advertisement*.

> ***Comment 5:*** *Please confirm when the piping and instrumentation (P&ID) drawing will be developed. Is it part of the contractor's design? Since the design consists of a lot of automation, a thorough and detailed P&ID would be helpful for long-term operations;*

Response: P&ID will be developed as part of the water treatment plant vendor's shop drawing process. This approach is consistent with a Phase 1, pilot-study scale system. After operations commence, an O&M manual will be developed to detail valve positions, etc. associated with treatment plant operations.

> ***Comment 6:*** *On a minor note, we suggest revising the bold elevations (currently in red) in the elevation schedule to be monochrome (black) for better visual appearance:*

Response: Red bold text on Sheet C-503 have been changed to black.

> ***Comment 7:*** *For the O & M Plan,*
> - *We suggest providing a routine schedule or the frequency (days/week) allocated for maintenance activities and system checks; and*
> - *Suggest preparing a brief sampling plan to assist O&M operators in collecting, storing, and shipping samples.*

Response:
USEPA provided clarification on February 26, 2019 indicating that Table 1 of the O&M plan is sufficient to address this comment. A details regarding collecting samples from the water treatment plant added into the O&M Plan and details regarding storing and shipping samples will follow SAS SOPs, as noted in the O&M Plan.

> ***Comment 8:*** *The term SGw is defined twice and needs correction. Please change one of these terms to SGd to reflect the specific gravity of DNAPL as shown in the formula.*

Response: SGd has been corrected on Design Report Section 2.2.2.1.

Mr. Ross Del Rosario
March 8, 2019

If you should have any questions regarding the content of this submittal please do not hesitate to contact me at (312) 240-4569 or Narendra.Prasad@WECEnergyGroup.com.

Regards,

Naren Prasad, P.E., MPH
Principal Engineer – Environmental

Enclosures: Final Remedial Design

For distribution to: Mr. Christoper Peters, IEPA (2 hard copies via US Mail and email)
Mr. David Klatt, Jacobs (via email)
Mr. Marcus Byker, OBG (via email)

Final Remedial Design Report

North Shore Gas Company's
Former South Plant Manufactured Gas Plant
Waukegan, Illinois

WEC Business Services, LLC

January 7, 2019

OBG
Part of Ramboll

JANUARY 7, 2019 | PROJECT #67860

Final Remedial Design Report

North Shore Gas Company's
Former South Plant Manufactured Gas Plant Site
Waukegan, Illinois

Prepared for:

WEC Business Services, LLC
200 E. Randolph St., 21st Floor
Chicago, IL 60601

MARCUS D. BAKER, PE
Senior Engineer

JENNIFER M. HAGEN
Senior Managing Engineer

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ACRONYMS AND ABBREVIATIONS

Akzo	Akzo Nobel Aerospace Coatings, Inc
AOC	Administrative Order on Consent
ARARs	Applicable or Relevant and Appropriate Requirements
Barr	Barr Engineering Company
bgs	Below Ground Surface
BMc	Burns and McDonnell
BMP	Best Management Practice
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COPC	Constituents of Potential Concern
COW	City of Waukegan
CQAP	Construction Quality Assurance Plan
cSt	Centistokes
°F	Degrees Fahrenheit
DNAPL	Dense Non-Aqueous Phase Liquid
DO	Dissolved Oxygen
DQO	Data Quality Objectives
DTW	Depth to Water
EIC	Employee-in-Charge
EJ&J	Elgin, Joliet, and Eastern
FS	Feasibility Study
FSP	Field Sampling Plan
ft	Feet
GAC	Granular Activated Carbon
GRO	Groundwater Remediation Objectives
gpm	Gallons Per Minute
HASP	Health and Safety Plan
HDPE	High-density polyethylene
IAC	Illinois Administration Code
IEPA	Illinois Environmental Protection Agency
in	Inches
LNAPL	Light Non-Aqueous Phase Liquid
MGP	Manufactured Gas Plan
NSPH	Net Positive Suction Head
NSG	North Shore Gas
OBG	O'Brien & Gere Engineers, Inc., part of Ramboll
O&M	Operations and Maintenance
ORP	Oxidation Reduction Potential
OSWER	Office of Solid Waste and Emergency Response
OWS	Oil-Water Separator
PAH	Polycyclic Aromatic Hydrocarbon

PDI	Pre-Design Investigation
%	Percent
PLC	Program Logic Controller
PTFE	Polytetrafluoroethylene
PVDF	Polyvinylidene fluoride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RA	Remedial Action
RAO	Response Action Outcome
RD	Remedial Design
RI	Remedial Investigation
ROD	Record of Decision
ROW	Right of Way
SOP	Standard Operating Procedure
SPCCP	Spill Prevention, Control, and Countermeasure Plan
SRP	Site Remediation Program
SSWP	Site-Specific Work Plan
UFP	Uniform Federal Policy
USACOE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
WPD	Waukegan Port District

1 INTRODUCTION

O'Brien and Gere Engineers, Inc., part of Ramboll (OBG) prepared this Pre-Final Remedial Design (RD) on behalf of North Shore Gas (NSG) for the remedy selected by the U.S. Environmental Protection Agency (USEPA) in the July 2015 Record of Decision for Interim Action (ROD) for the Former South Plant Manufactured Gas Plant and adjacent properties impacted by the former MGP (Site), located in Waukegan, Lake County, Illinois. This RD was prepared in accordance with *Guidance on USEPA Oversight of Remedial Designs and Remedial Actions Performed by Potentially Responsible Parties*, Interim Final, Office of Solid Waste and Emergency Response (OSWER) Directive No. 9355.5-01, April 1990 and USEPA Remedial Design/Remedial Action Handbook, OSWER Directive No. 9355.0-4B, June 1995.

1.1 OVERVIEW

NSG and USEPA entered into an Administrative Order on Consent (AOC), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Docket No. V-W-15-C-027 effective October 5, 2015, to perform RD activities for the Site. This Pre-Final RD describes:

- Design assumptions and parameters, including design restrictions and process performance criteria
- Proposed cleanup verification method for documenting compliance with the Response Action Outcome
- Outline of required Technical Specifications (Appendix A)
- Plan Drawings (Appendix B)
- Expected long-term operation and monitoring requirements
- Preliminary construction schedule, including detail regarding construction phases and strategy

The Pre-Final RD design is intended to represent approximately 95 percent (%) completion of the design process, with the goal of delivering a refined design based upon USEPA feedback on the Preliminary RD Report, provided on August 14, 2018. Consistent the September 17, 2018 email from NSG summarizing action items agreed upon during the September 12, 2018 meeting between USEPA, NSG, and their representative consultants, the focus of this Pre-Final design will be discussing the "phased approach" to remedy implementation, refining the entire well field based on USEPA comments, and developing a detailed design of Phase 1. Section 1.6 presents the "phased approach" in further detail. Additional design parameters and system designs related to the Phase 1 DNAPL recovery system, groundwater extraction system, groundwater treatment plant, and groundwater injection system, as well as additional construction and operation documents, were refined in this Pre-Final RD.

1.2 SITE BACKGROUND

This section summarizes background information presented in the USEPA-approved Remedial Investigation (RI) Report – Revision 1 (Natural Resource Technology [NRT], January 2014).

Owner/Operator:	North Shore Gas Company Contact: Mr. Naren Prasad, P.E. (NSG Project Manager) 200 E. Randolph St., 21st Floor Chicago, IL 60601 312.240.4569
Site Location:	T45N, R12E, Section 22 2 North Pershing Road and 1 South Pershing Road City of Waukegan, Lake County, Illinois
USEPA ID **Illinois EPA #**	ILD984809228 0971900058

1.2.1 Site Location and Description

The former South Plant MGP is generally located at 2 North Pershing Road and 1 South Pershing Road in an industrial/commercial area of the City of Waukegan, Illinois (Figure 1). The former MGP was constructed in 1897 and operated until 1946, prior to being demolished in 1951. NSG retained ownership of much of the property on which former MGP operations were conducted. The remaining portion of the former MGP is located beneath North and South Pershing Road on property which was transacted to the City of Waukegan in 1970.

The Site includes the former MGP and adjacent properties where MGP-affected media have been identified through site investigation activities. The properties that comprise the Site are shown on Figure 2 and are summarized below. The property sizes included in the below summary are estimated based on limits identified on Figure 2 and are not intended to convey the extent of MGP-affected media delineated on each property.

- **NSG –** The NSG property comprises three distinct parcels totaling 1.9 acres, separated by Pershing Rd and/or South Harbor Place. The NSG property is where the former South Plant MGP resided and is currently vacant and covered with grass.
- **Elgin, Joliet, and Eastern (EJ&E)** – The EJ&E property is located immediately east of the NSG Property. This 0.7-acre property includes the railroad tracks and right of way (ROW) located east of and at the south end of the NSG Property.
- **City of Waukegan (COW)** – The COW property is located southeast of the NSG Property between the EJ&E, Akzo Nobel, and Waukegan Port District properties. This 0.5-acre property is a vegetated and vacated former city street ROW. This parcel abuts a ComEd substation (not included as part of the investigation and remediation). Other COW properties investigated include nearby roads and associated ROWs.
- **Akzo Nobel Aerospace Coatings, Inc. (Akzo)** – The Akzo property is located east/southeast of the NSG Property and adjacent to Lake Michigan. This 6.2-acre property consists of asphalt parking lots and buildings used for manufacturing paints and aerospace coatings.
- **Waukegan Port District (WPD)** – The WPD property is located east of the NSG Property. This 12.3-acre property includes a marina, a visitor center/administration building, a maintenance building, a boat storage building (constructed in 2017), and asphalt parking lots adjacent to the marina and Lake Michigan.

The NSG Property is also bounded to the north by a City-owned Metra train parking lot and to the west by a Union Pacific railroad yard. There are no known MGP-residuals on these properties and both are upgradient, based on groundwater flow.

Waukegan Harbor and Lake Michigan are located approximately 600 feet east of the NSG Property. A break wall, extending east-northeast into Lake Michigan separates North Waukegan Harbor from South Waukegan harbor. North Waukegan Harbor was constructed in the 1890s and contains a United States Army Corps of Engineers (USACOE) navigation channel that exits east to Lake Michigan. South Waukegan Harbor was constructed in the mid-1980s, as a marina for recreational boats, and has a southern exit to Lake Michigan. The Waukegan River is located approximately 1,000 feet south of the NSG Property and flows east into Lake Michigan (Figure 2).

1.2.2 Summary of Previous Work

1.2.2.1 Previous Investigations

Site investigation activities have been performed since the early 1990s. Most site investigation and interim remedial activities on the NSG Property and WPD properties were conducted in accordance with Illinois EPA (IEPA) Site Remediation Program (SRP), as defined in Chapter 35 of the Illinois Administrative Code (IAC), Part 740 (35 IAC, Part 740). Investigations completed prior to the interim soil remediation activities on the NSG Property focused on identifying sources of MGP residuals and evaluating soil and groundwater conditions. Investigation activities included test pits, soil borings, soil probes, and groundwater wells. Soil and groundwater samples were collected and analyzed for a variety of constituents of potential concern (COPCs). Investigations completed after the soil remediation activities on the MGP focused on delineating the extent of impacts to

groundwater on the WPD property, as well as the delineation and recovery of dense non-aqueous phase liquid (DNAPL) from the NSG and WPD properties.

Entities investigating the Site, and the order in which they completed their investigations include the IEPA, Barr Engineering Company (Barr), and Burns and McDonnell (BMc). IEPA conducted a Preliminary Site Inspection in 1991. Barr completed site investigations throughout the 1990s, and BMc continued investigations between 2002 and 2006. These investigations are described in more detail in the Focused DNAPL Feasibility Study (FS) Report – Revision 2, submitted to USEPA in March 2015 and the reports referenced therein.

To supplement previous investigations, a Pre-Design Investigation (PDI) was conducted by OBG between August 2016 and November 2017. This investigation focused on delineating the DNAPL plume, determining characteristics of the groundwater aquifer, and characterizing both groundwater and DNAPL.

Results from previous Site investigations (prior to 2016) are presented in the RI Report – Revision 1, submitted to USEPA in January 2014 and the Focused DNAPL FS Report – Revision 2, submitted to USEPA in March 2015. Results from the 2016-2017 PDI investigation were presented to USEPA in-person in April 2017 and are included in this design report, as needed.

1.2.2.2 Previous DNAPL Recovery Activities

Passive DNAPL recovery has been completed at recovery wells installed on the NSG and WPD properties in April 2006. DNAPL recovery has been undertaken intermittently since that time, removing approximately 1,717 gallons of DNAPL.

1.3 REMEDIAL ACTION OBJECTIVES

USEPA elected to conduct an interim remedial action (RA) to address DNAPL impacts at the Site. This approach will involve implementation of a DNAPL-focused remedy, allowing NSG and the USEPA to make informed decisions about how to address any potentially remaining site risks following DNAPL remediation. The ROD established the following RAO to protect the public and the environment from potential, current, and future health risks associated with the continued presence of DNAPL in soil and groundwater on Site:

- Reduce the mass and mobility of recoverable DNAPL to the extent practicable.

The extent practicable will be defined using a decline curve analysis, as laid out in further detail in Section 3.

1.4 DESCRIPTION OF REMEDIAL ACTION

The USEPA-selected remedy consists of enhanced recovery of DNAPL using a network of groundwater injection and co-located DNAPL and groundwater extraction wells. Groundwater and DNAPL extracted from the system will be pumped as separated fluids through dedicated conveyance piping to a groundwater treatment plant, where DNAPL will be directly pumped into a DNAPL storage tank and groundwater will undergo treatment. The separated DNAPL will be containerized and shipped off-site for disposal. Extracted groundwater will be treated on site and reinjected into the aquifer, resulting in localized increases in hydraulic gradient and theoretically increasing the migration rate of mobile DNAPL towards the recovery wells.

1.5 RD-AOC REQUIREMENTS

In addition to discussion of the Pre-Final Design details, the RD-AOC identified additional information and documents to be included in this Pre-Final Design. Table A addresses these specific sections and plans, referencing the document name and location within the Pre-Final Design Report, as well as the location where the requirements are laid out in the RD-AOC.

Table A. Summary of RD-AOC Additional Design Requirements

Document	Location in Pre-Final RD Report	Reference Location in RD-AOC
Permit Requirements	Section 2.2	Appendix A, Page 3
DNAPL Reduction Performance Plan	Section 3.2	Appendix A, Page 5
Quality Assurance Project Plan (QAPP)	Section 5.1, Appendix C	Appendix A, Page 5
Health and Safety Plan (HASP)	Section 5.2, Appendix D	Appendix A, Page 7
Contingency Plan	Section 5.3, Appendix E	Appendix A, Page 7
Field Sampling Plan (FSP)	Section 5.4, Appendix F	Appendix A, Page 8
Construction Quality Assurance Plan (CQAP)	Section 5.5, Appendix G	Appendix A, Page 8
Operation and Maintenance (O&M) Plan	Section 5.6, Appendix H	Appendix A, Page 8
Groundwater Monitoring Plan	Section 5.6.1 (RD), Section 3 (O&M Plan, Appendix H)	Appendix A, Page 5
Plans and Specifications	Section 5.7, Appendix A (Specifications), Appendix B (Plans)	Appendix A, Page 3

Though identified in the RD-AOC, a Capital and O&M Cost Estimate was not completed for this Pre-Final Design. With development of the "phased approach" to the remedy and the focus of this Pre-Final Design on Phase 1, which will function as a pilot test, developing a reasonable cost estimate for the entire remedy is not feasible. Once Phase 1 has been completed, a Capital and O&M Cost Estimate will be developed as part of the full-scale design submittal.

1.6 PHASED IMPLEMENTATION

A plan for phased implementation of the RD was developed based upon the USEPA recommendation for a pilot study of the groundwater treatment plant. During a September 12, 2018 meeting between the NSG, USEPA, and their representative consultants, strategy for a two-phase implementation of the RD was proposed and approved. Implementing the RD in two phases will address USEPA's comment recommending a pilot study-scale groundwater treatment plant and provide the advantage of expediting the RA, allowing the pilot system to run and provide feedback while the full-scale system design details are finalized. Observations from the Phase 1 treatment system will provide insights into longer-term operational considerations, including potential mineral fouling. These insights will help validate and optimize the groundwater treatment plant for full-scale design, thus minimizing potential future full-scale system shutdowns.

Phase 1 of the RD will include installation of a recovery/injection well network and conveyance system west of the EJ&J property and construction of a groundwater treatment plant with the approximate capacity of 20 gallon per minute (gpm). The targeted section of well network installed in this initial phase will be used to verify and refine groundwater modeling assumptions related to extraction and injection, including efficiency and required gradient losses, and optimize the design of other system components (i.e. extraction pumps, extraction and injection well screen design, etc.). Existing recovery wells on the NSG Property, will be included as part of the extraction and injection network. As part of the optimization, the new vertical extraction wells installed to expand the system will be constructed with a smaller screen slot size than the current wells with the goal of determining the most efficient screen slot size for DNAPL extraction (refer to Section 2.2.2.3.1 for design rationale). Observations from these varying screen sizes will be used to refine the well design for the rest of the full-scale well network. After installation, the Phase 1 system is anticipated to operate for approximately six months at which point a meeting will be scheduled with USEPA to review the results of the system before full-scale design begins. Once USEPA and NSG are in agreement that sufficient information has been obtained from the Phase 1 system, design of the full-scale system will commence, which will include the remaining well network and conveyance infrastructure, as well as an expanded groundwater treatment plant.

A detailed description of all design components related to the Phase 1 implementation and the full-scale well network, along with an overview of the full-scale system, is provided in Section 2. Details of the full-scale system will be finalized after the Phase 1 system has operated for a suitable time to provide feedback on potential system issues and resolutions. Section 4 provides a more detailed schedule for implementation of Phase 1 and the path forward to full-scale design.

2 BASIS OF DESIGN

This section presents the basis of design for the USEPA-selected remedy to recover DNAPL from the NSG South Plant Site. Section 2.1 presents RD considerations relevant to the full-scale system, such as spatial and property constraints, hydraulic modeling of the full-scale system, DNAPL physical properties, and material compatibility testing. Section 2.2 presents the basis of design for components specific to the Phase 1 system.

2.1 REMEDIAL DESIGN CONSIDERATIONS—PHASE 1 AND FULL-SCALE

2.1.1 Spatial and Property Design Constraints

2.1.1.1 Property Ownership

Full-scale implementation of the RD will involve installation of injection and recovery wells, along with conveyance piping, on the properties adjacent to the NSG Property within the Area of Potentially Recoverable DNAPL (Figure 3). Identified in Section 1.2.1, these properties include Akzo, WPD, EJ&J and COW. Table B presents currently-known use restrictions for the impacted properties.

Table B. Use Restrictions by Property

Property	Use During Remedial Design	Property-Specific Restrictions	Affected by Phase 1
NSG Property	Staging areas, treatment system, recovery wells, injection wells, underground conveyance infrastructure	None	Yes
Akzo	Recovery wells, injection wells, underground conveyance infrastructure	Active employee parking lot also functions as secondary containment for the facility, as specified in their SPCC Plan.	No Impact
WPD	Recovery wells, injection wells, underground conveyance infrastructure	Active parking lot sees a high volume of public traffic during the boating season.	Minor impact associated with modification of existing recovery wells on boundary of NSG and WPD property.
EJ&J	Underground conveyance infrastructure	Must have a "qualified person" on site and remain 25 ft. away from the tracks or have a railroad Employee-in-Charge (EIC) on site. An extensive review/approval process is anticipated to get permission for boring beneath the active rail line.	No anticipated impact
COW	Recovery wells, injection wells, underground conveyance infrastructure	Dense vegetation may require clearing. Work on or near roads would require ROW permit.	Installation of one new recovery well, construction in ROW and road crossings

NSG presented the Preliminary Design to Akzo and the WPD for review. Based on their feedback, practical and reasonable updates to the system layout were incorporated into this Pre-Final Design. NSG also engaged with the COW, regarding utility crossings under roadways. COW's preference for installation is through directional drilling or jack and bore with the utilities then enclosed in steel casings. The COW's preference for utility crossings has been incorporated into the implementation scheme.

2.1.1.1.1 North Shore Gas Property

Minimal approval is necessary for any of the work taking place on the NSG property. Consequently, the parcel will be used for the bulk of staging equipment and for the long-term construction of the treatment facility.

2.1.1.1.2 Akzo Nobel Aerospace Coatings, Inc.

The Akzo property will have both injection and recovery wells located in the main parking lot, east of the production building, and in the grassy courtyard directly northwest of the production building. Conveyance infrastructure will be installed from these wells to the treatment plant, located on the NSG Property. Integrity of the main parking lot is an important consideration on the Akzo property, as the parking lot currently functions as a secondary containment system for potential spills associated with the facility. Therefore, approval will be needed for any intrusive work before it begins. It will be paramount to stage the work to maintain the secondary containment functionality of the parking lot during installation and to minimize damage to the continuous asphalt surface. Installed recovery vaults must be as watertight as practical. Additionally, the parking lot sustains heavy use with both employee and truck traffic, so careful consideration will go into sequencing construction to minimize inconvenience to daily plant operations.

2.1.1.1.3 Waukegan Port District

Injection and recovery wells will be located throughout the WPD property, including its main marina area, parking lot, boathouse lot, and maintenance area. Conveyance infrastructure will also be installed to connect wells to the groundwater treatment plant on the NSG property. Approval will be needed prior to commencing intrusive work on these areas of the property. In addition, the marina and parking lots experience high usage during summer months and on weekends. Construction will need to be scheduled and sequenced to minimize disruption to marina operations.

2.1.1.1.4 Elgin, Joliet, and Eastern

No wells are anticipated to be installed on the EJ&J property; however, conveyance infrastructure from wells on the surrounding properties will pass through this parcel. Approval will be needed for any intrusive work to take place on the property, particularly borings or trenching that would be conducted underneath the tracks.

Working near the tracks located on the EJ&J parcel requires that a qualified person, who has participated in the Canadian National safety orientation, be on site at all times. Additionally, work is not allowed within 25 feet of the tracks unless a Canadian National EIC is on site. The railroad must be notified 48 hours before commencing work on the property and at least 24 hours prior to any person or equipment (including boom extensions) within 25 feet of the tracks.

2.1.1.1.5 City of Waukegan

Injection and recovery wells, as well as conveyance infrastructure, will be installed on the COW property. The main restrictions on the small parcel east of the NSG Property will involve working around vegetated areas. Additional considerations will include working on or near the roads, including boring beneath the roads, where a ROW permit and traffic protection will be necessary. The ROW permit is discussed in more detail in Section 2.1.2.

2.1.1.2 Buildings and Roadways

Site features, including roads, parking lots, and buildings, will affect the placement of wells, conveyance infrastructure and the treatment plant. To minimize asphalt replacement, the design preference is to install infrastructure in the grassy areas of medians or alongside the roadways and parking lots. As most of the wells are anticipated to be vertical, the well layout will have to be arranged around the buildings, mainly the WPD boathouse, the WPD maintenance building, and the Akzo production building. Additional considerations will include areas with challenging access, such as the courtyard adjacent to the northwest side of the Akzo production building and abutting the COW property. The courtyard can only be accessed from a gate opening to the COW property. This gate is limited in size and will restrict the type of drill rig that can be used. Additionally, dense vegetation on the COW property may need to be cleared, both to access the Akzo courtyard and to install

wells and conveyance infrastructure on the COW property. The well design layout was developed to minimize, to the extent practical, the amount of clearing needed.

2.1.1.3 Utilities

As a part of the Fall 2017 PDI, Blood Hound, LLC conducted a thorough mapping of Site utilities. Utility locations will impact placement of both the horizontal and vertical wells, as well as determine pathways and depth of the conveyance piping. As stated in Section 2.1.1.2, the design preference is to install wells and complete other intrusive work in grassy areas, where practical; however, well locations shown on Sheet C-103 (Appendix B) have been adjusted to accommodate utility clearances. Utilities will need to be marked in the field and infrastructure installation adjusted, if needed. The following sections summarize the utilities located underneath each property. Sheet C-102 (Appendix B) shows the location of all utilities on the Site.

2.1.1.3.1 North Shore Gas Property

Electric, water and sewer lines are all present beneath the NSG Property. No utilities are present on the parcel north of Harbor Place Road. South of Harbor Place Road, electric, water and sewer lines all originate at the southern-most edge of the property. The sewer line continues through the middle of the parcel, while the water line splits, running northeast, then east towards the COW property, and northwest under Pershing Road and the western parcel of the NSG Property. A sewer line runs along the southern portion of the parcel located west of Pershing Road.

2.1.1.3.2 Akzo Nobel Aerospace Coatings, Inc.

Utilities are present under the Akzo parking lots. The main parking lot—north and east of the buildings—where wells are anticipated to be placed, contains sewer lines along the eastern edge and in the north section of the lot. The northern sewer splits at southeast and southwest diagonals from the northern terminus. A third storm sewer runs alongside an electrical conduit from the middle of the main parking lot towards the processing building. Water, electric, and gas lines are located under the small parking lot and loading dock area situated between buildings and the entrance gate. A water line runs west from the gas storage building on the north edge of the property to the fence line and then south underneath the process building.

2.1.1.3.3 Waukegan Port District

Utilities under the WPD parking lots include electric lines running the length of the main parking lot. These lines are located under the grassy border abutting the Akzo fence line, under the grassy median in the middle of the parking lot, and underneath the sidewalk directly adjacent to the west side of the office building. Water and gas also run along this corridor adjacent to the building. Sewers exist in several different locations around the parking lot. The maintenance building parking lot contains storm sewer, electric and gas lines along its eastern edge, with the sewer line branching off to run diagonally northwest through the middle of the parking lot. Gas and electric lines are located under the grassy median north of both parking lots, which separates the lots from Harbor Place Road. Water and electric also run alongside the north side of the maintenance building, crossing the entire width of the parking lot.

2.1.1.3.4 City of Waukegan

Electric lines run parallel to the railroad tracks on the northeastern half of the property, north of Harbor Place Road. A water line follows a similar path, with the water and electric lines separated by increased distance near the northern edge of the property. South of Harbor Place Road, water and sanitary sewer run east and west, connecting the Waukegan Port District Maintenance building utilities to those located along Pershing Road ROW.

2.1.2 Permitting

The RA is being conducted under the authority of CERCLA and will be implemented in accordance with Applicable or Relevant and Appropriate Requirements (ARARs) and "to-be-considered" criteria, as identified in the ROD. USEPA guidance (USEPA, 1992) states that permits are not required for CERCLA on-site RAs; however, a permit "equivalency" process should be followed. The lead agency is asked to participate in the equivalency process, and the applicant would typically perform the permitting application requirements; however, fees and public hearing requirements are typically waived. Table 1 identifies a list of state and local permits which would

potentially be required for non-CERCLA projects of this nature. As the RA begins, permit equivalencies for all necessary permits will be met.

2.1.3 Well Spacing and Flow Rate

Groundwater flow at the Site occurs within the unconsolidated sand and fill materials, with the water table encountered at 4-8 feet below ground surface (bgs). Results of hydraulic testing performed as part of the PDI are summarized in Appendix I – Hydraulic Testing Memorandum and indicate this unit is relatively transmissive, with estimated hydraulic conductivities of 15-60 feet per day (ft/d). The unconfined shallow sand aquifer is underlain by a low-permeability clay and silt aquitard beginning at approximately 20 feet bgs.

A site-specific groundwater flow model was developed to simulate site groundwater conditions and evaluate remedial well configurations and flow rates for the proposed simultaneous extraction and injection components of the DNAPL recovery remedy. This model development is summarized in Appendix J – Groundwater Modeling Technical Memorandum. OBG selected the model code MODFLOW, a publicly-available groundwater flow simulation program developed by the U.S. Geological Survey, for the construction and calibration of the Site numerical groundwater flow model,

Steady-state remedial simulations were performed using the calibrated flow model to estimate total flow rates and evaluate well spacing and hydraulic gradients for the proposed remedy. The following objectives were considered for the simulation of remedial well configurations:

- **Avoid dewatering below initial DNAPL surface at extraction points** - Obtaining maximum DNAPL extraction during waterflooding requires avoiding any flow of water through previously-DNAPL saturated material at or near the extraction well.
- **Prevent mounding within 2 feet of ground surface at the injection wells** - Potential daylighting of injected fluids was evaluated through comparison of simulated groundwater elevations to ground surface elevations.
- **Increase total and per-well rates to maximize groundwater gradients** - Waterflooding to mobilize and extract DNAPL from the surface is dependent on maintaining increased hydraulic gradient towards the extraction wells.
- **Maintain hydraulic control within the delineated DNAPL footprint** - A potential result of simultaneous extraction and re-injection at equivalent flow rates is escape of fluids outside the capture zone of the extraction wells.

Two scenarios of groundwater extraction and injection were simulated. Extraction and injection wells were simulated in MODFLOW as well boundaries. Evaluation of the steady-state remedial simulations yielded the following conclusions:

- The proposed full-scale remedy and simulated groundwater aquifer are capable of supporting flow rates of 139 gpm.
- A well spacing of approximately 50 feet is appropriate for simulated flow conditions.
- Higher rates of pumping may be obtained at the eastern portion of the site, where the overall saturated thickness of saturated aquifer material is greater.
- The sheet pile wall limits capture of water from Lake Michigan by the extraction system.
- Remedial hydraulic gradient is sensitive to flow rate and aquifer hydraulic conductivity.
- Engineering considerations, including a conservatively-sized groundwater treatment plant, groundwater extraction well pumps with variable flow capabilities, and contingency plans to manage excess extracted groundwater, should be considered to account for potential variability in hydraulic conductivity and well efficiencies.
- Simulated system configurations do not result in significant loss of containment from the potential extent of recoverable DNAPL.

The proposed well locations for the full-scale remedy are indicated on Sheet C-104 (Appendix B).

2.1.4 DNAPL Characteristics

As part of the 2017 PDI, DNAPL samples were collected for characterization. One sample of DNAPL was collected for waste characterization, and four samples were collected for analysis of the DNAPL's fluid properties. A summary of results is provided below. A table summarizing fluid properties, and the laboratory report containing the waste characterization results is included in Appendix K.

Individual samples of DNAPL from four of the current site recovery wells (RW-2, RW-7, RW-10, and RW-11) were collected and analyzed for fluid properties. DNAPL was pumped directly from each recovery well and containerized. A groundwater sample from each well was also collected and sent to the laboratory. The samples were run for density, specific gravity, and viscosity at three different temperatures (50 degrees Fahrenheit [°F], 60°F, and 70°F) with the goal of simulating temperatures likely encountered in the ground and in the treatment system. A previous DNAPL sample had been collected as part of the 2016 PDI, but the characteristics were measured at elevated temperatures (70°F-130°F) not likely to be encountered in the system. While those results are included on the table in Appendix K, they are not discussed here. The following is a summary of the 2017 PDI sample characteristics:

- DNAPL viscosity ranged from 41.5-170 centistokes (cSt) at 50°F with RW-2 yielding the highest viscosity DNAPL and RW-7 yielding the lowest.
- DNAPL viscosity decreased to a range of 23.4-71.9 cSt at 70°F with RW-2 yielding the highest viscosity DNAPL and RW-7 yielding the lowest.
- Viscosity appears to decrease with eastward movement across the Site. At all temperatures, recovery wells RW-2 and RW-11, located on the far west edge of the WPD maintenance building parking lot (nearest the Phase 1 area), had the highest viscosities, while RW-7 and RW-10, both located further east in the WPD marina parking lot, had lower viscosities. This change in characteristic across the Site was visually confirmed during previous DNAPL recovery activities.
- All DNAPL samples yielded density results slightly above one with densities ranging from 1.0548 to 1.082 grams/cubic centimeter (g/cc).

A small amount of DNAPL from all four of the aforementioned wells was composited and analyzed for waste characterization parameters, including reactive sulfide, reactive cyanide and flashpoint (closed cup). Values for both reactive sulfide and cyanide were non-detect. The sample measured a flashpoint of 135°F, which qualifies the DNAPL as hazardous waste under USEPA standards. The material is also considered a Class II Combustible Liquid, based on the National Fire Protection Association's classification system. The low flashpoint was a consideration in minimizing the wellhead electrical infrastructure and a driver for pump selection, as discussed in Sections 2.2.1.1 and 2.2.2.2.

2.1.5 Materials Testing and Constraints

As a part of the 2017 PDI, six construction materials were tested by full immersion in an DNAPL solution at room temperature. The materials were immersed for 79 days and then observations were made on visual or physical effects resulting from DNAPL exposure. The following six materials were tested:

- Type 304L stainless steel
- Type 316L stainless steel
- High-density polyethylene (HDPE)
- Polytetrafluoroethylene (PTFE)
- Polyvinylidene fluoride (PVDF)
- Viton®

The stainless steel, PTFE, and PVDF all performed well, proving compatible with the MGP residual solution and showing negligible or no effects from immersion. Viton® performed satisfactorily, with only a slight tendency for swelling (approximately 1.7% to 2.5% in thickness and less than 1% in length and width). HDPE proved to be generally resistant, though the material experienced discoloration and showed a tendency to swell slightly after immersion (approximately 1% to 2% each over length, width, and thickness). Based on these tests HDPE was not considered for use as well screen material for DNAPL recovery where swelling caused by exposure to MGP residuals could cause well slots to close, impeding the efficiency of the system. HDPE was determined to be suitable for drop piping as the anticipated swelling is unlikely to be detrimental to DNAPL extraction once it has passed through the screen. The suitability of HDPE for drop piping will be evaluated throughout Phase 1 System operations. The full results report is included in Appendix L.

2.2 REMEDIAL DESIGN COMPONENTS—PHASE 1

The Phase 1 Area was selected as the target location for initial system installation because the wells are located predominantly on NSG Property, the area is in close proximity to the groundwater treatment plant, and the ground surface is predominantly grass, allowing for simpler installation of infrastructure. Review of the Groundwater Modeling Technical Memorandum (Appendix J) indicates that maximum anticipated flow rate from wells in the Phase 1 Area (EW-1 through EW-6) is 20 gpm. Injection capacity of the horizontal well is anticipated to reach a similar flow-rate.

Plan Drawings of the Phase 1 Area are included in Appendix B. These plan drawings represent NSG's preferential locations of proposed infrastructure. Exact locations may be modified, where necessary, to reflect reasonable comments received from adjacent property owners. NSG will communicate potential modifications to locations of proposed infrastructure to USEPA as comments are received.

2.2.1 Site Preparation and Erosion Controls

The Pre-Final RD incorporates site preparation and erosion control elements that are protective of human health, ecological health, and public utility. This RD describes erosion control measures that will be used to protect from inadvertent environmental conditions that could detrimentally affect potential off-site environmental receptors.

Site preparation elements include the following:

- Site controls to protect the public and adjacent properties from the RA, including signage and fencing around the project area, as necessary, to prevent the public from entering the Site except through designated entrances.
- Best Management Practices (BMPs), such as silt fence, inlet protection, and other erosion controls, to prevent soil and water transport in accordance with applicable permit requirements.
- Clearing and grubbing for access to the system installation areas, as necessary.

Site preparation elements and erosion controls are shown on Sheet C-104 (Appendix B).

2.2.2 Fluid Extraction

2.2.2.1 DNAPL Recovery

During the 2017 PDI investigation, four pumps were tested for use as recovery pumps (Appendix M). Though two pumps were recommended during the Preliminary Design, a review of all four pumps was completed for the Pre-Final design, taking into consideration ease of maintenance, the low flash point of DNAPL at the Site, and the suction lift that could be achieved. The low flash point of Site DNAPL was a primary influence on both pump and electrical infrastructure selection. With this consideration, an air-operated pump was determined to be safer and more reliable for the RD. Based on this determination, the two air operated pumps which were tested during the PDI, the air-operated double diaphragm and pneumatic displacement, were evaluated further.

Design calculations were completed to determine the suction head needed to remove DNAPL from the wells (Appendix N). Completion of a net positive suction head (NPSH) calculation determined that Site conditions are

on the upper limit of the suction lift capacity for the double diaphragm pump, which would be the preferred pump based upon evaluation during the PDI. In order to determine the best pump for long-term DNAPL recovery, during Phase 1 three of the six extraction wells will be outfitted with air-double diaphragm pumps. In these wells, a high-density polyethylene (HDPE) drop pipe will be connected to the pump and then inserted in the well, extending to the DNAPL-bearing interval. The pump will be situated within the recovery vault and rely on the pump's suction lift to bring DNAPL to the surface. The other three wells will be equipped with the submersible pneumatic displacement pump, which also performed well during the PDI. The submersible pneumatic displacement pumps will be set into the three wells with the lowest inverts, as this pump style does not rely on suction lift. Based on the performance of the two pumps during Phase 1 operations, a determination will be made regarding which pump to move forward with for full-scale implementation.

As the DNAPL recovery rate is anticipated to vary spatially (different between each well) and temporally (recovery rates are anticipated to fluctuate with time), the air-operated system will provide the flexibility to adjust flow rates of individual wells by increasing or decreasing the pressure through the system or the length of the cycles, including shutting down a well for a time once recovery has slowed. Timers will be incorporated to regulate the pump cycle to greater precision than can be accomplished by pressure alone. A regulator on each air line will control the pressure of air to each pump, and cycle counters will be used to quantify number of pump cycles. Based upon the volume each cycle of the pump can recover and the number of cycles per minute, a flow rate will be calculated. During Phase 1, system operators will spot-check the cycle counters regularly to confirm accuracy and consistency, and the calculation of flow rates will be completed manually.

While it can be challenging to predict DNAPL recovery with reasonable accuracy, a review of previous recovery volumes at the Site indicates that system-wide DNAPL recovery rates may be anticipated to fall between 5 to 10 gallons per day. Actual recovery rates will be established in the field upon operation of the system. The cycle timers associated with each pump will provide the control needed to achieve the low pumping rates, and the timer delay can be increased or decreased to match DNAPL recovery rates. To monitor DNAPL levels, two pressure transducers will be inserted into the extraction well—one in the DNAPL layer and one in the water column—to collect real-time pressure readings in each layer. During Phase 1, pressure readings will be downloaded manually and used for the DNAPL thickness calculation. The success of this method of DNAPL measurement will be compared against manual DNAPL thickness measurements. If it proves to provide an accurate measurement of DNAPL, methods for further automation of the process will be refined as part of the full-scale design.

Thickness of DNAPL in each well at any given time will be calculated using a form of Bernoulli's Equation and based upon the difference in specific gravity between the DNAPL and groundwater:

$$b_d = \frac{(H_2 - H_1 - \Delta Z) * SG_w}{(SG_d - SG_w)}$$

Where:
b_d = DNAPL thickness (feet)
H_1 = Pressure reading of pressure transducer 1, installed in water column (feet)
H_2 = Pressure reading of pressure transducer 2, installed in DNAPL (feet)
ΔZ = Elevation difference between pressure transducer 1 and pressure transducer 2
SG_w = Specific gravity of water (dimensionless)
SG_d = Specific gravity of DNAPL (dimensionless)

During Phase 1, manual DNAPL measurements will be collected regularly using the string and sinker method to confirm the accuracy of the real-time system. Based on these results and the flow rate measurements, the timer controlling the flow of air to each pump will be adjusted to increase or decrease the frequency of the pump cycles so that the extraction rate matches, as near to as practical, the rate of DNAPL migration into the well.

Each DNAPL extraction well will be powered by a dedicated air line terminating at the groundwater treatment plant. An air line solenoid and timer manifold will be installed in the groundwater treatment plant where the

pump rate from each extraction well will be controlled. If a high-level alarm in the DNAPL storage tank is activated, the solenoid will prevent additional cycling of DNAPL extraction pumps until DNAPL is extracted from the tank.

Detail A, Sheet M-503 (Appendix B) illustrates pump placement and connections within the vault. Sizing and other pump details are included in the Technical Specifications (Appendix A).

2.2.2.2 Groundwater Extraction

Groundwater extraction will be co-located with DNAPL extraction in the vertical wells. To minimize emulsion, a separate pump and separate conveyance piping will be utilized for groundwater extraction. Based on its performance during the PDI, the same air-operated double diaphragm pump preferred for DNAPL extraction has also been selected for groundwater extraction. Utilizing the same pump for recovery of both groundwater and DNAPL will result in efficiencies and cost-savings in maintenance and repair. NPSH calculations (Appendix N) indicate that the pump has sufficient suction lift capacity for groundwater extraction. The pump will be installed in the recovery vault, and a HDPE drop pipe will be placed in the well to an elevation of approximately 581 ft. NAVD88. This will place the bottom of the pipe below the surface of the water table, measured at approximately 584 ft. NAVD88, and above the highest measured DNAPL, which is found below 581 ft. NAVD88. The height of the drop pipe may be readjusted as DNAPL levels change throughout the course of system operations.

Based on the hydraulic modeling, groundwater extraction rates are expected to be higher than DNAPL recovery rates. This will decrease the hydraulic head at the well location and theoretically increase DNAPL migration. Given that flow rates of between 2 and 4 gpm are expected from each Phase 1 well, a cycle timer will not be required and flow control will be established through adjusting the regulator associated with each pump. Cycle counters will be used to measure the individual flow rates. Based upon the volume of water each cycle of the pump can recover, and the number of cycles per minute, a flow rate will be calculated. During Phase 1, system operators will spot-check the cycle counters regularly to confirm accuracy and consistency, and the calculation of flow rates will be completed manually. For Phase 1, the system-wide groundwater extraction flow rate is anticipated to be between 10 and 20 gpm.

The groundwater gradient will be monitored by collecting groundwater elevations at each of the wells. Real-time groundwater elevations will be measured using pressure transducers. Water elevations will be verified through collection of manual water level measurements at each well. During Phase 1, manual water levels will be collected regularly to verify accuracy of the real-time measurements. Based on these results and the flow rate measurements discussed above, the regulator associated with each pump will be adjusted to achieve the desired flow rate and groundwater gradient.

A shared air trunk line will provide air from the groundwater treatment plant to the groundwater extraction pumps. A solenoid will be installed in the groundwater treatment plant, and groundwater extraction will cease if either a high-level condition is detected in the influent holding tank or if the treatment plant is shut down due to high pressure or other alarm conditions.

Detail A, Sheet M-503 (Appendix B) illustrates pump placement and connections within the vault. Sizing and other pump details are included in the Technical Specifications (Appendix A).

2.2.2.3 Extraction Well Design and Hydraulic Testing

2.2.2.3.1 Extraction Well Design and Construction

The extraction well network was developed with the goal of repurposing as many of the previously installed recovery wells as practical. As part of the Phase 1 well network, three recovery wells on the NSG Property will be repurposed as extraction wells. Existing recovery wells consist of a 6-inch diameter continuously slotted screen, ranging from 9-10 feet in length, with a slot size of 90 (0.09 inches [in.]). At the completion of the two-day pump test conducted at RW-5 during the PDI, sand was noted in the groundwater extraction pump during cleaning. While not problematic during a two-day pump test, there is potential that the volume of sand accumulation in the well associated with long-term groundwater extraction may present long-term operational problems and lead to excessive well maintenance.

A comparison of current Site recovery well construction with that of wells installed for a similar DNAPL recovery system at a wood treating site in North Little Rock, Arkansas (URS, 2009), supports the concept that the current well construction and screen slot size should promote DNAPL flow into the well, rather than matching the screen design with the surrounding lithology. The Little Rock site well construction included 100-slot screens with a pea-sized gravel filter pack.

When evaluating the geotechnical data generated during the PDI, the data was reviewed with a well-screen manufacturer. This evaluation determined that a slot size larger than 20-slot (0.02 in.) may allow for fine sand to enter the well during pumping. The geotechnical samples most resembling the Phase 1 lithology consist of a range between coarse gravel and fine sand with D_{50} values of 0.0085 and 0.0929 inches and D_{85} values of 0.0118 and 0.3248 inches, respectively. While these values present a wide range of material size, they encompass the varying sand and gravel conditions within the top 15-20 feet of material on Site. Geotechnical laboratory reports and a summary of all calculated diameter values for the two relevant samples are included in Appendix O.

Considering the objective of these extraction wells—to encourage DNAPL to readily flow in, rather than to entirely preclude aquifer material from entering—a 60-slot screen was selected to bias the screen size towards meeting the primary well construction objective. Based on manufacturer's recommendations, a corresponding number 60 filter pack with a D_{50} of approximately 0.085 inches will be used. Wells will be constructed with a minimum well seal thickness of 0.5 feet, a minimum secondary filter pack thickness of 1 foot, and sump depth of 2.5 feet. Screen length will be determined in the field based upon the depth of the well in relation to the depth of the recovery vault and the length needed in order to meet the other well construction requirements. Screen lengths are estimated to range between a minimum of 7.5 ft. and a maximum of 10 ft. An estimate of well construction details, based on a review of adjacent borings, is provided in Detail B on Sheet C-503 (Appendix B).

As a midpoint between the formation size and the current extraction well construction, the selected slot size and filter pack will allow for DNAPL flow into the well while minimizing the amount of material being pulled in from the surrounding aquifer. Observations will be made during Phase 1 to determine if the screen slot size has a meaningful impact on DNAPL recovery and how it affects well and pump conditions. Based on these observations, construction details for the rest of the well network will be refined for full-scale implementation.

2.2.2.3.2 Well Development

Wells will be developed no sooner than 24 hours following installation to allow cement grout to cure. Well development of three newly installed wells and 3 existing recovery wells will be performed using mechanical surging and pumping to remove fine-grained materials and a minimum of five well volumes of fluid. Field parameters, including turbidity, will be monitored and recorded to determine when measurements have stabilized and well development is complete. Well development will conclude once turbidity readings have stabilized below 25 NTU or following removal of 10 well volumes of fluid, whichever is sooner.

2.2.2.3.3 Hydraulic Testing at Extraction Wells

Following new well installation and development or redevelopment of all extraction wells, well performance testing will be performed at all the extraction well locations. Testing will include a step-drawdown test at each location, consisting of three constant-rate steps, for an anticipated total duration of 3-4 hours. This testing will be performed in order to obtain estimates of well yield and efficiency and assist in determining a suitable flow rate for each well. Stabilized water levels for the purpose of this testing are defined as less than 0.02 ft of change over a 10-minutes period, as a general guide.

Following completion of the step-drawdown testing at each well, a constant-rate pumping test will be conducted at EW03, using the sustainable rate identified from the step-drawdown testing. A duration of eight hours is planned for this test. This pumping test will be carried out in the same fashion as the pumping test during the PDI. Pumping rates will be maintained by a valve and measured with an electronic in-line flow meter. Water levels in surrounding monitoring wells will be documented throughout the test. The data from this constant-rate pumping test will be used to confirm the aquifer parameters specified in the groundwater flow model.

2.2.3 Recovery Vaults and Conveyance System

2.2.3.1 Recovery Vaults

Design of the recovery vaults was developed based on the non-submersible pump selection, conveyance system requirements, water-tightness, and safety. The vaults will be large enough to support the double diaphragm pumps for both DNAPL and groundwater extraction, as well as related pump and conveyance infrastructure. As a safety consideration, the vaults are designed to be no more than 3.9 feet in deep. At this depth, the vaults will not be considered a confined space and can be safely entered by system operation personnel. To prevent leakages and water pooling on the vaults, the rim will be raised approximately 0.2 inch above grade and the concrete apron will slope down to match the surrounding grade.

For the three existing recovery wells on the NSG property that will be repurposed as extraction wells for Phase 1, the current vaults will be removed and replaced with the same expanded vaults that the new wells will be constructed with. The current wells will be protected during this process.

Recovery vaults at each extraction well will be constructed as indicated in Detail A on Sheet C-503 (Appendix B).

2.2.3.2 Conveyance System and Road Crossings

To minimize intrusive work, all conveyance infrastructure will be contained within a single trench, with each system installed at a different depth. A plan view of the conveyance system is shown on Sheet C-105. The water conveyance lines will be situated the deepest, direct buried at approximately 50 inches bgs to the water lines below the frost line. The 1-inch HDPE lines from each pump will be routed downward through the base of the vault and intersect with the extracted groundwater force main. These pipes will be direct-buried rather than installed in conduit, as their depth below the frost line removes the need for any heat-tracing, and they should not be in danger of fouling or require extensive maintenance or frequent replacement. Within the vault, the pumps and water lines will be covered with a heat blanket during cold weather to prevent freezing.

The ¾-inch, HDPE DNAPL conveyance lines will be installed approximately 30 to 48 inches bgs. The conveyance line will be wrapped with approximately two inches of insulation and heat-traced along its entire length to prevent freezing and to increase the DNAPL temperature, thus reducing DNAPL viscosity and allowing the DNAPL to flow more readily. The insulated pipe assembly will be placed within an 8-inch conduit, allowing easier access for cleaning or replacement of the piping or the heating system.

To promote flow, both water and DNAPL piping will be sloped at a minimum of 0.2% between the vault and the main line inverts. Profiles of the conveyance system, with elevations and the individual slopes, are shown on Sheet C-201.

Adjacent to the DNAPL piping will be a 2-inch PVC conduit containing the high-voltage electric lines needed for the heat trace, a 2-inch PVC conduit for future the low-voltage electric lines, and a 3-inch HDPE conduit for the air lines connected to each pump. Sheet C-502 shows the locations of each line within the trench and Sheet M-503 provides details regarding inverts coming in and out of the vaults.

For Phase 1, conduits and conveyance piping from each vault will feed into a central line routed to the groundwater treatment plant. Wells located north of Harbor Place road will cross under Pershing Road through a 16-inch diameter steel casing pipe. The 16-inch diameter casing pipe is of sufficient size to accommodate the four extraction wells and will be sufficient for full-scale design which does not involve additional infrastructure through this crossing. Wells located south of Harbor Place road will cross under Pershing Road through a 24-inch diameter steel casing pipe, which was sized to accommodate anticipated infrastructure associated with the full-scale system. Detail E on Sheet C-502 provides a cross-sectional view of how the conduits and conveyance piping will be situated within the steel casings.

2.2.4 Groundwater Treatment Plant

The groundwater treatment plant will be located on the western parcel of NSG property on the west side of Pershing Road. As part of Phase 1, a smaller version of the treatment plant will be designed and constructed. Based on observations from the pilot-scale plant, the system will be refined and scaled up for full-scale implementation of the well network.

2.2.4.1 Relevant Design Considerations

The groundwater treatment plant was designed with the objective of managing maximum flow, removing any DNAPL entrained with the extracted groundwater, and then treating the groundwater for reinjection into the aquifer. To achieve this, design considerations for Phase 1 include:

- Ability to treat effluent as near to Illinois Class 1 Groundwater Remediation Objectives (GROs) as achievable by best available treatment technologies. An influent sample was collected during the 2017 PDI investigation as a composite of four wells with known MGP and dissolved phase residuals. These data were used as an initial influent baseline for plant design. Compounds acting as drivers in the system design include benzene, ethylbenzene, polycyclic aromatic hydrocarbons (PAHs), iron, and manganese. A table summarizing sample results and showing order of magnitude and removal efficiencies required to meet the Tier 1 GROs is included in Appendix P.
- Capacity to treat an anticipated maximum flow rate of 20 gpm.
- Pre-treatment: Oil-water separator for removal of DNAPL, which will be containerized and disposed of separately.
- Minimize addition of dissolved oxygen (DO) during treatment or reduction of DO prior to reinjection to prevent precipitation
- Management of potential mineral fouling due to reducing subsurface conditions

For system operating efficiency and best control of effluent characteristics, additional operational goals include:

- Ability for the system to operate autonomously for up to one week between site visits.
- Removal or management of calcium, iron, and manganese to minimize potential for fouling of the carbon media vessels and injection wells

Given the scope of the Phase 1 system, the treatment plant will be operated primarily through manual means. However, key interlocks for process safety and equipment protection will be automated through a program logic controller (PLC). Anticipated key interlocks will include: pressure gauges/high pressure switches on pressure vessels and geotube to monitor pressure and shut down system when a set point is exceeded; high-high level switches on tanks to prevent overtopping; and high/low level control switches on tanks to control pump operations. Based on what is learned during Phase 1, additional automation and instrumentation and control will be considered during the full-scale design.

2.2.4.2 Process Flow

A process flow diagram depicting the Phase 1 water treatment scheme is included on Sheet M-601 (Appendix B). Consistent with the discussions during the September 12, 2018 meeting, the Phase 1 system is expected to be a modular system, constructed with equipment that is readily available on a rental basis from water treatment equipment providers. As the implementation goal for this Phase 1 system is to readily construct from components that can be easily rented, it is not practical to provide exact specifications for each component in this design report. The size and equipment type will be contingent on what is available from rental equipment providers. Consistent with the September 17, 2018 email clarifying the scope of the Phase 1 design, this section presents the basis of design text, process flow, and preliminary estimates on size of key components. Detailed piping and instrumentation diagrams, along with equipment layout drawings, will be developed and evaluated as part of a vendor shop drawing review, based on rental equipment available from vendors. The rental equipment provided for the Phase 1 system will be, at a minimum, capable of treating 20 gpm.

The groundwater treatment plant will be installed on the gravel pad shown in Sheet C-105 (Appendix B) and is anticipated to be pre-assembled by rental vendors in shipping containers and/or flatbed trailers. The groundwater treatment plant will consist of the following processes presented in sequential order:

- **Oil-Water Separator (OWS) –** The main role of the OWS will be to separate out LNAPL and DNAPL from extracted groundwater. Free LNAPL and DNAPL will be removed from the influent groundwater through phase separation and then stored in metal totes compliant with NFPA-30. Free LNAPL will be periodically pumped from the top of the OWS following the coalescing plates. Free DNAPL will be collected and periodically pumped from the DNAPL hopper. The OWS recommended for this system will include a coalescing filter, as shown on Sheet M-601, which will collect the neutrally buoyant particles as they pass through the filter. Following the OWS, the decanted groundwater will move through the system for additional treatment in preparation for reinjection into the aquifer. LNAPL/DNAPL droplets or emulsion that passes through the OWS will be removed further downstream in the treatment process.
- **Chemical Precipitation –** Based on site characterization, groundwater is expected to have metal concentrations greater than the Class I Remediation Objectives and high enough to potentially cause scaling at the injection wells. Following, the OWS, chemical precipitation is recommended to remove remaining metals, particularly Iron. Air sparging is not recommended due to concerns of the effects of high Dissolved Oxygen of the groundwater upon return to the aquifer. To achieve this precipitation, 50% Sodium Hydroxide will be added in a mixed tank to raise the pH to approximately 9-9.5 S.U. This will promote precipitation of dissolved constituents into the suspended phase, making them available for collection through solids settling.
- **Solids Settling –** Solids settling is expected to achieve two primary objectives: removal of precipitated metals, and removal of suspended solids to protect downstream adsorbent. Once the pH has been raised and metals precipitated, the groundwater will be directed to a Lamella inclined plate clarifier for solids removal. The lamella clarifier is expected to have two upfront mixing chambers prior to settling. Coagulant will be added in the first mixed chamber to neutralize suspended particles. In the second chamber, flocculant will be added to promote development of easily settleable flocs. The second chamber will be equipped with a slow-speed paddle mixer to prevent floc disruption. Inclined plates following the mixing chambers will aid solids settling. The settled sludge will be pumped into a contained geotube for dewatering and future disposal. Groundwater that filters through the geotube will be pumped back to the pH adjustment tank. The sludge containment unit includes approximately one foot of void space between the geotube support and the bottom of the roll-off. This space will be used to store water, when needed, as a temporary allowance for minor differences between the injection system flow rate and the treatment system flow rate. A summary report from a solids treatability study conducted to assess settlement is included in Appendix N.
- **Post-Settling pH Adjustment –** Following the clarifier, groundwater will be directed through an in-line mixer for pH readjustment through use of Nitric Acid. The objective of this step is to lower the pH back towards matching the aquifer chemistry. A lower pH will also help to prevent precipitation of metals and fouling within the rest of the system, including the injection well screens.
- **Solids Bag Filtration –** Following the pH re-adjustment, this filtration step will consist of a bag filter unit. The primary purpose of the bag filter will be to remove any remaining suspended solids to protect downstream adsorbents.
- **Organoclay –** Following suspended solids removal, groundwater will be directed through an organoclay bed. This unit will target PAHs, along with remaining emulsified DNAPL. With a great capacity of absorption by weight (the unit can absorb up to 70% of its weight in hydrocarbons), the life of organoclay is longer than similar process media. Placing organoclay units before the granular activated carbon (GAC) vessels will extend the useful life of the GAC, helping to reduce media costs and increase the efficiency of those units. It also provides an additional step for collection of any DNAPL that passes through the OWS and pH adjustment stages.
- **Oleophilic Bag Filtration –** Following the organoclay, an Oleophilic bag filter will be installed to assess breakthrough of DNAPL through the organoclay and help determine when those units will need to be changed out. The secondary purpose of this unit will be to capture any remaining DNAPL or suspended solids that have made it through the treatment thus far.
- **Granular Activated Carbon Vessels –** The last step in the treatment process, three GAC vessels connected in series will act as the predominant mechanism for removing VOCs and PAHs. These units will be sized based

on available systems and will contain a mesh size of 8-20. It is expected that the carbon will have a usage rate of 400-500 gallons/lb of Carbon prior to reaching capacity. Phase 1 operation of the groundwater treatment plant will help refine the size of the full-scale GAC units and the length of productive operation for the media.

- **Effluent Holding Tank –** Consideration was given to directly discharging from the GAC units to the injection wells. However, as the pressure across the filter media increases, there is concern that the pump may not have sufficient capacity to reach the optimal injection pressure. An effluent holding tank was incorporated to reduce the head on the filter media pump and provide a final location to conduct minor adjustments to the pH of the water prior to injection.

A benefit of running this smaller pilot-scale treatment plant during Phase 1 is the opportunity to observe GAC and organoclay consumption rates and to develop more accurate material calculations and unit sizing when the plant is brought to full-scale. The Phase 1 system will also help determine if the GAC will provide sufficient treatment to remove any additional DO and minimize precipitation of inorganics and fouling in injection wells. If fouling or precipitation is observed, the treatment system will be refined for full-scale implementation using best management practices that are in alignment with an optimal balance between removal efficiencies, ease of continuous operations, and reasonable capital/operation and maintenance costs.

2.2.4.3 Air Compressor

Select pumps used for DNAPL and sludge transfer in the groundwater treatment plant will be operated by compressed air. Similarly, the DNAPL recovery and groundwater extraction wells will all be operated by compressed air. Accordingly, a 100-cubic foot per minute air compressor will be installed on the gravel pad (Detail C, Sheet C-502) and used for operating both select groundwater treatment plant pumps and all groundwater extraction and DNAPL recovery pumps. Air consumption calculations and basis of design of the air compressor configuration is included in Appendix N.

2.2.5 Water Injection

Following treatment to acceptable levels, groundwater will be reinjected into the aquifer. Phase 1 will consist of one newly-installed horizontal well and one repurposed vertical well, as shown on Sheet C-105 (Appendix B). Reinjection rates for Phase 1 are anticipated to range between 10 to 20 gpm.

2.2.5.1 Horizontal Injection Well Design

The Phase 1 horizontal injection well will be construction as indicated in Profile-C on Sheet C-201 (Appendix B), consisting of a 3-inch HDPE pipe. Water will be supplied to the injection well from buried a 3-inch HDPE force main connected to the groundwater treatment plant effluent. The groundwater water treatment plant effluent pipe will also serve as a location where the well can be accessed for future cleaning. The well screen will terminate into JV04, where a clean out will also be installed. In order to diffuse injection along the length of the 185-foot screen and minimize aquifer material coming into the well, a screen slot size of 0.02 inches (20-slot) was chosen to align closely with the aquifer formation, based on the geotechnical data collected during the 2017 PDI (Appendix O). A slot length of 1.5 inches was chosen as the pipe manufacturing minimum.

For the most consistent injection, and increased potential to manage future fouling, the screen was designed with one slot every 2.5 feet along the top of the pipe and one slot every 5 feet along the bottom of the pipe. OBG reviewed the well screen design calculations with Brian Younkin, PhD, an engineer with Directional Technologies Drilling, to confirm the practicality of the slot size and spacing. Once installed, the well will be developed thoroughly to remove fine materials and create a natural filter pack around the screen. Calculations related to slot size and number are included in Appendix N. Based on performance of the well during Phase 1, screen design and injection methods may be refined for full-scale implementation. The horizontal well screen will be installed at an elevation of 583 feet, which is approximately one foot below the static water table in this area.

2.2.5.2 Vertical Injection Well Design

No vertical injection well was proposed in the location of the Phase 1 system in the Preliminary Design. However, there is valuable information to be gained regarding the capacity of vertical injection wells to diffuse

water and the resulting gradients induced from vertical well injection. For the purpose of Phase 1, one former recovery well on the western parcel of the NSG Property will be temporarily repurposed as an injection well. This well currently consists of a 9-foot, 90-slot screen with a D_{50} of 5/8-inch gravel filter pack. The well riser will be equipped with a cam-lock fitting to allow for connection with temporary injection piping. It is anticipated that injection activities in this well will be completed over a 5-day duration and flow rates, pressure, and groundwater levels from surrounding monitoring points will be regularly observed. No permanent injection infrastructure will be added to the well for Phase 1. Observations of the injection performance here will be used to refine the vertical injection well construction for full-scale implementation.

2.2.5.3 Injection Monitoring

Piezometers will be installed along the length of the horizontal injection wells or immediately adjacent to vertical injection wells to monitor aquifer water levels. For Phase 1, operating staff will manually collect and review the transducer data and make the decision on when an injection well needs to be shut off to prevent over-injection and potential daylighting. Water level monitoring and control of reinjection flows is anticipated to be automated during full-scale implementation.

Existing monitoring wells will be repurposed for this task, to the extent practical, and new piezometers will be installed to fill in any gaps in the monitoring network. The new monitoring piezometers will be 2-inch PVC wells, constructed in accordance with Standard Operating Procedure (SOP) SAS-05-03 to match wells installed during the RI. Locations of proposed monitoring piezometers are shown on Sheet C-105 (Appendix B). These newly installed piezometers along with select existing monitoring wells will be used to monitor the injection activities, as discuss in Appendix H Operations and Maintenance Plan.

2.2.6 Electrical Connection

Currently, three-phase over-head power lines are present on the west side Pershing Road and adjacent to the location of the proposed gravel pad for treatment containers. Once a groundwater treatment plant vendor has been selected and provides estimated electrical power requirements for the treatment plant, OBG will coordinate with Commonwealth Edison (the local electric utility) to obtain a power drop of sufficient capacity at a location adjacent to the gravel pad.

2.2.7 Site Restoration

After construction of the treatment facility and related infrastructure has been concluded, all equipment and additional materials needed to complete the RA will be demobilized from the Site, excluding the new treatment system infrastructure. Parking lots, roadways, vegetation, and other items disturbed or degraded during the construction process will be restored to pre-RA conditions.

2.2.8 Operations and Maintenance

Following the conclusion of restoration activities, the operations, monitoring, and maintenance program outlined in the O&M Plan will commence (Appendix H).

3 PERFORMANCE MONITORING

3.1 CLEANUP VERIFICATION

Performance monitoring and cleanup verification for this RA will be determined by monitoring DNAPL recovery rates throughout remedy operations. Performance monitoring and cleanup verification for this RA will solely be determined by DNAPL recovery. The RAO presented in Section 1.3 provides a general objective for DNAPL remediation, and a decline curve analysis will be utilized to determine when DNAPL mass and mobility have been reduced to the extent practical, thereby achieving the RAO. For the purposes of this RA, the maximum practical DNAPL volume is defined as approaching or exceeding 95% of the maximum theoretical recoverable volume.

3.2 DNAPL RECOVERY RATE CALCULATION

The decline curve analysis was developed in the Petroleum Production Handbook (Frick and Taylor, 1962) as an approach for estimating future recovery performance and the maximum theoretical yield of an oil or gas well. Identical procedures may be used for forecasting DNAPL recovery. A graphical tool, the DNAPL recovery rate is plotted on the vertical axis and the cumulative volume of recovered DNAPL is plotted on the horizontal axis. Under field conditions, the rate of DNAPL recovery for any type of extraction system typically exhibits a rapid increase at the beginning of recovery before reaching a relative maximum value. With increasing operation time, DNAPL recovery rates typically decrease in a linear fashion until approaching zero.

The decline curve analysis assumes that future behavior of a well will be governed by past performance. Through field measurements of DNAPL recovery rates and cumulative recovery volumes, a regression analysis will be performed to estimate the slope of the declining DNAPL recovery rate. This analysis is performed by fitting the decline rate to one of three empirical decline models:

- Exponential
- Harmonic
- Hyperbolic

These three decline models are related through the fundamental decline rate formula:

$$\frac{1}{q}\frac{dq}{dt} = -bq^{d}$$

Where:
q = DNAPL production (decline) rate
b and d = empirical constants, determined based on DNAPL recovery data

When d=0 the equation becomes an exponential decline model. When d=1, the equation yields a harmonic decline model. When 0<d<1, the equation describes a hyperbolic decline model (Guo, et al. 2007). Methods and software for selecting the appropriate decline model are described in detail in Petroleum Production Engineering: A Computer-Assisted Approach (Guo, et al. 2007).

Once a reliable declining slope has been determined from historic recoveries, the line is projected to estimate the cumulative volume of DNAPL once the recovery rate reaches zero. This projected volume is considered the maximum theoretical volume of DNAPL that can be recovered by the current system. Field recovery data will be integrated into the model as collected, continuing to refine the maximum theoretical volume. Operation of the DNAPL recovery system continues until the maximum theoretical volume becomes impractical. Therefore, the DNAPL recovery system would be operated until the selected remedy removes the maximum practical volume of DNAPL from the treatment areas, defined above as approaching or exceeding 95% of the maximum theoretical volume.

3.3 DNAPL PRODUCTION PERFORMANCE PLAN

For Phase 1, well-specific DNAPL extraction rates will be measured both at the well (through cycle counters and paired transducers) and system wide (through measurement of the DNAPL accumulation rate in the DNAPL storage tank). Initially, a decline curve analysis will be conducted both for each recovery well individually, and system wide, allowing for greater precision in management of the system. If the well-specific measurements cannot be readily correlated with the DNAPL accumulation rate in the DNAPL storage tank, then decline curve analysis would be exclusively conducted system-wide.

An amalgamation of information generated by the cycle counters attached to the air lines of each DNAPL recovery pump and the transducers measuring water and DNAPL thickness will be used in order to develop a decline recovery curve for each well. With a known extraction volume per pump cycle, and a count of the cycles each pump runs, the volume of material extracted from each well over a period of time will be known. With the two transducers in each extraction well to measure the pressures needed to calculate DNAPL thickness, both increases and decreases in thickness can be known. These pressure measurements can be used to calculate the decrease in DNAPL thickness after a pump cycle, and thereby the volume of DNAPL removed with each cycle. Since the method of transducer-measured DNAPL will be piloted during Phase 1, a secondary method for estimating the amount of DNAPL per pump cycle may also be applied. Based on the amount of water being pumped into the treatment system per each pump cycle, a per-well calculation can be conducted and back-applied to each well. Subtracting this water volume from the total pump volume will give an estimate of DNAPL extracted per cycle.

Conceptually, if one well approaches its maximum practical volume that well can be shut off and/or repurposed as a reinjection well to assist with the enhanced recovery. Once it has been determined that the entire system has approached 95% or greater of the maximum theoretical volumes, the RA would be considered complete.

4 PRELIMINARY CONSTRUCTION SCHEDULE

Implementation of RA Phase 1 is targeted for summer 2019. The actual schedule is subject to change based on the actual construction start date and other project variables. Construction of Phase 1 of the RA is anticipated to take 11 weeks to complete. Following construction, Phase 1 of the RA is anticipated to last three to six months during which time the pilot-scale treatment system will be operated. After approximately six months, NSG anticipates meeting with the USEPA to discuss the results observed and combined thoughts regarding the current effectiveness of the treatment system and improvements for full-scale implementation. Following that meeting, design for full-scale implementation would be expected to begin while the Phase 1 treatment system continues to operate. Full-scale design is loosely anticipated to start in early 2020, and a more detailed schedule for design and construction of the full-scale system will be developed along with the design at that time.

4.1 OPERATIONS SEQUENCING

The sequence of operations is dependent on the means and methods of the remedial contractors, as well as off-Site property access. A conceptual operations sequence is presented below and will be refined following the selection of remedial contractors and approval from the necessary property owners.

4.1.1 Site Preparation

Prior to commencing the RA, Site security controls, erosion controls, and temporary electric and water utilities will be installed, consistent with Sheet C-104 (Appendix B) and the Technical Specifications (Appendix A). Conceptually, the primary Site access, equipment and material staging, and Site offices will be located on the fenced portions of the NSG Property. Site preparation is anticipated to take two weeks.

4.1.2 Wells, Vaults and Conveyance System

Following the completion of Site preparation activities, it is anticipated that installation of the new extraction and injection wells would begin concurrent with refurbishment and installation of the new recovery vaults. Following well and vault installation, conveyance and pumping infrastructure will be installed. Open-cut trenching be used for conveyance installation, so all piping and conduits (water, DNAPL, electrical, air) will be laid concurrently. Installation of all the entire well, vault, and conveyance system is anticipated to take six weeks.

4.1.3 Groundwater Treatment Plant

Concurrent to the Site preparation work and installation of the well network, the groundwater treatment plant will be fabricated by the chosen contractor. The system is anticipated to be brought to the Site in prefabricated pieces that will be assembled on the NSG property over approximately two weeks. Connections from the well network to the treatment system will be completed during this time.

4.1.4 Restoration

Following the conclusion of the RA, all equipment, land improvements, and infrastructure installed to support the RA shall be disassembled and appropriately reused or disposed of off-site. Disturbed vegetation, roadways, parking lots, and other items damaged or degraded during the RA shall be restored to pre-RA conditions. Active restoration of the Site is anticipated to be completed over one week.

4.1.5 Operations, and Monitoring

Following the conclusion of restoration activities, the operations, monitoring, and maintenance program outlined in the O&M Plan (Appendix H) will begin. While the system continues to run, O&M will be conducted through the entire course of system operations.

5 SUPPLEMENTAL PLANS

Based on the requirements of the RD-AOC, the following supporting documents were prepared as part of the Pre-Final Remedial Design:

- Quality Assurance Project Plan
- Health and Safety Plan
- Contingency Plan
- Field Sampling Plan
- Construction Quality Assurance Plan
- Operation and Maintenance Plan
- Groundwater Monitoring Plan
- Plan Drawings
- Specifications

These supporting documents are described in further detail in the following sections and are appended to this Pre-Final Remedial Design Report.

5.1 QUALITY ASSURANCE PROJECT PLAN (QAPP)

The Multi-Site QAPP Rev 2 (IBS 2007a) is adopted by reference for this project. No site-specific updates are needed for the RA. The Multi-Site QAPP is provided as Appendix C.

5.2 HEALTH AND SAFETY PLAN (HASP)

A HASP has been developed to protect on-site personnel and local residents from physical, chemical, and other hazards posed by this RA. As part of the Pre-Final Design Report, a Site-specific HASP has been developed to supplement the Multi-Site HASP (IBS 2007b), previously approved by the USEPA. The Multi-Site HASP includes general information relevant to the Multi-Site program and more detailed health and safety information related to groundwater sampling. The Multi-Site HASP was completed in accordance with USEPA guidance and OSHA requirements as outlined in 29 CFR Parts 1910 and 1926. The Site-specific HASP provides additional Site-specific information, as well as performance levels, and criteria related to construction and the operation and maintenance of the DNAPL extraction system. The HASPs address the following areas:

- Facility Description
- Personnel
- Site-specific hazards
- Levels of protection
- Safe work practices and safe guards
- Medical surveillance
- Personal and environmental air monitoring
- Personal protective equipment
- Personal hygiene
- Decontamination - personal and equipment
- Site work zones
- Contaminant control
- Logs, reports, and record keeping

The HASP is provided as Appendix D.

5.3 CONTINGENCY PLAN

The Contingency Plan describes procedures to be used in the event of an accident or emergency. The Contingency Plan includes the following:

- Name of the person or entity responsible for responding in the event of an emergency incident
- Plan and date(s) for meeting(s) with the local community, including local, State, and Federal agencies involved in the cleanup, as well as local emergency responders and hospitals
- Air Monitoring Plan
- Spill Prevention, Control, and Countermeasure Plan (SPCCP), as specified in 40 CFR Parts 109 and 112 describing measures to prevent potential spills and discharges from materials handling and transportation

The Contingency Plan is attached in Appendix E.

5.4 FIELD SAMPLING PLAN (FSP)

The Multi-Site FSP Rev 4 (IBS 2008), previously approved by the USEPA, is adopted by reference as the FSP for this project. The FSP addresses sample collection activities proposed during RA and outlines methods and procedures intended to ensure that sample collection and analytical activities are conducted in accordance with acceptable protocols, meeting the Data Quality Objectives (DQOs) established in the QAPP. The Field Sampling Plan is attached in Appendix F.

5.5 CONSTRUCTION QUALITY ASSURANCE PLAN (CQAP)

The CQAP provides a detailed framework and approach for task-specific quality control (QC) and project-specific quality assurance (QA) requirements and describes the procedures for RA observation, documentation, and sample collection. The CQAP establishes the following elements:

- Personal responsibilities and authority
- Procedures, guidelines, checklists, and forms for inspection, sampling, testing, and documentation of RA activities
- Identification of proposed sampling activities
- Procedures for monitoring, documenting, and managing fugitive emissions, odors, vapors, and noise
- Deficiencies, noncompliance, and corrective actions
- Provisions for final storage of records

The CQAP identifies the methods and items that need to be observed, documented, and sampled to confirm that the implemented work meets design requirements. Field forms used to track these specific items include the following:

- Forms for tracking and documenting various field activities that include sample management and shipping, documentation of analytical sampling, disposal documentation of any debris removed from site, and documentation of air monitoring data.
- Forms for documenting daily activities, weekly progress meetings, and changes to scope.

The CQAP is attached in Appendix G.

5.6 OPERATION AND MAINTENANCE PLAN

The O&M Plan describes anticipated activities related to treatment system operation and maintenance; inspection, maintenance, and replacement, if necessary, of injection and recovery wells; monitoring of the

groundwater gradient; DNAPL recovery monitoring; and groundwater monitoring. The Groundwater Monitoring Plan is included as a part of the O&M Plan.

The O&M Plan identifies the general schedule, equipment, and procedures for ongoing operation and monitoring of the groundwater treatment plant and well network. Field forms used to track these specific items include the following:

- Forms for documenting operational aspects of the treatment system that include fluid levels in wells and tanks, quantity of DNAPL and solids in storage, pressures across media vessels, chemical levels, and discharge rates.
- Forms for documenting in-process sampling.

The forms identified in this Pre-Final design are the minimum requirements for O&M field documentation. Once the groundwater treatment plant goes on-line and O&M activities begin additional requirements may be added. These requirements will be included in the O&M manual developed once Phase 1 O&M begins.

The O&M Plan is attached in Appendix H.

5.6.1 Groundwater Monitoring Plan

The Groundwater Monitoring Plan describes the monitoring well network, anticipated sampling events, and a preliminary sampling schedule, along with the equipment, and methodology that would be employed during groundwater sampling events. The Groundwater Monitoring Plan is included in Section 3: Groundwater Monitoring of the O&M Plan (Appendix H).

5.7 PLANS AND SPECIFICATIONS

A full set of Plan Drawings and Technical Specifications addressing each phase of work have been prepared for this Pre-Final RD. The proposed Technical Specifications and Plan Drawings are attached as Appendix A and Appendix B, respectively.

6 REFERENCES

Azzolina Nick. "Case Study: Application of DNAPL Mobility Assessment Protocol at an Site" EPRI Workshop: DNAPL Mobility Assessment to Support Closure of manufactured Gas Plant Sites, 14 April 2015, Biltmore Hotel, Providence, Rhode Island.

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In-Situ Inc., October 2011. *Technical Note: Real Time Monitoring of Water and DNAPL Levels Using Level TROLL® 500 Instruments*.

Integrys Business Support (IBS), August 2007. *Multi-Site Health and Safety Plan Former Manufactured Gas Plant Sites*.

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United States Environmental Protection Agency (USEPA) 2005. *Intergovernmental Data Quality Task Force Uniform Federal Policy for QAPPs*, EPA-505-B-04-900A.

United States Environmental Protection Agency (USEPA), 2015. *South Plant Remedial Design Administrative Settlement Agreement and Order on Consent for Remedial Design*, V-W-15-C-027.

United States Environmental Protection Agency (USEPA) 1992. *Permits and Permit "Equivalency" Processes for CERCLA On-site Response Actions,* OSWER Directive 9355.7-03.

Tables

Table 1. Summary of Required Permits

Organization	Project Need	Requirement	Contact	Phone	Lead Time
Elgin, Joliet, and Eastern Railroad	Railroad Utility Crossing Permit	Permit for installation of conveyance piping beneath the rail road	Elgin, Joliet, and Eastern Railroad	NA	Unknown - Assumed at 120 days for planning purposes
North Shore Water Reclaimation District	If final design of groundwater treatment plant requires sanitary sewer connection	**Environmental Remediation Wastewater Connection** -Permit Application for a Non-residential Sewer Connection -Agreement to Accept Environmental Remediation Wastewaters - Discharge Control Document Remediation Site Application	John Reuskens	(847) 623-6060	30 day review period
City of Waukegan	Land disturbance to an area greater than 5000 square feet	Watershed Development Ordinance Permit Application	City of Waukegan Engineering Department	(847) 625-6858	30 day review period
	Work conducted in City of Waukegan Right of Way	Right of Way Permit Application	City of Waukegan Engineering Department	(847) 625-6858	30 day review period
	Construction of groundwater treatment plant	**City of Waukegan Building Permit Application** - Water Service - Plumbing - Mechanical - Electical	City of Waukegan Engineering Department City of Waukegan Water Utility	(847) 625-6858 (847) 599-2687	Unknown; typically not a long lead time item.
Illinois Environmental Protection Agency	Land disturbance to an area greater than 1 acre	**General National Pollutant Discharge Elimination System Permit for Storm Water Discharges from Construction Site Activities** -Notice of Intent and Storm Water Pollution Prevention Plan. -Illinois Historic Preservation Agency Review -Endangered Species Assessment	Division of Water Pollution Control	(217) 782-3397	30 day review period Considered accepted if no comments received by end of review periods
	Injection of treatement water into aquifer	Class V Injection Well Inventory Form	Bureau of Land Permit Section	(217) 524-3300	12-18 Months before construction
	If final design of groundwater treatment plant requires sanitary sewer connection	**Application for Construction and Operations of Wastewater Treatment Plant** -WPC - PS-1 - Application for Construction/Operation Permit Approval - Schedule A - Sewer Service Connection Schedule J - Application for Construction/Operation Permit for Industiral Treatment/Pretreatment Works Schedule N - Application for Waste Charectoristics.	Bureau of Water Permit Section	(217) 782-0610	90 days (45 days if fee is submitted with app)

Figures

SITE LOCATION MAP

FINAL DESIGN REPORT
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

N

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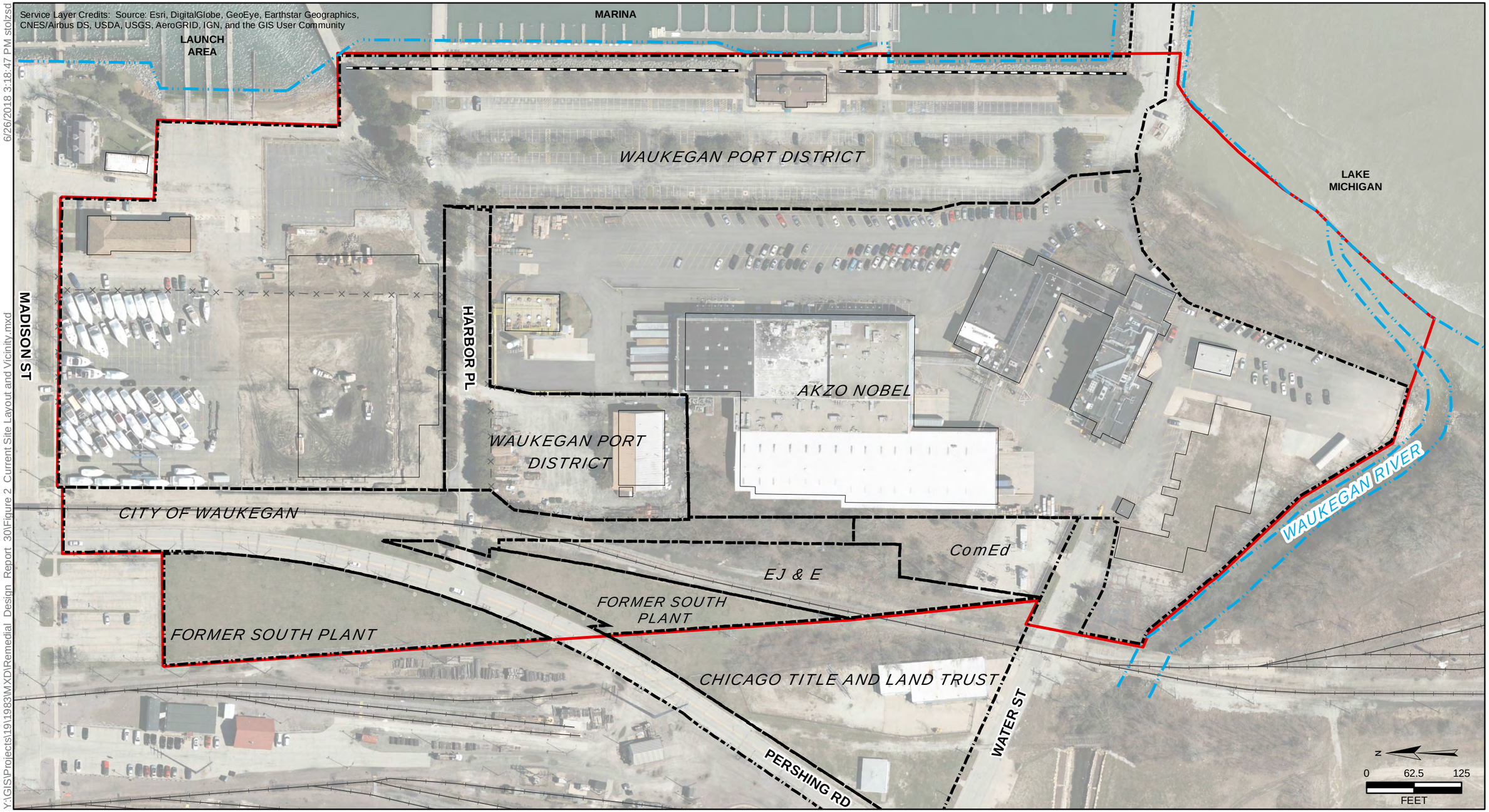
Feet

O'BRIEN & GERE ENGINEERS, INC.



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Y:\GIS\Projects\19\1983\MXD\Remedial Design Report 30\Figure 2 Current Site Layout and Vicinity.mxd

- SHEET PILE WALL
- WATERLINE
- RAILROAD
- FENCE
- OPERATIONAL UNIT BOUNDARY
- BUILDINGS
- APPROXIMATE PROPERTY BOUNDARIES

CURRENT SITE LAYOUT AND VICINITY

FINAL DESIGN REPORT
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

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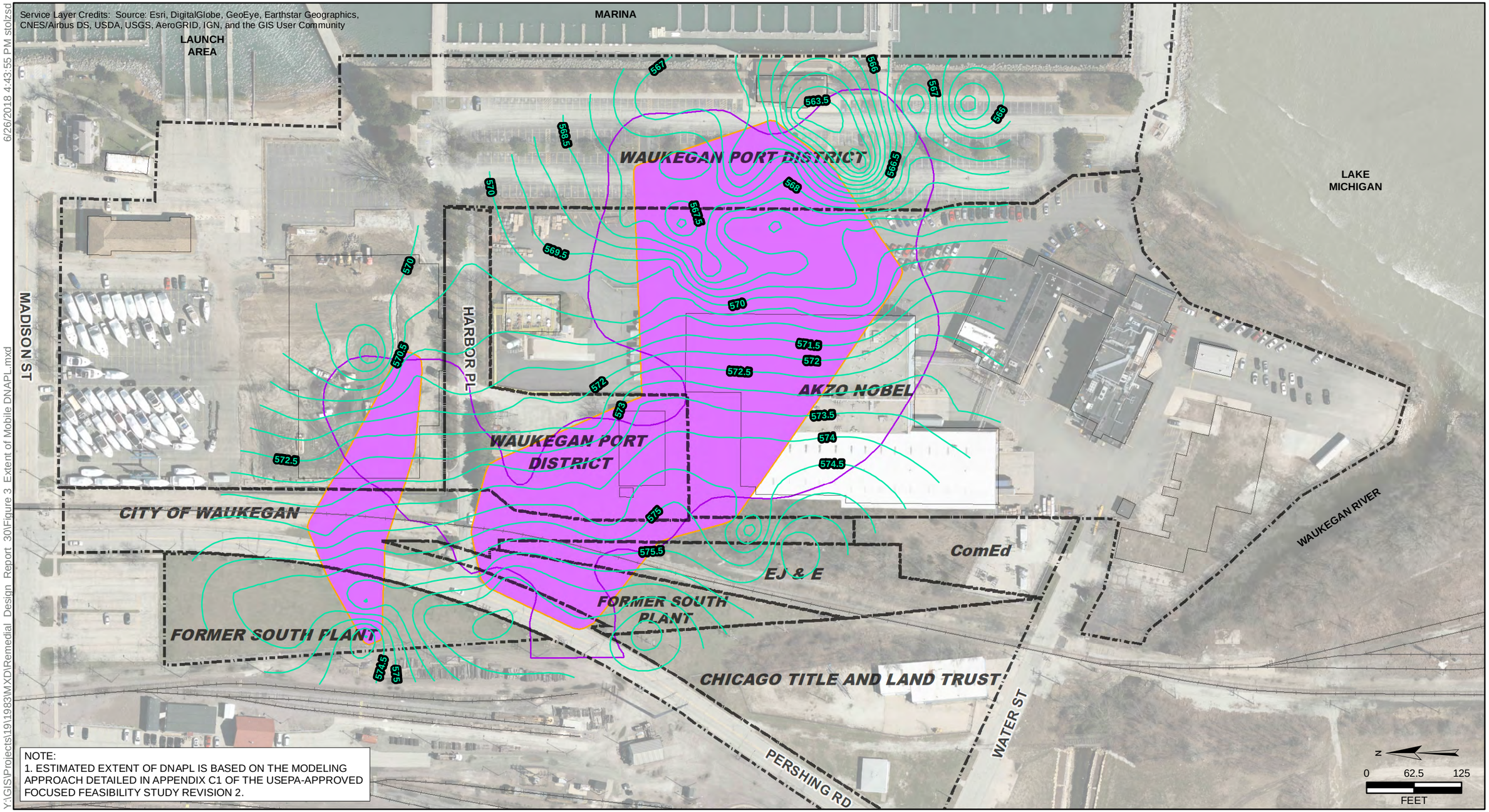


NOTE:
1. ESTIMATED EXTENT OF DNAPL IS BASED ON THE MODELING APPROACH DETAILED IN APPENDIX C1 OF THE USEPA-APPROVED FOCUSED FEASIBILITY STUDY REVISION 2.

- TOP OF NAPL BARRIER SURFACE (0.5 FT CONTOURS)
- ESTIMATED DNAPL EXTENT BASED ON MODELING
- POST-PDI NAPL BOUNDARY
- RAILROAD
- BUILDINGS
- APPROXIMATE PROPERTY BOUNDARIES

EXTENT OF POTENTIALLY RECOVERABLE DNAPL

FINAL DESIGN REPORT
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

O'BRIEN & GERE ENGINEERS, INC.

Appendix A

Technical Specifications

TABLE OF CONTENTS

END OF SECTION

SECTION 01 10 00
SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Definitions
2. Project information
3. Work covered by Contract Documents
4. Phased construction
5. Work by others
6. Work under separate contracts
7. Future work
8. Purchase contracts
9. Products furnished by others
10. Access to site
11. Work restrictions
12. Specification and drawing conventions

B. Related Sections:

1. Section 01 50 00 – Temporary Facilities and Controls
2. Section 01 35 20 – Site Health and Safety

1.2 DEFINITONS

A. Contract Drawings: Set of construction drawings titled, Former North Shore Gas South Plant Manufactured Gas Plant Remedial Design Phase 1.

B. Site: Refers to the North Shore Gas Company Former South Plant MGP Site and surrounding impacted properties, including: Akzo Nobel Aerospace Coatings, Inc, City of Waukegan, Elgin, Joliet, and Eastern, and Waukegan Port District, defined by property lines shown on Contract Drawings.

C. Specifications: Technical Specifications consisting of Division 01 – General Requirements, Division 02 – Existing Conditions, Division 03 – Concrete, Division 22 – Plumbing, Division 26 – Electrical, Division 31 – Earthwork, Division 32 – Exterior Improvements, Division 33 – Utilities, Division 40 – Process Interconnections, Division 43 – Process Gas and Liquid Handling, Purification, and Storage Equipment, and Division 46 – Water and Wastewater Equipment

D. Work: Refers to all of the services, materials, and equipment to be performed or furnished by the Subcontractor or its Subsubcontractor(s) with respect to meeting the requirements of the Contract Documents. Also referred to as “Construction,” “Remedial Action,” or “Project” as specified.

E. Owner: WEC Energy Group, Inc. on behalf of North Shore Gas Company.

1) Project Manager: Mr. Naren Prasad P.E., MPH, LEED AP

F. Engineer: O'Brien & Gere Engineers, Inc.

G. Subcontractor: The Subcontractor contracted to perform the Work.

1.3 PROJECT INFORMATION

A. Project Identification: Former South Plant MGP Site

1. Project Location: 2 North Pershing Road, Waukegan, Illinois.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Subcontractor shall perform the Work indicated in the [*ENTER FUTURE CONTRACT DOCUMENT NAME*]

1. Site Preparation: Includes installation of erosion control measures, installation of Site security fence, and vegetation clearing, as shown indicated on the Contract Drawings and in the Technical Specifications,

2. Installation of vertical recovery wells and corresponding recovery vaults: Includes drilling and installing recovery wells as shown on the Contract Drawings and indicated in the Technical Specifications, backfilling any over-excavated areas, containerizing any soil spoils and contact water for disposal.

3. Installation of horizontal injection well: Includes drilling and installing recovery wells as shown on the Contract Drawings and indicated in the Technical Specifications, backfilling any over-excavated areas, containerizing any soil spoils and contact water for disposal.

4. Installation of conveyance piping, air lines, pumps, and electrical infrastructure: Includes excavation, installation of infrastructure at depths with products specified on the Contract Drawings and as indicated in the Technical Specifications, backfilling conveyance trenches, containerizing any soil spoils and contact water for disposal.

5. Assembly of Groundwater Treatment System: Includes installation of plumbing required to complete connections between water treatment system components and assembly of separate water treatment plant elements.

6. Site Management/Fugitive Emissions Controls: Includes fugitive dust and odor controls, covering of stockpiles, and preventing off-site tracking of materials, as needed throughout the duration of Work.

7. Site Restoration: Includes construction of soil cover over treated areas, site grading, seeding, and removal of temporary erosion control measures.

1.5 PHASED CONSTRUCTION

A. The Work shall be conducted in phases as proposed by the Subcontractor and approved by the Engineer.

B. Before commencing Work of each phase, submit an updated copy of the Subcontractor's construction schedule showing the sequence and commencement and completion dates for all phases of the Work.

1.6 WORK BY OTHERS

A. Work conducted by others will consist of the following:

1. Obtaining permits for National Pollutant Discharge Elimination System and development of a Storm Water Pollution Prevention Plan.

2. Installation and operation of a perimeter air monitoring system for real-time monitoring of MGP constituents in ambient air during construction.
3. Final As-Built Survey documenting the Work.

1.7 PRODUCTS FURNISHED BY OTHERS

A. None

1.8 ACCESS TO SITE

A. General: Subcontractor shall have full use of the Site for construction operations, as approved by the Engineer and Owner.

B. Do not disturb portions of the Site beyond areas in which the Work is being performed.

C. Construction Limits: Confine construction operations, storage of materials and equipment to the areas within the Site as shown on the Contract Drawings unless otherwise approved by the Engineer.

D. Work on Properties Owned by Others:

1. Subcontractor shall be familiar with the Site's property boundaries and those of the adjacent properties as shown on Contract Drawings.
2. Work on property owned by others will be in compliance with applicable access agreements or permits, copies of which will be supplied by the Engineer or Owner prior to project start.
3. Storage of materials or equipment on property owned by others is not allowed unless as authorized by the Engineer.
4. Notify and receive advance approval from the Engineer regarding the need to remove or disturb materials not addressed by these Contract Documents.

1.9 WORK RESTRICTIONS

A. General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit heavy equipment work to normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, except as otherwise indicated or approved, or as required by municipal ordinance if applicable.

1. Weekend Hours: Work may be performed on Saturdays, as approved by the Engineer.
2. Alternate work schedules, proposed by the Subcontractor, may be acceptable as approved by the Engineer.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated below:

1. Notify Engineer and Owner not less than two days in advance of proposed utility interruptions.
2. Obtain written permission from the Engineer and Owner before proceeding with utility interruptions.

D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption with Engineer to minimize disturbance to adjacent property owners and the community. Subcontractor operations shall comply with the requirements provided in the Fugitive Emissions Management Plan (FEMP) and Air Monitoring Plan contained in the Construction Quality Assurance Plan.

1. Notify Engineer and Owner not less than two days in advance of proposed disruptive operations.

2. Obtain Owner's written permission before proceeding with disruptive operations.

E. Controlled Substances: Use of tobacco products and other controlled is not permitted except in an area designated by Engineer and Owner.

1.10 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Technical Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

2. Specification requirements are to be performed by Subcontractor unless specifically stated otherwise.

B. Drawing Coordination: Requirements for materials and products are identified in detail on the Drawings and more generally in the Specifications. The Specifications describe the means and methods of procurement, implementation, and documentation of the Work. One or more of the following are used on the Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections. Materials may be specified by name and comparable products indicated, as defined in Section 01 60 00 – Product Requirements.

2. Abbreviations: Materials and products are identified by abbreviations.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 22 00
MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for measurement and payment.

B. Related Sections:

1. Section 01 29 00 – Payment Procedures

1.2 DEFINITONS

A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.3 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. Owner and Engineer reserve the right to reject Subcontractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Subcontractor.

D. Payment for all Work done in compliance with the Contract Documents, inclusive of furnishing all labor, equipment, materials, and performance of all operations relative to construction of this project, will be made under Pay Items listed herein. Work for which there is not a Pay Item will be considered incidental to the Contract and no additional compensation will be allowed.

E. The Engineer reserves the right to alter the Contract Drawings, modify incidental Work as may be necessary, and increase or decrease quantities of Work to be performed to accord with such changes, including deduction or cancellation of any one or more of the Pay Items. Changes in the work shall not be considered as a waiver of any conditions of the Contract nor invalidate any provisions thereof. When changes result in changes in quantities of Work to be performed, the Subcontractor will accept payment according to Contract Unit Prices that appear in the original Contract. For significant changes in the quantity for a particular item or total estimated cost of a particular item from the Contract Price as addressed under the General Conditions, a supplemental agreement between the Subcontractor and the Engineer may be negotiated and/or required.

F. Quantities necessary to complete the work as shown on the Contract Drawings or as specified herein shall govern over those shown in the Proposal Form. The Subcontractor shall take no advantage of any apparent error or omission in the Contract Drawings or Technical Specifications, and the Engineer shall be permitted to make corrections and

interpretations as may be deemed necessary for fulfillment of the intent of the Contract Documents.

G. The Engineer will make measurements and determinations, as necessary, to classify the work within Pay Items and determine the quantities for pay purposes; such decisions will be final after 3 days if the Subcontractor does not submit a written notice as defined in the following paragraph.

H. If the Subcontractor differs with the Engineer's classification of the Pay Items or determination of quantities of the Pay Items, the Subcontractor must notify the Engineer in writing within 3 days of the time that the Subcontractor is informed of the Engineer's decision. Otherwise, the Owner will not consider any such difference as a claim for payment.

I. Failure on the part of the Subcontractor to construct any item to plan or authorized dimensions within the specification tolerances shall result in: reconstruction to acceptable tolerances at no additional cost to the Owner or Engineer; acceptance at no pay; or, acceptance at reduced final pay quantity or reduced unit price, all at the discretion of the Engineer.

J. The quantity for a payment item will be revised only in the event that it is determined to be substantially in error. An error shall be deemed substantial if the quantity will increase or decrease in excess of five percent of the original quantity for that item or the amount due for that item will increase or decrease in excess of $500, whichever is smaller. In general, such revisions will be determined by final measurement or plan calculations or both as additions to or deduction from plan quantities specified within these Contract Documents.

K. Work shall not be considered complete until all testing has been satisfactorily completed and the item of work has demonstrated compliance with Plans and Specifications.

L. A preliminary monthly application for payment shall be submitted to the Engineer for review 5 days prior to the submittal for approval of the Subcontractor's monthly payment request.

M. Pay item numbers shown on the bid form are only provided for use in pay application purposes. Use the descriptions on the bid form, and within the Technical Specifications, to determine the work associated with each pay item.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 25 00
CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

B. Owner will issue a Field Order through the Engineer authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

1.3 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Contract Drawings and Technical Specifications.

1. Proposal Requests issued by Engineer are not instructions either to stop Work in progress or to execute the proposed change.

2. Within time specified in Proposal Request submit a quotation, estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

   a. Include a list of product quantities required or eliminated and unit costs, with total amount of purchases and credits to be made.
   b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
   c. Include costs of labor and supervision directly attributable to the change.
   d. Include an updated Subcontractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
   e. Quotation Form: Use forms acceptable to Engineer.

B. Subcontractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, following proper notice of potential changes conditions, the Subcontractor may initiate a claim by submitting a request for a change to the Engineer.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.

2. Include a list of product quantities required or eliminated and unit costs, with total amount of purchases and credits to be made.

3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

4. Include costs of labor and supervision directly attributable to the change.

5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start

and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

6. Comply with requirements in Submittal Procedures (Section 01 33 00) if the proposed change requires substitution of one product or system for product or system specified.

7. Proposal Request Form: Use form acceptable to Engineer

1.4 ADMINISTRATIVE CHANGE ORDERS

A. Unit Price Adjustment: Refer to Measurement and Payment (Section 01 22 00) for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit price work

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Engineer will issue a Change Order for signatures of Owner and Subcontractor.

1.6 WORK CHANGE DIRECTIVE

A. Work Change Directive: Engineer may issue a Work Change Directive. Work Change Directive instructs Subcontractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 29 00
PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Sections:

1. Section 01 22 00 – Measurement and Payment
2. Section 01 32 00 – Construction Progress Documentation
3. Section 01 33 00 – Submittal Procedures

1.2 DEFINITONS

A. Schedule of Values: A statement furnished by Subcontractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Subcontractor's Applications for Payment.

1.3 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Subcontractor's construction schedule.

1. Correlate line items in the schedule of values with other required administrative forms and schedules, including the following:
    a. Application for Payment forms with continuation sheets
    b. Submittal schedule
    c. Items required to be indicated as separate activities in Subcontractor's construction schedule.
2. Submit the schedule of values to Engineer at earliest possible date but no later than 10 days before the date scheduled for submittal of initial Applications for Payment for review.
3. Sub-schedules for Separate Elements of Work: Where the Subcontractor's construction schedule defines separate elements of the Work, provide sub-schedules showing values correlated with each element.

B. Format and Content: Use the Bid Forms as a guide to establish line items for the schedule of values. Provide at least one line item for each bid item.

1. Identification: Include the following project identification on the schedule of values:
    a. Project name and location
    b. Name of Engineer
    c. Engineer's project number
    d. Subcontractor's name and address
    e. Date of submittal

2. Arrange schedule of values consistent with format of ***Engineer's Joint Contact Document Committee's (EJCDC) Document C-620.***
3. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
4. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
    a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
5. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
7. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
8. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be either shown as separate line items in the schedule of values or distributed as general overhead expense, at Subcontractor's option.
9. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.4 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Engineer and paid for by Owner.
    1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: Progress payments shall be submitted to Engineer by the 5th day of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.

C. Application for Payment Forms: Use ***EJCDC Document C-620*** as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Engineer will return incomplete applications without action.
    1. Entries shall match data on the schedule of values and Subcontractor's construction schedule. Use updated schedules if revisions were made.
    2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
    3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
    4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:
    a. Materials previously stored and included in previous Applications for Payment.
    b. Work completed for this Application utilizing previously stored materials.
    c. Additional materials stored with this Application.
    d. Total materials remaining stored, including materials with this Application.

F. Transmittal: Submit one copy in electronic format and paper copy of each Application for Payment to Engineer. Include waivers of lien and similar attachments, if required.

1. Transmit with a transmittal form listing attachments and recording appropriate information about application.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage (if required), on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner and Engineer reserve the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner and Engineer.

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors
2. Schedule of values
3. Subcontractor’s construction schedule (preliminary, if not final)

I. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted including, but not limited to, the following:

1. Evidence of completion of Project closeout requirements
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid
3. Updated final statement, accounting for final changes to the Contract Sum
4. Evidence that claims have been settled
5. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General project coordination procedures
2. Administrative and supervisory personnel
3. Coordination drawings
4. Requests for Information (RFI)
5. Project meetings

B. Related Sections:

1. Section 01 32 00 – Construction Progress Documentation
2. Section 01 70 00 – Execution and Closeout Requirements

1.2 DEFINITONS (NOT USED)

1.3 COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1.4 SUBCONTRACTOR SUPERVISION AND SUBCONTRACTED WORK

A. A superintendent and/or foreman shall be on site continuously during working hours from start to finish of project. Submit all site superintendent and foreman's names and phone numbers prior to project start. If Subcontractor changes a superintendent and/or foreman assigned to site, Subcontractor shall notify the Engineer 30 days prior to the change and make transition seamless to avoid lost work. The Engineer reserves the right to approve or disapprove changes in supervisory personnel.

B. Use adequate number of skilled workers who are thoroughly trained and experienced in necessary crafts and who are completely familiar with specified requirements and methods needed for performance of Work.

C. Use experienced professional personnel for that work which requires judgment, knowledge, and expertise of qualified professionals and who are familiar with all aspects of Work.

D. Subcontractor's Superintendent/Foreman shall maintain communication between subsubcontracted personnel and retain personnel, and shall be on site when Subsubcontractor's are on site performing Work.

E. Subcontractor shall direct and supervise all Subsubcontractors.

F. Subcontractor shall submit names of all Subsubcontractor's who shall be performing any work with Bid.

1.5 KEY PERSONNEL

A. Key Personnel Names: With bid, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1.6 PROJECT MEETINGS

A. General: Engineer in coordination with Subcontractor will schedule and conduct meetings and conferences at Site unless otherwise indicated.

1. Attendees: Engineer will Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. A principal member of Subcontractor's staff, authorized to make decisions on the Subcontractor's behalf, shall represent Subcontractor at each meeting. Owner and/or Engineer may direct certain Subsubcontractors to attend meetings as needed. Failure to attend a meeting does not relieve Subcontractor from acting on contents of meetings.
2. Agenda: Engineer will prepare the meeting agenda and distribute to all invited attendees.
3. Minutes: Engineer will record significant discussions and agreements achieved and distribute the meeting minutes to everyone concerned prior to next meeting.
4. Special Meetings may be called at discretion of the Owner or Engineer for purpose of resolving problems or other purposes concerning Work. Attendance at special meetings is mandatory for Subcontractor, Subsubcontractors, or other parties notified by Engineer to attend.

B. Pre-construction Meeting (Conference): Engineer will conduct a preconstruction conference before starting construction, at a time convenient to Owner. Subcontractor shall submit before the meeting all submittals required prior to the project start. Meeting shall be held at the Site unless otherwise announced.

1. Conduct the conference to review responsibilities and personnel assignments.
2. Attendees: Authorized representatives of Owner, Engineer, Subcontractor and its superintendent/foreman; major Subsubcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect progress, including the following:

a. Safety procedures
b. Construction schedule as prepared by Subcontractor
c. Construction phasing
d. Review status of submittals required to be transmitted prior to project commencement.
e. Discuss Subcontractor's submitted Work Plans, remedy construction sequencing, and location of major equipment.
f. Discuss project administration prior to start of work.
g. Schedule weekly progress meetings
h. Discuss the coordination and scheduling of extraction well installation, installation of conveyance system, as well as the arrival and assembly of the groundwater treatment plant as it pertains to Earthwork, as applicable.
i. Discuss the coordination and scheduling of each major element of the remedy construction
j. Discuss Owner's emergency notification and operating practices for emergencies.
k. Critical work sequencing and long-lead items
l. Designation of key personnel and their duties
m. Lines of communications
n. Procedures for processing Field Orders, Work Change Directives, and Change Orders
o. Procedures for testing and inspecting
p. Procedures for processing Applications for Payment
q. Distribution of the Contract Documents
r. Submittal procedures
s. Preparation of record documents
t. Use of the premises
u. Work restrictions
v. Working hours
w. Responsibility for temporary facilities and controls
x. Procedures for disruptions and shutdowns
y. Construction waste management and recycling
z. Parking availability
aa. Office, work, and storage areas
bb. Equipment deliveries and priorities
cc. Site security
dd. Progress cleaning

4. Minutes: Engineer will record and distribute meeting minutes to all interested parties prior to the next meeting.

C. Weekly Progress Meetings: The Engineer will conduct weekly progress meetings. All parties at pre-construction meeting shall agree upon day of week and hour of day. Meetings shall be held at the Site unless announced otherwise.

1. Attendees: Subcontractor, Subsubcontractors (as necessary), Owner, and Engineer.
2. Agenda: Review progress of work and coordination of work:
    a. Subcontractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
        1) Review schedule for next period as prepared by Subcontractor.
    b. Review present and future needs of each entity present including, but not limited to, the following:
        1) Safety improvements
        2) Interface requirements
        3) Sequence of operations
        4) Status of submittals
        5) Deliveries
        6) Site utilization
        7) Temporary facilities and controls
        8) Progress cleaning
        9) Quality and work standards
        10) Status of correction of deficient items
        11) Field observations
        12) Status of proposal requests
        13) Pending changes
        14) Status of Change Orders
        15) Pending claims and disputes
3. Documentation of information for payment requests. Engineer will record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Engineer will distribute minutes of the meeting to each party present and to other parties requiring information.
5. Schedule Updating: Subcontractor shall provide an updated construction schedule at each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule at weekly meetings.

D. Project Closeout/Inspection Meeting: Engineer and Subcontractor will schedule and conduct a project closeout/inspection meeting in accordance with (Section 01 70 00) Closeout Procedures when Subcontractor Work is substantially complete and ready for Engineer's inspection.

1. Conduct the meeting to review requirements and responsibilities related to project closeout/inspection.
2. Attendees: Authorized representatives of Owner, Engineer, and Subcontractor and shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay project closeout, including the following:
    a. Preparation of record documents
    b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    c. Submittal of written warranties
    d. Preparation of Subcontractor's action item list of Work remaining (Punch List)
    e. Procedures for processing Applications for Payment at Substantial Completion and for final payment
    f. Submittal procedures
    g. Responsibility for removing temporary facilities and controls
4. Minutes: Engineer will record and distribute meeting minutes.
5. Inspection: Engineer will conduct a final inspection of the work

1.7 REPORTS

A. Subcontractor shall be responsible for submitting a progress report each week prior to regularly scheduled progress meeting. Weekly report shall include following:

1. Safety report with accidents, improvements, and near misses
2. A brief description of work completed each week
3. Quantities and volumes of work completed each week
4. Subcontractor's summary of work completed and estimate of percentage of completion for each work item
5. A list of work scheduled for the following week
6. Quantities and volumes of work anticipated for the following week
7. A list and number of supervision and craft people on-site by craft
8. A review of conditions affecting execution of work, including encountered or anticipated problem areas, including delays and causes

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Subcontractor's construction schedule
2. Daily construction reports
3. Material location reports
4. Field condition reports
5. Special reports

B. Related Sections:

1. Section 01 31 00 – Project Management and Coordination
2. Section 01 33 00 – Submittal Procedures
3. Section 01 40 00 – Quality Requirements
4. Section 01 70 00 – Execution and Closeout Procedures

1.2 DEFINITONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish time.

B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by Engineer.

C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

D. Event: The starting or ending point of an activity.

E. Float: The measure of flexibility in starting and completing an activity. Float time belongs to the project and to any parties in the Contract.

1.3 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. PDF electronic file

B. Subcontractor's Preliminary Progress (construction) Schedule: Preliminary schedule with Bid and revised schedule 10 days after the Effective Date.

C. Daily Construction Reports: Submit the next day.

D. Field Condition Reports: Submit at time of discovery of differing conditions.

E. Special Reports: Submit at time of unusual event.

1.4 QUALITY ASSURANCE

A. Pre-Scheduling Meeting (Conference): Engineer will schedule a conference at the Site in coordination with Subcontractor to review methods and procedures related to the Subcontractor's construction schedule including, but not limited to, the following:

1. Review and finalize list of construction activities to be included in schedule.
2. Review submittal requirements and procedures.
3. Review procedures for updating schedule.

1.5 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate subcontractors.

B. Coordinate Subcontractor's construction schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBCONTRACTOR'S CONSTRUCTION SCHEDULE

A. Time Frame: Extend schedule from date established for final completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities for each principal element of the Work. Comply with the following:

1. Activity Duration: Define expected duration for each activity.
2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
3. Submittal Review Time: Include review and re-submittal times indicated in Submittal Procedures (Section 01 33 00) in schedule. Coordinate submittal review times in Subcontractor's construction schedule with submittal schedule.
4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Engineer's administrative procedures necessary for certification of Substantial Completion.
5. Punch List and Final Completion: Include not more than 20 days for punch list and final completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work Restrictions: Show the effect of the following items on the schedule:

a. Use of premises restrictions

b. Seasonal variations

c. Environmental control

d. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities.

3. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

D. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.2 SUBCONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a preliminary construction schedule with Bid. Following review and comment by Owner and Engineer, resubmit a fully comprehensive, fully developed, horizontal Gantt Chart-type Subcontractor's construction schedule within 10 days after the Effective Date. Base schedule on the additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately.

2.3 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Site to include or as approved by the Engineer:

1. List of Subsubcontractors at Site
2. Approximate count of personnel at Site
3. Equipment at Site
4. Material deliveries
5. General weather conditions including high and low temperatures and precipitation
6. Accidents
7. Meetings and significant decisions
8. Unusual events (refer to special reports)
9. Stoppages, delays, shortages, and losses
10. Meter readings and similar recordings
11. Emergency procedures
12. Orders and requests of authorities having jurisdiction
13. Change Orders received and implemented
14. Work Change Directives received and implemented
15. Services connected and disconnected

B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request

for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.4 SPECIAL REPORTS

A. General: Submit special reports directly to Engineer within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at the Site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Subcontractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner and Engineer in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 SUBCONTRACTOR'S CONSTRUCTION SCHEDULE

A. Subcontractor's Construction Schedule Updating: At weekly intervals, update schedule to reflect actual construction progress and activities. Issue schedule at each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As Work progresses, indicate final completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Engineer**,** Owner, and other parties identified by Subcontractor with a need-to-know schedule responsibility.

1. Post copies in temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Drawings, Product Data, and other submittals.

B. Related Sections:

1. Section 01 29 00 – Payment Procedures
2. Section 01 32 00 – Construction Progress Documentation
3. Section 01 40 00 – Quality Requirements
4. Section 01 70 00 – Execution and Closeout Procedures

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action.

B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action.

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls, within which internal and external users are able to access files.

D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.3 GENERAL REQUIRMENTS

A. Procedures and format for submittals required by the Technical Specifications that may include, but are not limited to:

1. Soil and/or material test data
2. Survey data
3. Product test data
4. Product specifications
5. Progress reports
6. Drawings
7. Manufacturers' instructions, certifications, guarantees, and warranties
8. Management, staging, and sequencing plan
9. Schedules

B. Refer to Technical Specifications sections for required submittals.

C. Subcontractor shall prepare and submit to the Engineer a Work Plan to ensure that Drawings and Specifications are followed efficiently and safely through each phase of the

Work. Submittal of the Work Plan is divided into two phases: Draft Work Plan and Final Work Plan.

D. A Preliminary Submittals Schedule shall be submitted within 10 days of Notice of Award. The Bidder should carefully review all Technical Specifications to confirm submittal requirements.

E. A Draft Work Plan shall be submitted with Subcontractor's Bid. The Bidder should carefully review all Technical Specifications to confirm submittal requirements. The Draft Work Plan elements include but are not limited to the following:

1. Submittals Schedule
2. Draft Construction Health and Safety Plan (HASP) in accordance with Section 01 35 20.
3. Draft Construction Quality Control Plan (CQCP) in accordance with Section 01 40 00.
4. Plan for sequencing of the Work
5. Conceptual plan for environmental management including proposed transportation routes for equipment and transport vehicles.
6. A plan for decontamination of equipment during operations.
7. MGP Contact Water Management Plan, including collection, handling, and containerizing for off-site disposal, or with Engineer's approval, treatment through the groundwater treatment system. Align plan with specifications in Section 02 72 11 – MGP Contact Water Management.

F. Following submittal and review of the Draft Work Plan by the Owner and Engineer, a Final Work Plan shall be submitted within 14 days of Contract award. The Bidder should carefully review all Technical Specifications to confirm submittal requirements. Within the Final Work Plan the Subcontractor shall incorporate the following submittals:

1. Updates and final plans for all elements contained within the Draft Work Plan.
2. The Final Construction Health and Safety Plan (HASP) that includes all elements required in Section 01 35 20.
3. The Final Construction Quality-Control Plan (CQCP) that includes all elements required in Section 01 40 00.

1.4 SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals for review and approval by the Engineer, arranged in chronological order by dates required by construction schedule and Technical Specifications. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the Engineer and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subsubcontracts, the schedule of values, and Subcontractor's construction schedule.
2. Format: Arrange the following information in a tabular format:
   a. Project name and contract number
   b. Scheduled date for first submittal (or revision number)
   c. Specification Section number, title, and submittal number
   d. Submittal category: Action or informational

e. Name of subcontractor or subsubcontractor

f. Description of the Work covered

g. Scheduled date for Engineer's final release or approval

h. Sequential page numbers

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Digital Data Files: Electronic copies of AutoCAD Drawings of the Contract Drawings will be provided by Engineer for Subcontractor's use in preparing submittals.

1. Engineer will furnish Subcontractor one set of digital data drawing files of the Contract Drawings for use in preparing Drawings.

a. Engineer makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.

b. Digital Drawing Software Program: The Contract Drawings are available in AutoCAD Civil 3D.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.

3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.

4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow five days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Subcontractor when a submittal being processed must be delayed for coordination.

2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.

3. Resubmittal Review: Allow five days for review of each resubmittal.

D. Identification and Information: Place a permanent label or title block on each submittal item for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.

2. Provide a space approximately 6 by 8 inches on label or beside title block to record Subcontractor's review and approval markings and action taken by Engineer.
3. Include the following information for processing and recording action taken:
    a. Project name
    b. Date
    c. Name of Engineer
    d. Name of Subcontractor
    e. Name of subsubcontractor
    f. Name of supplier
    g. Name of manufacturer
    h. Submittal number or other unique identifier, including revision identifier. Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06100.01.A).
    i. Number and title of appropriate Specification Section
    j. Drawing number and detail references, as appropriate
    k. Location(s) where product is to be installed, as appropriate
    l. Other necessary identification

E. Identification and Information: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
    a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., Project-020500.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., Project -02050.01.A).
3. Provide means for insertion to permanently record Subcontractor's review and approval markings and action taken by Engineer.
4. Include the following information on an inserted cover sheet:
    a. Project name
    b. Date
    c. Name and address of Engineer
    d. Name of Subcontractor
    e. Name of firm or entity that prepared submittal
    f. Name of Subsubcontractor
    g. Name of supplier
    h. Name of manufacturer
    i. Number and title of appropriate Specification Section

j. Drawing number and detail references, as appropriate

k. Location(s) where product is to be installed, as appropriate

l. Related physical samples submitted directly

m. Other necessary identification

5. Include the following information as keywords in the electronic file metadata.

a. Project name

b. Number and title of appropriate Specification Section

F. Options: Identify options requiring selection by the Engineer.

G. Deviations: Identify deviations from the Contract Documents on submittals.

H. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Engineer.

I. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Engineer will return submittals received from sources other than Subcontractor.

1. Transmittal Form: Provide locations on form for the following information:

a. Project name

b. Date

c. Destination (To:)

d. Source (From:)

e. Names of subsubcontractor, manufacturer, and supplier

f. Category and type of submittal

g. Submittal purpose and description

h. Specification Section number and title

i. Indication of full or partial submittal

j. Drawing number and detail references, as appropriate

k. Transmittal number (numbered sequentially)

l. Submittal and transmittal distribution record

m. Remarks

n. Signature of transmitter

2. On an attached separate sheet, prepared on Subcontractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

J. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.

2. Note date and content of revision in label or title block and clearly indicate extent of revision.

3. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.

K. Distribution: Furnish copies of final submittals to manufacturers, subsubcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

L. Use for Construction: Use only final submittals that are marked with approval notation from Engineer's action stamp, if applicable.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Submit electronic submittals via email as PDF electronic files.
    a. Engineer will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
2. Action Submittals: Submit one electronic submittal to Engineer, unless otherwise indicated.
3. Informational Submittals: Submit one electronic submittal to Engineer, unless otherwise indicated.
4. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 70 00 – Execution and Closeout Procedures.
5. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
    a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
6. Test and Inspection Reports Submittals: Comply with requirements specified in Section 01 40 00 - Quality Requirements.

B. Provide all submittals and information as identified in Technical Specifications to named individuals in the time frames as indicated in the Subcontractor's Schedule of Submittals. Payments may be withheld, in whole or in part, at discretion of the Owner in the event that submittals are not made in times specified, unless previously requested in writing by the Subcontractor (to Engineer) and approved in writing by Engineer or Owner.

C. Transmit submittals by appropriate means to expedite review or submittal. Submittals delivered by hand facsimile, email, or mail service are acceptable. Business address of project representatives shall be provided at the pre-construction meeting.

D. Submittals shall identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of completed work.

E. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.

2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
    a. Manufacturer's catalog cuts
    b. Manufacturer's product specifications
    c. Statement of compliance with specified referenced standards
    d. Testing by recognized testing agency
    e. Application of testing agency labels and seals
    f. Notation of coordination requirements
    g. Availability and delivery time information
4. Submit Product Data before or concurrent with Samples.
5. Submit Product Data in the following format:
    a. PDF electronic file, unless otherwise indicated.

F. Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based upon Engineer's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    a. Identification of products
    b. Schedules
    c. Compliance with specified standards
    d. Notation of coordination requirements
    e. Notation of dimensions established by field measurement
    f. Relationship and attachment to adjoining construction clearly indicated
    g. Seal and signature of professional engineer, if specified
2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches.
3. Submit Drawings in the following format, unless otherwise indicated:
    a. PDF electronic file
    b. One digital data file (e.g., AutoCAD .dwg file)
    c. Stamp, sign, or initial submittal certifying products or field dimensions, whichever pertains, in accordance with requirements of Work and Contract Documents.

G. Subcontractor's Construction Schedule: Comply with requirements specified in Construction Progress Documentation (Section 01 32 00).

H. Application for Payment: Comply with Specification Section 01 29 00 requirements and use EJCDC Form C-620 (Section 00620).

I. Subsubcontractor List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.

3. Drawing number and detail references, as appropriate, covered by subcontract.
4. Submit subsubcontract list in the following format, unless otherwise indicated:
    a. PDF electronic file

J. Coordination Drawings: Comply with requirements specified in Project Management and Coordination (Section 01 31 00).

K. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of Engineers and Companies, and other information specified.

L. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents, and where required, is authorized by manufacturer for this specific Project.

M. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

N. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

O. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

P. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

Q. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

R. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with the specifications and applicable building code in effect for Project. Include the following information:

1. Name of evaluation organization
2. Date of evaluation
3. Time period when report is in effect
4. Product and manufacturers' names
5. Description of product
6. Test procedures and results
7. Limitations of use

S. Schedule of Tests and Inspections: Comply with requirements specified in Quality Requirements (Section 01 40 00).

T. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

U. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests

performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

V. Field Test Reports: Submit reports indicating and interpreting results of field tests either performed during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

W. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

PART 3 - EXECUTION

3.1 SUBCONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.

B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Execution and Closeout Procedures (Section 01 70 00).

C. Approval Stamp: Stamp each submittal with a uniform approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Subcontractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ENGINEER'S ACTION

A. General: Engineer will not review submittals that do not bear Subcontractor's approval stamp and will return them without action.

B. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or modifications required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

C. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.

D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.

E. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

F. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION

SECTION 01 35 20
SITE HEALTH AND SAFETY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General Health and Safety Issues
2. Disclosure – Chemical Characteristics
3. Public Safety
4. Accident Reports
5. Fire Protection and Emergencies
6. Security
7. Working in Proximity to Overhead Transmission Lines
8. Compliance with Perimeter Air Monitoring Program

1.2 GENERAL HEALTH AND SAFETY ISSUES

A. Subcontractor is responsible for implementation and enforcement of health and safety requirements and shall take necessary precautions and provide protection for the following:

1. Personnel working on or visiting the Site, irrespective of employer.
2. Work and materials or equipment to be incorporated in Work area on- or off-site.
3. Other property at or adjacent to the Site.
4. Public exposed to job-related operations or potential release of toxic or hazardous materials.

B. Subcontractor shall provide a dedicated Health and Safety Officer to be on site through the duration of the Work. Include name and qualifications with Bid.

C. Subcontractor shall prepare a Construction Health and Safety Plan (HASP) for project. The HASP will be reviewed by the Engineer and Owner. The HASP may be revised throughout construction, as necessary. Submit a signed copy to Engineer prior to mobilization. Prepare HASP in accordance with applicable OSHA guidance. HASP shall address all major elements of the Subcontractor Work. The Subcontractor's HASP does not supersede or in any way relieve the Subcontractor of obligations under any applicable OSHA regulations including 29 CFR 1910: Occupational Safety and Health Standards and 29 CFR 1926: Health and Safety Regulations for Construction. At minimum, the Subcontractor HASP shall include the following:

1. Site description and history
2. Project activities and coordination with other Subsubcontractors
3. Hazards evaluation
4. Heavy equipment operation
5. On-site safety responsibilities
6. Description of Subcontractor's drug and alcohol policy

7. Work zones
8. Personnel training
9. Atmospheric (Work Zone) monitoring
10. Personal protection, clothing, and equipment
11. Emergency procedures
12. Spill Control and Countermeasures Plan
13. Name of person who will be responsible in the event of an emergency incident
14. Plan for initial site safety orientation and training for all Subcontractor and Subsubcontractor personnel
15. Listing of on-site health and safety equipment, supplies, and locations
16. Maps clearly depicting routes to closest emergency medical facilities and hospitals
17. Provisions for mitigating the potential for exposure to the community

D. Spill Control and Countermeasures Plan shall include the following:

1. Contingencies for potential spills or discharges
2. Means, methods, and facilities to manage and prevent loss of contaminated soil, groundwater, and surface water to the environment
3. Descriptions of proposed personnel and equipment for conducting decontamination of personnel, equipment, and materials
4. Notification requirements to regulatory agencies in accordance with applicable Federal Clean Water Act and IEPA requirements.
5. Emergency notification protocols and procedures to the Owner and the Engineer.

E. Subcontractor shall be and remain liable for compliance by employees, agents, and Subsubcontractors with Subcontractor's HASP and procedures for Site and shall not hold Owner and/or Engineer accountable to any claims, damages, suits, losses, and expenses in any way arising from noncompliance with Health and Safety Plan. It is Subcontractor's responsibility to enforce all necessary safety rules.

F. Engineer and Owner may adopt Subcontractor's HASP for on-site Owner and Engineer personnel. Regardless, Subcontractor shall be responsible for its own health and safety at all times

G. Notify Engineer of any chemical products to be used by Subcontractor while on Site. Furnish Safety Data Sheets (SDS) for chemical products to Engineer before any such chemicals are brought on premises throughout duration of project. Comply with standards set in 29 CFR 1910.120 in providing such notifications and SDS.

H. Provide all necessary safety equipment needed to perform required Work. Provide and properly use adequate ventilation and personal protection equipment, including respirators as required according to OSHA regulations.

I. Train personnel in use, limitations, and proper fit of all necessary safety equipment. General Site workers expected to be in contact with MGP contaminated soil or water shall have received 40-hour Hazardous Waste Operations and Emergency Response training in accordance with 29 CFR 1910.120.

J. At a minimum, hard hats, eye protection, steel toe boots, and high-visibility vests are required, as necessary, in all construction areas.

K. Conform to OSHA Safety and Health Regulations for construction.

1.3 DISCLOSURE – CHEMICAL CHARACTERISTICS

A. Engineer and Owner will furnish or make available to Subcontractor documents and information that relate to identity, location, quantity, nature, or characteristics of hazardous substances near work Site. Owner, however, assumes no responsibility or liability for accuracy or completeness of such documents or information, and all such documents and information will remain property of the Owner.

B. Soil: The soils beneath the Site are heterogeneous fill material consisting of sand and gravel to silt and clay, with varying quantities of coal, cinders, slag, wood, construction debris, and building rubble. The heterogeneous fill material is present at ground surface to depths of approximately 15-25 feet below ground surface (bgs). The fill is underlain on the eastern portion of the Site by a primarily brownish-gray medium to fine grained silty sand or a silty clay confining unit. The average thickness of the sand unit is 25 feet beginning at depths ranging from 20-25 feet bgs. The sand is underlain by a silty clay confining unit beginning at depths ranging from 40 to 50 feet bgs. On the western portion of the site, the confining clay lies directly underneath the fill unit and no silty sand is present. Residual amounts of coal tar (containing polycyclic aromatic hydrocarbons [PAH] compounds) and other constituents of MGP operations (such as arsenic, cyanide, benzene, ethylbenzene, toluene, and xylene) have also been identified in various areas. Refer to the Engineer's HASP for additional information regarding residual MGP constituents in soil.

C. Groundwater: Chemical analyses have been performed on groundwater samples from monitoring wells at the Site. Depth to groundwater ranges from approximately 6 to 8 feet bgs. Groundwater flow generally flows to the east. Groundwater impacts include benzene and naphthalene. Refer to the Engineer's HASP for additional information regarding residual MGP constituents in groundwater.

1.4 PUBLIC SAFETY

A. Protect finished and unfinished work against any damage, loss, or injury during performance of and up to completion of work.

B. Provide adequate protection around all openings wherever required to safeguard work or public.

C. Protect all openings and surface obstructions with fencing, barricades, signs, and warning devices in accordance with local, state, and federal requirements.

D. No smoking or eating will be allowed within Site boundaries except in locations agreed upon by Owner and Subcontractor.

1.5 ACCIDENT REPORTS

A. If a death, serious injury, or damage occurs, the Subcontractor shall report the accident immediately by telephone to the Owner and Engineer and appropriate local authorities. In addition, the Subcontractor must promptly report in writing to the Owner all accidents occurring in connection with the Work, giving full details, names and statements of witnesses.

1.6 FIRE PROTECTION AND EMERGENCIES

A. Subcontractor shall execute all Work in a fire-safe manner. Furnish and maintain a suitable type and amount of portable fire extinguishers on site and in each piece of equipment as applicable.

B. Abide by Engineer's and Owner's emergency notification and operating practices for emergencies. Practices will be discussed at pre-construction meeting (Section 01 31 00 – Project Management and Coordination).

1.7 WORKING IN PROXIMITY TO OVERHEAD TRANSMISSION LINES

A. Subcontractor shall conform to, when work is performed in proximity to energized electrical conductors, the provisions and requirements, with any amendments hereto, of OSHA Safety and Health Regulations for Construction, in particular, but not limited to subpart 1926.550 and local and State electrical code and any amendments thereto.

B. Contactor shall not stockpile below the transmission lines.

C. No line outage will be allowed.

1.8 COMPLIANCE WITH PERIMETER AIR MONITORING PROGRAM AND FUGITIVE EMISSIONS MANAGEMENT PLAN

A. A perimeter air monitoring program for vapor phase and fugitive particulate matter will be implemented by others during the remedial construction under an Air Monitoring Plan (AMP) included in the Engineer's Construction Quality Assurance Plan (CQAP). The Subcontractor shall be required to fully comply with this plan during construction.

B. Fugitive emissions shall be managed by the Subcontractor in conformance with a Fugitive Emissions Management Plan (FEMP) included in the Engineer's CQAP. The Subcontractor shall be required to fully comply with this plan during construction.

C. To maintain compliance with AMP and FEMP requirements, the Subcontractor shall comply with the perimeter air monitoring response requirements as discussed in the FEMP. Response actions shall include physical controls such as covering stockpiles, and modifying the sequence of the work, as specified in the CQAP Engineer's.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Subcontractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities.

2. Specified tests, inspections, and related actions do not limit Subcontractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.

3. Requirements for Subcontractor to provide quality-assurance and -control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Engineer

C. Preconstruction Testing: Tests and inspections performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria

D. Product Testing: Tests and inspections that are performed by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements

E. Source Quality-Control Testing: Tests and inspections that are performed at the source, (i.e., plant, mill, factory, or shop)

F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency

H. Installer/Applicator/Erector: Subcontractor or another entity engaged by Subcontractor as an employee, or Subsubcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade or trades.

I. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of two previous projects similar in nature, size, and extent to this Project in the last five years; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.4 SUBMITTALS

A. Subcontractor's Construction Quality-Control Plan (CQCP): For quality-assurance and quality-control activities and responsibilities.

B. Subcontractor's Quality-Control Manager Qualifications: For supervisory personnel.

1.5 SUBCONTRACTOR'S CONSTRUCTION QUALITY-CONTROL PLAN

A. Construction Quality-Control Plan: Submit draft CQCP as indicated in the Contract Schedule to be established at the time of award. Submit in format acceptable to Engineer. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Subcontractor's quality-assurance and quality-control responsibilities. Coordinate with Subcontractor's construction schedule. Following review and comment by the Engineer and Owner, the Subcontractor shall incorporate revisions and resubmit within 10 days for review and approval. The CQCP shall address all aspects of the construction operations to include but not be limited to well installation, conveyance, fluid control, air, and electrical infrastructure, connection to groundwater treatment plant, on and off-site management of excavated materials, and site restoration.

B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager shall not have other Project responsibilities

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: Include in quality-control plan a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Subcontractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Subcontractor-elected tests and inspections
2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections"
3. Engineer-performed tests and inspections indicated in the Contract Documents

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Engineer has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.6 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue
2. Project title and number
3. Name, address, and telephone of testing agency
4. Dates and locations of samples and tests or inspections
5. Names of individuals making tests and inspections
6. Descriptions of the Work and test inspection methods
7. Identification of product and Specification Section
8. Complete test or inspection data
9. Test and inspection results and an interpretation of test results
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting
11. Comments or professional opinion or whether tested or inspected Work complies with the Contract Document requirements
12. Name and signature of laboratory inspector
13. Recommendations on retesting and re-inspecting

B. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.7 QUALITY ASSURANCE

A. Engineer will arrange for construction oversight, as specified in the Engineer's Construction Quality Assurance Project Plan (CQAP), to confirm that the construction activities and completed project complies with Contract Documents.

B. Engineer's inspection and testing activities will consist of following activities:

1. Documentation of pre- and post-construction conditions of the Site and surrounding areas.
2. Daily observation and record of Subcontractor activities.
3. Reviewing and verifying all materials and products brought on Site for compliance with the Technical Specifications and Contract Drawings.
4. On-site observation and assessment of air monitoring and fugitive emissions.

C. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

D. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

F. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

G. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar to those indicated for this Project in material, design, and extent.

H. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

I. Testing Agency Qualifications: An independent agency with the experience and capability to conduct testing and inspecting indicated in individual Sections; and where required by authorities having jurisdiction that is acceptable to authorities

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Within time specified in Proposal Request submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
   a. Provide test specimens representative of proposed products and construction.
   b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Engineer with copy to Subcontractor. Interpret tests and inspections and state in each report whether

tested and inspected work complies with or deviates from the Contract Documents.

1.8 QUALITY CONTROL

A. Subcontractor Responsibilities: Tests and inspections not explicitly assigned to Owner or Engineer are Subcontractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Subcontractor by authorities having jurisdiction, whether specified or not.
2. Where services are indicated as Subcontractor's responsibility, engage a qualified testing agency to perform these quality-control services.
    a. Subcontractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Subcontractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Subcontractor and not required by the Contract Documents are Subcontractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
7. Perform work in strict accordance with Technical Specifications and Contract Drawings. Coordinate, supervise, and oversee subsubcontractors as needed to perform construction activities.
8. Perform testing as deemed necessary to satisfy requirements of Technical Specifications related to off-site materials prior to delivery to site. Subcontractor is required to continue locating new material sources and testing the material until the material is approved by Engineer. Materials that do not meet specifications and are not approved by Engineer shall be removed from site at Subcontractor’s expense.

B. Engineer’s Responsibilities.

1. Provide clarifications to Technical Specifications and Contract Drawings, as well as any necessary design changes requested by the Owner.
2. Review Subcontractor’s submittals and advise Owner on results of review of these items.
3. Provide manifests for disposal or transport of contaminated soil and debris, and contact water, if necessary.
4. Verifying well screening interval during well installation.
5. Surveying vault covers and aprons to verify elevations.
6. Leaking testing of conveyance piping and functionality testing on all fluid control equipment.
7. Communicate any pertinent issues with the Owner and/or Subcontractor.
8. Monitor construction progress, and report to Owner with respect to planned schedule.

9. Provide photo documentation and daily written reports documenting construction according to the Technical Specifications and Contract Drawings.
10. Conduct perimeter ambient air monitoring and notify Owner and Subcontractor of any fugitive emissions noted.
11. Sample contact water treatment system when required according to obtained permit or substantive requirements.

C. Owner's Responsibilities

1. Perform Owner's engineering review and monitor construction progress and progress payment approval.
2. Perform Owner's administrative and managerial responsibilities. Owner has authority to accept/reject materials and workmanship, and for dispute resolution.
3. Communicate any pertinent issues with Subcontractor and/or Engineer. Maintain communication with USEPA.
4. Approve/reject Contactor's submittals and post-treatment results.

D. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Subcontractor's responsibility, Subcontractor shall provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. Testing Agency Responsibilities: Cooperate with Engineer and Subcontractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Subcontractor.
2. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
3. Do not perform any duties of Subcontractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work
2. Incidental labor and facilities necessary to facilitate tests and inspections
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples
4. Facilities for storage and field curing of test samples
5. Delivery of samples to testing agencies
6. Security and protection for samples and for testing and inspecting equipment at Project site

G. Coordination: Subcontractor shall coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

H. Schedule of Tests and Inspections: Subcontractor shall prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a

component of the Subcontractor's CQCP. Coordinate and submit concurrently with Subcontractor's construction schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to Owner, Engineer testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TESTING AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Engineer.
4. Identification of testing agency or inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Engineer's reference during normal working hours.

END OF SECTION

SECTION 01 41 00
PERMITS AND FEES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Applicable permits, approvals, and associated fees required for completion of the Work.
2. Party responsible for obtaining the approvals and permits.

B. Related Sections:

1. Section 02 01 00 – Site Preparation and Maintenance of Existing Conditions
2. Section 02 72 11 – MGP Contact Water Management
3. Section 31 01 01 – Earthwork
4. Section 31 25 00 – Erosion and Sedimentation Controls
5. Section 32 91 15 – Topsoil, Seeding, and Site Restoration

1.2 DEFINITIONS

A. IAC: Illinois Administrative Code

B. IEPA: Illinois Environmental Protection Agency

C. IDOT: Illinois Department of Transportation

D. NOI: Notice of Intent

E. SWPPP: Stormwater Pollution Prevention Plan

1.3 PROJECT REQUIREMENTS

A. Permits and Approvals:

1. Owner and Engineer
   a. Owner and Engineer will obtain IEPA Construction Site Erosion Control and Storm Water Discharge Permit for disturbance of one or more acres of land by completing a Notice of Intent (NOI) form and a Storm Water Pollution Prevention Plan (SWPPP).
   b. Owner and Engineer will complete waste profiling and approval for landfill disposal of MGP-impacted special waste at an approved RCRA Subtitle D landfill.
2. Subcontractor
   a. Subcontractor will obtain a temporary fence, right of way access and street use permits.
   b. Subcontractor shall obtain any applicable permits required to complete the Work and not obtained by the Owner or Engineer. Subcontractor shall submit a list of required permits with bid.

B. Fees:

1. Owner

a. Owner will pay for fees associated with all permits and approvals of their responsibility.

b. Owner will pay for landfill tipping fees for MGP impacted special waste disposal.

2. Subcontractor

a. Subcontractor shall pay for fees associated with all permits and approvals of their responsibility.

C. Copies of permits and approvals obtained by the Owner and Engineer will be made available to the Subcontractor.

D. Copies of permits obtained by the Subcontractor shall be provided to the Owner and Engineer.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, parking, and security and protection facilities.

B. Related Sections:

1. Section 01 10 00 – Summary of Work
2. Section 01 35 20 – Site Health and Safety
3. Section 02 01 00 – Site Preparation and Maintenance of Existing Conditions
4. Section 31 25 00 – Erosion and Sedimentation Control

1.2 USE CHARGES

A. General: Installation, removal of, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost including, but not limited to, Owner, Engineer, testing agencies, and authorities having jurisdiction.

B. Sanitary Services:

1. Subcontractor will provide on-site sanitary facilities conforming to state and local health and sanitation regulations in sufficient number for use by all entities for construction operations.

C. Water Service:

1. Subcontractor shall provide water requirement for Work to be completed on the Site along with bid documents.
2. Subcontractor shall provide potable water, containers, and ice for Subcontractor's employees.

D. Electric Power Service:

1. Engineer will coordinate power drops at the Site. The Subcontractor is responsible for connecting to the power drops for access to single and three phase electrical service. The Subcontractor shall provide electrical requirements along with their bid documents.
2. OSHA regulation require that employers shall use either ground fault circuit interrupters or an assured equipment grounding conductor program in addition to any other regulations for equipment grounding conductors.

E. Internet/Telephone Service:

1. Engineer to provide, maintain, and pay for one internet and local land-line telephone service to Subcontractor construction trailer for duration of project. Subcontractor will provide connections to the site service panels as required.
2. Cellular phone is required for the on-site superintendent or foreman.

1.3 SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Erosion Control and Surface Water Management Plan: Show compliance with local, State, and Federal requirements, whichever is more stringent, including the Engineer's Stormwater Pollution Prevention Plan.

1.4 USE OF SITE FACILITIES

A. Subcontractor shall consult with the Owner and Engineer regarding locations for offices, trailers, material storage, access roads, and areas within the Work area for use by Subcontractor.

B. Confine equipment, storage of materials, and operations of work persons to designated areas approved by the Owner. Do not bring materials onto Site until reasonably required for progress of work.

C. Subcontractor or Subsubcontractors may not use area outside of the approved areas at the Site for any purpose unless expressly approved by the Owner in writing.

D. Store, place, and handle material and equipment to protect from any damage. Subcontractor shall move materials sheds, or equipment, as necessary, or when required for continuing construction at Subcontractor's expense.

E. Owner assumes no responsibility for project material or equipment stored on or off site. Subcontractor assumes full responsibility for damage due to storing of materials.

F. Subcontractor is responsible to schedule work, storage of materials, etc., to minimize interference with construction activities.

G. Subcontractor, prior to start of work, shall inspect Site with Owner and Engineer to determine existing conditions in conjunction with preconstruction meeting.

1.5 SECURITY

A. Security may be provided by the Owner.

B. Subcontractor is responsible for loss or injury to persons or property where subcontractor's work is involved, and shall provide security and take precautionary measures as deemed necessary to protect Subcontractor's and Owner's interests.

1.6 PARKING

A. Parking areas at the Site will be designated by Engineer.

1.7 ARCHAEOLOGICAL OR HISTORIC RELICS

A. Native American relics or items with an apparent archaeological or historical value discovered during construction shall not be touched, moved, or otherwise disturbed.

B. Report existence of these items to Engineer and Owner immediately upon discovery.

1.8 FIELD OFFICES AND STRUCTURES

A. The Engineer shall provide a field office within the fenced in work area shown on Sheet C-104 for project administration, project meetings, plan review, and equipment and sample storage

B. Subcontractor shall provide necessary temporary sheds or other storage facilities to accommodate Subcontractor's supply and storage needs.

1.9 CONSTRUCTION NOISE

A. The Subcontractor shall take all necessary precautions to minimize construction noise in accordance with the Fugitive Emission Management Plan (FEMP) for the Site. All equipment shall be fitted with suitable noise reduction devices such as mufflers, inlet and exhaust silencers, and engine covers that shall be maintained in good working order.

1.10 BARRIERS AND PROTECTION OF INSTALLED WORK

A. Protect installed work and provide special protection as stated in Technical Specifications.

B. Construction traffic shall be prohibited on completed and/or landscaped areas.

C. Provide barriers to prevent unauthorized entry to construction and staging areas as necessary. Protect existing facilities and adjacent properties from damage during construction operations.

1.11 FUEL STORAGE AND HANDLING

A. Store fuel according to local, state, and federal laws.

B. At no time, shall overtopping fuel tank or spillage to ground surface be allowed.

1.12 PROTECTION OF ENVIRONMENT

A. Minimize air pollution by use of properly operating combustion emission control devices on construction vehicles and equipment. Encourage shutdown of motorized equipment not in use.

B. Trash burning is not permitted on site.

C. All areas for handling and storage of fuels, oils, and other potentially hazardous liquids shall have spill containment or release prevention measures. Maintenance of on-site equipment shall be with prior approval of the Engineer.

D. All waste materials shall be recycled, hauled to a licensed solid waste landfill, or otherwise disposed of in an environmentally sound manner and in compliance with all applicable local, state, and federal rules as approved by the Engineer and Owner

E. All hazardous waste shall be stored, handled, and disposed of in compliance with applicable local, state, and federal rules.

F. Other measures shall be taken, as necessary, to maintain Site in an environmentally sound matter.

G. All spills or leaks of fuels, oil, or other reportable liquids resulting from handling or equipment malfunctions shall be reported immediately to Owner and/or Engineer. Affected soils shall be properly removed from limits of construction and disposed in accordance with applicable local, state, and federal rules as approved by the Owner and Engineer. A copy of manifests, if necessary, shall be provided to Owner/Engineer within 5 working days of disposal. Waste Generator Manifests shall not state Owner as Generator. Owner reserves right to order leaking equipment removed from Site.

1.13 PUBLIC ROAD REQUIREMENTS

A. The Subcontractor shall conduct operations on the Site in a manner that shall minimize interference with the normal operation of adjoining public roads and parking lots and shall implement all specified and other appropriate measures to ensure the safety of all users of adjoining public roads and parking lots.

B. During periods of heavy truck or equipment traffic near public roadways, the Subcontractor shall provide sufficient flag persons to direct construction equipment and safeguard vehicular traffic. At the close of each workday, the Subcontractor shall leave the Site in a safe condition.

C. At no time during construction shall any soil be permitted to leave the Site without being fully contained and covered unless expressly approved by the Owner. All trucks shall be covered and covers shall be securely fastened without gaps and shall be approved by the Engineer.

1.14 ADDITIONAL REQUIREMENTS

A. Owner has first right of refusal for any items with an apparent historical or monetary value present or discovered during construction or items that can be salvaged and reused elsewhere (i.e., trees, planters, benches, signs). Notify Owner of suggested items at least 5 days prior to removal.

B. No cameras are allowed on the Site without written permission from the Owner.

C. No firearms or explosives are allowed on the Site.

D. Possession and/or use of intoxicating beverages and nonprescription drugs are prohibited at all times. Persons caught in possession or under the influence of drugs or alcohol will be immediately dismissed and removed from the Site.

E. Smoking will be allowed in designated areas only.

F. No horseplay is permitted on the Site.

G. Visitors or personnel not employed by the Subcontractor or approved Subsubcontractors shall not be permitted on the Site without prior approval by the Owner and Engineer.

H. Owner and Engineer reserve the right to require that any of the Subcontractor's personnel be excluded from work at the Site at any time.

1.15 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Engineer & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for egress from project office facilities.

1.16 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

A. Field Office, General: Engineer will provide a field office at the Site for project administration, project meetings, plan review, and equipment and sample storage.

B. Storage and Fabrication Sheds: Subcontractor shall provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations, as needed.

1. Store combustible materials apart from field offices.

2.2 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated, with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

3.1 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Electric Power Service: Access electric power of sufficient size, capacity, and power characteristics for construction operations.

C. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

D. Telephone Service: Access temporary telephone service in common-use facilities for use by all construction personnel.

1. At each telephone, post a list of important telephone numbers.
    a. Police and fire departments
    b. Ambulance service
    c. Subcontractor's home office
    d. Engineer’s offices
    e. Owner’s office
    f. Principal Subsubcontractors' field and home offices
2. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

END OF SECTION

SECTION 01 55 00
MOBILIZATION, DEMOBILIZATION, AND DECONTAMINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Description of Work

1.2 DESCTIPTION OF WORK

A. Mobilization consists of the Work and operations necessary for the movement of personnel, equipment, supplies, and incidentals to the project Site including work and operations that must be performed or for which costs must be incurred before beginning Work on the various items at the Site. Includes all labor, equipment, and materials necessary to fulfill the requirements of all Technical Specifications. Demobilization shall include all Work and operations to vacate the Site, including movement of personnel, equipment, supplies, and incidentals from the Site.

B. Decontamination of personnel clothing, equipment, and disposition of decontamination wastes is an integral part of the overall Health and Safety Program. The selection of protective clothing, respirators, and equipment to prevent human contact and the spread of contaminants shall be addressed in the Subcontractor's Health and Safety Plan. Decontamination consists of physically removing contaminants or changing their chemical nature to innocuous substances. This item consists of all Work and operations necessary for the Subcontractor to safely enter and exit the Site and perform the Work contained in these Contract Documents.

C. Subcontactor shall submit a written plan for decontamination to the Engineer as part of the comprehensive Work Plan for approval prior to proceeding with decontamination activities.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.2 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1.3 ACTION SUBMITTALS

A. Provide submittals as required in individual Sections.

1.4 QUALITY ASSURANCE (NOT USED)

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Maintain on-site file of Safety Data Sheets of products used and stored on the Site.

C. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at the Site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to the Site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

D. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.

4. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Subcontractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

B. Submittal Time: Comply with requirements in Execution and Closeout Procedures (Section 01 70 00).

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged, and unless otherwise indicated, are new at time of installation.

1. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," or “or similar” comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Engineer will consider Subcontractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named on the Contract Drawings or in the Specifications.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of Engineers and Companies, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 70 00
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution and contract closeout of the Work including, but not limited to, the following:

1. Construction layout
2. Field engineering and surveying
3. Installation of the Work
4. Cutting and patching
5. Progress cleaning
6. Starting and adjusting
7. Protection of installed construction
8. Correction of the Work
9. Substation Completion procedures
10. Final Completion procedures
11. Final cleaning

B. Related Sections:

1. Section 01 33 00 – Submittal Procedures

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.3 SUBCONTRACTOR'S RESPONSIBILITIES

A. Upon commencement of Work, become familiar with the location of existing reference benchmarks, control points, and other necessary reference construction points. Maintain their accuracy and prevent disturbance or destruction. Subcontractor is responsible for re-establishing control points and benchmarks if such items are destroyed at no cost to Owner.

B. Establish and verify grades, lines, levels, locations, and dimensions as shown on Contract Drawings and report any errors or inconsistencies to Engineer before commencing Work.

C. Lay out own work and be responsible for all surveys, lines elevations, and measurements of structures and other Work executed under Contract. Exercise proper preparation to verify figures on Contract Drawings within construction limits before laying out work. Any error resulting from failure to exercise such precautions or work done without being properly located may be removed at Engineer's direction and corrected or replaced at Subcontractor's expense

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor and/or professional engineer.

B. Certificates: Submit certificate signed by land surveyor and/or professional engineer certifying that location and elevation of improvements comply with requirements.

C. Documentation Surveys: If required, submit two copies signed by registered land surveyor (RLS). Also submit as a digital file in AutoCAD .dwg format.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where the Work is located and who is experienced in providing land-surveying services of the kind indicated.

1.6 SURVEY DATA FOR CONSTRUCTION DOCUMENTATION

A. Subcontractor shall conduct surveys in accordance with the frequencies and requirements indicated in Table 3.

B. Final As-Built Survey: Will be completed by the Engineer upon completion of the Work.

C. Documentation Surveys: If required, to be supplied by the Subcontractor to Engineer within four working days following completion of survey for a particular surface or set of features.

D. Survey data shall be supplied to Engineer in the following formats:

1. Topographic map identifying invert elevations (hard copy and electronic compatible for import into AutoCAD).
2. Tabular (northing, easting, elevation).

E. Subcontractor will be notified by Engineer of areas that will require adjustment or will be given written approval of surveyed area within two working days of receiving survey data.

1.7 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.

1. Prepare a list of items in conjunction with the Engineer to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise Engineer of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, final certifications, and similar document.
4. Prepare and submit required Project Record Documents, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Engineer will either proceed with inspection or notify Subcontractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Subcontractor of items, either on Subcontractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.

1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.8 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:
   1. Submit a final Application for Payment using the EJCDC Form C-620 (Section 00620).
   2. Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
   4. Certify in writing that the Work is complete and ready for final inspection.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Engineer will either proceed with inspection or notify Subcontractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Subcontractor of construction that must be completed or corrected before certificate will be issued.
   1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.9 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Prepare list of incomplete items in conjunction with the Engineer. Include name and identification of each area of the construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Subcontractor that are outside the limits of construction
   1. Organize list of areas in sequential order.
   2. Organize by major construction elements element and categories.
   3. Include the following information at the top of each page:
      a. Project name
      b. Date
      c. Name of Engineer
      d. Name of Subcontractor
      e. Page number
   4. Submit list of incomplete items in the following format:
      a. PDF electronic file, unless otherwise indicated.

1.10 RECORD DOCUMENTS

A. Produce and maintain on site, one set of the following record documents of all items or work; record actual revisions of all items of work:

1. Contract Drawings
2. Technical Specifications
3. Change orders and other modifications to contact
4. Submittals
5. Other documents including Work Plans, CQAP, HASP, and SWPPP
6. A copy of approvals of work performed

B. Store record documents separate from documents used for construction.

C. Record information concurrent with construction progress including changes made by addenda and modifications.

D. Maintain a Daily Field Log inclusive work times, personnel on-site, equipment used and other essential information of the operations progress.

1.11 WARRANTIES

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces damaged during installation by methods and with materials so as not to void existing warranties.

B. Submittal Time: Submit written warranties on request of Engineer for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning Work on the Site, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for Work that must be performed by public utilities serving Site.

3.2 PREPARATION

A. Field Measurements: Take field measurements as required to verify proper execution of the Work.

B. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Subcontractor, submit a request for information to Engineer according to requirements in Project Management and Coordination - Section 01 31 00.

3.3 FIELD ENGINEERING

A. Identification: Subcontractor shall identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Engineer. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Engineer before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

3.4 CONSTRUCTION LAYOUT AND DOCUMENTATION

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Contract Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Engineer promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project. Subcontractor is responsible for re-establishing control points and benchmarks if such items are destroyed at no cost to the Owner.

2. Establish dimensions within tolerances indicated. Do not scale Contract Drawings to obtain required dimensions. Report any errors or inconsistencies to Engineer before commencing work.

3. Exercise proper preparation to verify figures on Contract Drawings within construction limits before laying out work. Any error resulting from failure to exercise such precautions or work done without being properly located may be removed at Owner's direction and corrected or replaced at Subcontractor's expense.

4. Inform Subsubcontractor(s) of lines and levels to which they must comply.

5. Check the location alignment and elevation of every major element as the Work progresses.

6. Notify Engineer when deviations from required lines and levels design limits

7. Rework grades at own expense if grades are altered by weather conditions before or after survey work or before final restoration is completed.

8. Verify own work with respect to required grades prior to documentation surveys. Areas deficient will be corrected and resurveyed at Subcontractor's expense.

C. Site Improvements: Locate and lay out recovery well locations, conveyance trenches, location of the groundwater treatment system pad, site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer.

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 PROGRESS CLEANING

A. General: Clean Site and work areas daily. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.

2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).

3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

a. Use containers intended for holding waste materials of type to be stored.

B. Site: Maintain Site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

D. Construction Waste Disposal: Do not bury or burn waste materials on site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 50 00 - Temporary Facilities and Controls.

3.7 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Clean entire Site and neighboring properties from any materials/waste from the construction activities.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project.

a. Clean Site in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.

b. Pressure wash and sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.

c. Remove tools, construction equipment, machinery, field office equipment, and surplus material from the Site.

d. Leave the Site clean and ready for use by others

2. Construction Waste Disposal: Comply with waste disposal requirements in Temporary Facilities and Controls - Section 01 50 00.

END OF SECTION

SECTION 01 78 10
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings
2. Record Specifications
3. Record Product Data
4. Miscellaneous record submittals

B. Related Sections:

1. Section 01 33 00 – Submittal Procedures
2. Section 01 70 00 – Execution and Closeout Requirements

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit copies of Record Drawings as follows:

a. Initial Submittal: Submit one PDF electronic file of marked-up record prints and one record digital data files. Engineer will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal: Submit one PDF electronic file of marked-up record prints and one set of record digital data files. Plot each drawing file, whether or not changes and additional information were recorded.

B. Record Specifications: Submit one annotated PDF electronic file of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one annotated PDF electronic file of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: Refer to other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one annotated PDF electronic file and directory of each submittal.

E. Reports: Submit written report weekly indicating items incorporated in Project record documents concurrent with progress of the Work, including modifications, field changes, and other notations incorporated.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    a. Give particular attention to information that would be difficult to identify or measure and record later.
    b. Accurately record information in an acceptable drawing technique.
    c. Record data as soon as possible after obtaining.
2. Content: Types of items requiring marking include, but are not limited to, the following:
    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Number location and depths of ISS treated columns and other treated areas.
    d. Locations and depths of relocated, reinstalled, and/or abandoned underground utilities.
    e. Construction Surveys listed on Table 3.
    f. Changes made by Change Order or Field Directive.
    g. Changes made following Engineer's written orders.
    h. Details not on the original Contract Drawings.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Work Change Directive numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Engineer. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Engineer for resolution.
4. Engineer will furnish Subcontractor one set of digital data files of the Contract Drawings for use in recording information.
    a. Refer to Submittal Procedures (Section 01 33 00) for requirements related to use of Engineer's digital data files.
    b. Engineer will provide data file layer information. Record markups in separate layers.

C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

2. PDF Files: Annotated PDF electronic file with comment function enabled.

3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Note related Change Orders and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file and a paper copy.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Include significant changes in the product delivered to the Site and changes in manufacturer's written instructions for installation.

3. Note related Change Orders and record Drawings where applicable.

B. Format: Submit record Product Data as annotated PDF electronic file.

1. Include record Product Data directory organized by specification section number and title, electronically linked to each item of record Product Data.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

1. Include miscellaneous record submittals directory organized by specification section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and modifications to project record documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Engineer's reference during normal working hours.

END OF SECTION

SECTION 02 01 00
SITE PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

Site preparation shall be performed by the Subcontractor in accordance with the Contract Drawings and this section.

A. Section Includes:

1. Preparation
2. Protection of Utilities and Structures
3. Decontamination Area
4. Snow and Ice Management and Freeze Protection
5. Saturated Material Management
6. Decontamination Operations
7. Staging and Stockpile Areas
8. Hauling Routes, Tracking Pads, and Transportation Routes
9. Demolition and removal of Subsurface Features

B. Related Sections:

1. Section 01 41 00 – Permits and Fees
2. Section 01 50 00 – Temporary Facilities and Controls
3. Section 01 35 20 – Site Health and Safety
4. Section 02 72 11 – MGP Contact Water Management
5. Section 31 25 00 – Erosion and Sedimentation Controls

1.2 REFERENCES

A. Association of Illinois Soil and Water Conservation Districts, Illinois Urban Manual, Current Edition.

B. Illinois Department of Transportation (IDOT), Standard Specifications for Road and Bridge Construction, Current Edition.

C. Illinois Administrative Code (IAC).

1.3 DEFINITIONS

A. Exclusion Zone: Fenced area identified on the Contract Drawings are Exclusion Zones. Visitors are not allowed inside the Exclusion Zone until they have been informed and understand the health and safety issues at the Site and have signed the Health and Safety Plan (HASP). Within the Exclusion Zone, visitors must be in the escort of the on-site Engineer or Subcontractor at all times. Unauthorized personnel and personal vehicles are not allowed inside the Exclusion Zone. Equipment inside the Exclusion Zone may not go outside the Exclusion Zone until the equipment is properly decontaminated. Hard hats, eye protection, steel-toed boots, and high-visibility vests are required in the Exclusion Zone. No eating or smoking is permitted inside the Exclusion Zone.

B. Surface Features: Existing surface features including signs, posts, utility poles, monitoring wells and piezometers, bridges, fences, trees, shrubs, landscaped surface features, and other miscellaneous items.

C. Utilities: Existing gas mains, water mains, electric lines, storm sewers and conduits, telephone and other communication lines and conduits, sewer pipe, cable television, other utilities, and appurtenances.

Product data: Manufacturer's catalog cuts indicating materials and all conditions of specifications for supplied products have been met.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 00.

B. Provide Owner and Engineer written notice of construction start date at least 30 working days prior to beginning site activities.

C. Prior to start of construction submit product data and the name and location of all sources that will be used to obtain the materials specified in this Section.

D. Submit for documentation, certificates and/or test results for one sample of each material obtained from on- and off-site sources indicating compliance with Specifications prior to start of construction. Engineer may take random samples or request additional information of the material upon delivery or placement to verify compliance with the Specifications.

E. Subcontractor shall submit information that demonstrates the Subcontractor's means and methods for complying with the Fugitive Emissions Management Plan included in the Engineers Construction Quality Assurance Plan. This information shall be submitted as part of the comprehensive Draft Work Plan (Section 01 33 00) that will be discussed at the pre-construction meeting (Section 01 31 00). The information shall include provisions for compliance with these specifications, including proposed fugitive dust and odor mitigation measures, engineering controls, and equipment/application details.

1. Conduct operations and maintain Site at all times to minimize creation and dispersion of dust and mud.

2. Provide equipment necessary to control dust generation resulting from wind effects on open stockpiles, and from Subcontractor's vehicle and equipment traffic at all times. Control dust by application of water to affected areas, such that surfaces are moistened to prevent dust from becoming a nuisance to public, neighbors, and concurrent performance of other work at Site. Subcontractor shall prevent dusting 24 hours per day from project commencement to substantial completion of the Work.

3. Control mud and tracking of mud on Site access roads and public roads along haul routes. Provide stone surfaces at entrances and exits to prevent tracking. The Engineer will monitor daily site conditions related to dust and mud generation and direct Subcontractor to take actions as necessary to address observed deficient practices or conditions deleterious to construction and/or public.
4. Clean public right-of-ways (ROWs) and streets as needed, with a commercial street sweeper.

1.5 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site preparation operations.

B. Utility Locator Service: Notify "JULIE" Illinois' one-call system (1-800-892-0123 or 811 from a cell phone) and locate underground utilities at least three business days before beginning any site work.

C. Do not commence excavation activities until temporary erosion and sedimentation control measures have been inspected and repaired if necessary.

PART 2 - PRODUCTS

2.1 MISCELLANOUS MATERIALS

A. Refer to Section 31 05 14 – Select Fill and Contract Drawings for tracking pad materials.

PART 3 - EXECUTION

3.1 PREPARATION

A. Maintain, repair, and/or replace existing visual barrier along temporary construction fence as needed, or as instructed by the Engineer, throughout the duration of the work.

B. Monitoring wells to remain, as identified on the Contract Drawings, shall be protected throughout the duration of work.

C. Protect and maintain benchmarks and survey control points from disturbance during construction. If damaged during construction, notify Engineer immediately.

D. Locate and clearly identify trees, shrubs, and other vegetation to remain, as directed and approved by Engineer.

E. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 PROTECTION OF UTILITIES AND STRUCTURES

A. Preserve and protect groundwater monitoring wells, benchmarks, and site improvements to remain. If damaged during construction, notify Engineer immediately. Refer to payment deduction below for destroyed wells. If determined by Engineer that the monitoring well, benchmark, or site improvement integrity is compromised, Subcontractor shall repair damage at Subcontractor's expense under observation of Engineer.

B. The following table lists payment deductions for destroyed wells (i.e., damaged beyond repair). Well replacements shall be by the Engineer or Owner at the Subcontractor's expense.

Well	Payment Deduction if Destroyed
Monitoring Well or Water Level Well ≤ 20 ft deep	-$2,000
Monitoring Well > 20 ft deep	-$3,000

C. Protect, support, and maintain existing utilities (i.e., conduits, wires, pipes) that are to remain in place during work as indicated in the Contract Drawings. If uncharted utilities are encountered during excavation, stop work, place work in a safe condition, and notify Engineer. Locate existing underground utilities by hand excavation, as necessary

D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Engineer's written permission.

3.3 DECONTAMINATION

A. Construction decontamination pad in a location within the fenced work area approved by the Engineer.

B. Subcontractor shall maintain the pad integrity throughout the duration of the work and repair the pad as needed, or as instructed by the Engineer.

C. Maintain access to the decontamination area throughout the duration of work.

D. Following completion of use, remove MGP impacted material from decontamination area, as identified by Engineer. Impacted materials shall be disposed at a Subtitle D landfill. Transportation and disposal fees will be paid for by the Owner. Non-MGP impacted materials, as identified by Engineer, may be recycled as approved.

E. Trucks and heavy equipment with noticeable surface contamination or soil shall be decontaminated prior to leaving the Site and may include other vehicles and equipment not belonging to the Subcontractor.

F. Decontamination shall first be conducted by scraping, brushing, or other mechanical means to the extent practical to remove soil and contaminants from equipment. Soil and debris removed during the decontamination operations shall be managed on site and transported to the landfill, as directed by the Engineer.

G. Subcontractor shall provide high-pressure low-volume washing equipment with steam capabilities for the purpose of decontamination, unless approved otherwise by the Engineer. Equipment may also be used for decontamination of debris and structures encountered during excavation.

H. Decontamination liquids shall be contained at all times and shall be collected for off-site disposal or for treatment in accordance to Section 02 71 11.

I. Tracking pad surfaces shall remain clean and graded level at all times to prevent tracking. Replacement coarse aggregate additions shall be made by the Subcontractor as needed until Work is complete.

3.4 SNOW AND ICE MANAGEMENT, AND FREEZE PROTECTION (AS NEEDED)

A. Non-MGP Contact Snow: As necessary, throughout the course of the Work, snow shall be plowed and removed to maintain access to the Site, and access roads to and from the Work areas. As required to maintain access, accumulated snow shall be transported to an on-site location approved by the Engineer.

B. MGP Contact Snow: Accumulated MGP contact snow in Remedial Action Areas shall be containerized and managed as in Section 02 72 11 or as approved by the Engineer.

C. Drain, protect, insulate, and temporarily winterize waterlines or any other conveyance lines or storage vessels to prevent freezing and damage.

3.5 STAGING AND STOCKPILING AREAS

A. Subcontractor shall stockpile clean materials in the clean material staging area at a location approved by the Engineer.

B. Stockpiles of non-MGP impacted soil shall not exceed 12 feet in height, unless approved otherwise by the Engineer, and shall be surrounded with a 9-inch high berm at the perimeter. Silt fence or other erosion control measures shall be placed around the perimeter of the stockpile areas.

C. Inactive stockpiles shall be covered, anchored, and inspected with plastic, as approved by Engineer.

3.6 TRACKING PADS

A. Maintain tracking pads and Site entrances, as shown on the Contract Drawings with materials indicated on the Drawings and in Section 31 05 14. Place and compact material to a hard and durable surface with no soft areas.

3.7 TRANSPORTATION ROUTES

A. The transportation routes should avoid residential areas and follow posted trucking routes. All routes, including public roads and site entrance, shall be maintained throughout the duration of the project. Clean public ROWs and streets as needed with commercial street sweepers, or as approved by the Engineer.

3.8 DEMOLITION OF SUBSURFACE FEATURES

A. Subcontractor shall demolish and remove well vaults at existing recovery wells that are to be repurposed as Extraction Wells as part of Phase 1 Area, as indicated on the Contract Drawings. Take care to leave the existing well casing undisturbed for reuse.

B. If MGP residuals are encountered or demolition debris is impacted by residuals, the materials shall be disposed at a Subtitle D landfill as approved by the Engineer. Material will be transported by others, Owner will pay tipping fees for soil and debris disposed at the Subtitle D landfill.

C. Reduce the size of the debris and/or piping to a maximum size of 3 ft in any dimension, as required by the receiving disposal facility, prior to loading.

D. Demolition debris not visually impacted with MGP residuals may be loaded and transported for off-site disposal as construction debris or recycled, as approved by Engineer.

END OF SECTION

SECTION 02 60 00
IMPACTED MATERIALS MANAGEMENT

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Handling, storage, and disposal of impacted materials generated as part of the Work. This Specification addresses the following media;

1. Soil from excavations
2. Treatment plant media waste including: Clarifier sludge, filter bags, and organoclay
3. Recovered Dense Non-Aqueous Phase Liquid (DNAPL) and Light Non-Aqueous Phase Liquid (LNAPL)

B. MGP contact water from groundwater and stormwater is addressed in Section 02 72 11 – MGP Contact Water Management.

1.2 RELATED SECTIONS

A. Section 01 41 00 – Permits and Fees

B. Section 01 55 00 – Mobilization, Demobilization, and Decontamination

C. Section 02 72 11 – MGP Contact Water Management

D. Section 31 20 00 – Earthwork

1.3 EXISTING CONDITIONS

A. Groundwater may contain coal tar and lighter phase oils (DNAPL and LNAPL).

1.4 HEALTH AND SAFETY

A. Handling of all impacted materials should be carried out per the Subcontractor's and Engineer's Health and Safety Plans.

B. Subcontractor shall be and remain liable for compliance by employees, agents, and subsubcontractors with both HASP and procedures for the Site.

1.5 SUBMITTALS

A. In accordance with Section 01 33 00.

B. Provide a copy of all landfill or disposal manifest tickets to the Engineer.

1.6 WORK BY OTHERS

A. Engineer will perform necessary characterization sampling and develop waste profiles for each media.

B. Owner will pay disposal fees and fees for transportation and disposal of any impacted materials.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SOIL MANAGEMENT

A. Soils determined to be clean by the Engineer may be stored on Site per Section 02 01 00 and reused as backfill. All impacted soils will be managed as described below.

B. On-Site Soil Storage: Impacted soils not immediately removed from Site should be stored temporarily on Site on either:

1. An impermeable liner with a minimum 9-inch high berm at the perimeter. Silt fence or other erosion control measures should be placed around the base of the stockpile for soil stored longer-term.
2. Lugger/roll-off boxes with an impermeable liner.
3. Stockpiles and lugger/roll-off boxes should be covered and anchored.

C. Soil Disposal: Coordinate disposal of impacted soils by licensed waste hauler in accordance with local, state, and federal requirements.

1. Impacted soil taken off-site shall be manifested and sent to the landfill chosen by the Engineer.
2. All soil must be removed from Site prior to job completion.

3.2 TREATMENT PLANT WASTE

A. Clarifier Sludge and Filter Bags

1. Clarifier sludge and filter bags will be disposed of under waste profiles approved by landfill and owner.
2. Materials sent from the clarifier to sludge storage will be containerized inside a geotube for dewatering located in a lined roll-off box.
3. Spent filter bags will be containerized and stored on Site until the next sludge roll-off disposal event.
4. Once the sludge storage has reached capacity coordinate disposal to landfill chosen by the Engineer by a licensed waste hauler in accordance with local, state, and federal requirements.
5. Clarifier sludge will be completely dewatered before disposal. Material should meet landfill requirements for dewatered soils.

B. Organoclay

1. Organoclay will be profiled and disposed of separately from other treatment plan waste.
2. Once organoclay can no longer be regenerated, coordinate disposal to landfill chosen by the Engineer by a licensed waste hauler in accordance with local, state, and federal requirements.

3.3 DNAPL AND LNAPL

A. On-Site Storage: DNAPL and LNAPL recovered as part of DNAPL recovery or water treatment will be stored in a container as specified on the Contract Drawings.

B. Disposal: When DNAPL storage container nears capacity, coordinate disposal of materials with the hazardous waste transporter chosen by the Engineer.

3.4 RECORD KEEPING

A. All soil and solid waste removed from Site should be manifested according to state and federal requirements.

3.5 DECONTAMINATION

A. Subcontractor should decontaminate all equipment, containers, etc. at project completion per Section 01 55 00 and properly dispose of residuals.

END OF SECTION

SECTION 02 24 10
MGP CONTACT WATER MANAGEMENT

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Control, handling, and storage of groundwater and surface water derived from excavation, decontamination areas, and stockpiling of soils at the Site, including all other groundwater, surface water, or stormwater contacted with MGP impacted soils from the Work, as directed by the Engineer.

B. Preventing surface water in contact with MGP residuals from flowing off site.

1.2 RELATED SECTIONS

A. Section 02 01 00 – Site Preparation and Maintenance of Existing Conditions

B. Section 31 20 00 – Earthwork

C. Section 31 25 00 – Erosion and Sedimentation Control

1.3 REFERENCES

A. Applicable rules and regulations of Illinois related to construction site dewatering; NPDES requirements under the jurisdiction of the Illinois IEPA, Division of Water Pollution Control

1.4 EXISTING CONDITIONS

A. Depth to groundwater ranges from approximately 6 to 8 feet below ground surface (bgs).

B. Groundwater may contain coal tar and lighter phase oils.

1.5 PERFORMANCE REQUIREMENTS

A. Provide method of control, handling, and conveyance of water from within excavation and areas at the Site by whatever means necessary and in conformance with this Section to obtain satisfactory working conditions and maintain progress of Work.

B. If necessary based on Site conditions, dewatering equipment shall be required to remove water accumulated in excavations. The Subcontractor shall provide all means necessary to convey water to storage.

C. Containerized water for storage and gravity settling. If coal tar or lighter phase MGP residual oils are present, the Subcontractor shall remove the MGP residuals to the extent practical prior to discharging to the storage container.

D. The Subcontractor shall be responsible for decontaminating all frac tanks used for MGP contact water storage.

E. Engineer may provide option for water to stay on Site and be treated at the groundwater treatment plant. The water will be treated and measured to ensure it meets the reinjection permit.

F. Subcontractor shall comply with the applicable local and state rules and regulations for construction site dewatering.

G. Provide adequate backup systems to accomplish control of water.

H. Exercise reasonable means for minimizing production of run-on water into excavations, material management, and stockpile areas to reduce off-site disposal volumes.

1.6 SUBMITTALS

A. In accordance with Section 01 33 00.

B. Submit as part of the Draft Work Plan (Section 01 33 00) a description of proposed MGP Contact Water Control Plan including, but not limited to:

1. Methods, equipment, and power supply.
2. Construction details of typical dewatering sumps and conveyance facilities, if necessary.
3. Methods of controlling fines and turbidity.

C. If changes occur prior to construction, submittal shall be revised no later than five days prior to start of construction or installation of water control systems.

1.7 WORK BY OTHERS

A. Engineer will obtain necessary stormwater and injection permits.

B. Engineer will perform compliance monitoring.

C. Engineer will perform water treatment on contact water, if water is approved to remain on site to be treated.

D. Owner will pay water disposal fees and fees for transportation and disposal of any MGP residuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pumping, conveyance, and temporary sump equipment and materials are to be selected by Subcontractor to accomplish Work of this Section.

2.2 PUMPING EQUIPMENT

A. Use equipment specifically applicable to dewatering work.

B. Equipment shall be operated and maintained in an efficient manner to produce acceptable results.

C. The Subcontractor shall have on hand at all times sufficient pumping equipment and machinery in good working condition for all ordinary emergencies, and shall have available at all times competent workmen for the operation of the pumping equipment.

PART 3 - EXECUTION

3.1 GENERAL WATER CONTROL IN EXCAVATION

A. Use water control methods appropriate to ground conditions, construction operations, and requirements of these documents.

B. Methods shall involve removal of water within excavation using temporary sumps or other appropriate means for collecting and controlling water within the excavation.

C. Preparation and procedures shall be in place to take immediate steps to control large amounts of water inflow into excavation. A large amount of inflow requiring immediate control shall be defined as that which adversely affects the performance of Work or that having the potential for causing loss or damage to adjacent property or structures.

D. Temporary dewatering sumps shall be constructed and operated to minimize generation of high total suspended solids and prevent infiltration of fines from adjacent soil into pumped water.

3.2 SURFACE DRAINAGE

A. Prevent any and all discharge of Site runoff.

3.3 WATER STORAGE AND TREATMENT

A. Subcontractor shall be responsible for containerizing all MGP contact water.

B. At completion of project, contact water shall either be disposed of off-site, or with the approval of the Engineer, remain on Site until the water treatment plant is brought on line and treated on-site.

C. Water that remains on Site and is treated through the groundwater treatment system will be reinjected into the aquifer as part of the Remedial Action.

END OF SECTION

SECTION 03 41 00
PRECAST CONCRETE STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes precast concrete groundwater valve vaults of the type scheduled and as shown on the Drawings. Structures shall consist of the combination of base and riser sections resulting in the fewest number of joints. The interior and exterior surfaces of these structures, including the underside of the base section and the riser section joints, shall be coated and lined as specified herein.

1.2 REFERENCES

A. Materials and installation shall be in accordance with the latest revisions of the following codes, standards and specifications, except where more stringent requirements have been specified herein:

1. American Society for Testing and Materials (ASTM)
2. American Association of State Highway Transportation Officials (AASHTO)
3. American Concrete Institute (ACI)

B. Pre-cast concrete shall conform to the "Structural Precast Concrete" Specification.

PART 2 - PRODUCTS

2.1 MATERIALS AND CONSTRUCTION

A. Structures

1. Concrete structures and slabs shall be constructed in accordance with the "Structural Precast Concrete" specification. Joints shall be sealed with ConSeal CS-231 as manufactured by ConSeal Concrete Sealants, Inc., or engineer-reviewed equivalent. Storage, surface preparation, and application shall comply with manufacturer's recommendations.
2. Base sections of the structures shall have reinforced flat bottoms protruding 6 inches beyond the outside face of the riser section. The flat bottoms shall be minimum of 8-inch thickness.
3. Top sections, tapered or flat, shall be adequate to withstand H-20 wheel loads. Top sections shall have concentric or eccentric opening as specified or shown for the type of structure. The edge of eccentric openings for flat top sections shall be a maximum of 2 inches from the inside wall of the section.

B. Coatings

1. All internal and external surfaces of concrete structures shall be coated with a solvent-free, 100% solids, cold-applied waterproofing compound which forms an elastomeric rubber waterproof seal resistant to thermal shock. Coating shall be ConSeal CS-1800 as manufactured by ConSeal Concrete Sealants, Inc. or engineer-reviewed equivalent. The coating system shall be capable of curing properly given the project site conditions and temperatures within 24 hours. Storage, surface preparation, and application shall comply with manufacturer's recommendations.

2. Pre-Application
    a. Examine surfaces to be coated and report any conditions that would adversely affect the appearance or performance of the coating systems, and which cannot be put into an acceptable condition by the preparatory work specified or recommended by coating manufacturer.
    b. Ensure that moisture content of surfaces is within manufacturer's recommendations and that other manufacturer-required environmental conditions are maintained throughout the surface preparation, coating and curing process.
3. Surface Preparation
    a. Comply with manufacturer's recommendations.
    b. Remove dust and loose material by dusting, sweeping, vacuuming, or blowing with high-pressure air.
    c. Remove oil, wax, and grease in accordance with the manufacturer's recommendations.
    d. Verify that all surfaces to be coated are dry (to the extent required), clean, and free from dirt, dust, wax, grease, or other contaminants.
    e. Patch holes and cracks in the concrete flush with the surface using coating manufacturer's recommended grout/repair materials.
    f. Clean joints and prepare substrate as specified by the manufacturer technical requirements.
    g. Concrete surfaces to receive coating shall be cleaned and abraded/scarified using mechanical means to produce a sound surface with adequate profile and porosity to an ICRI CSP 2-5, in accordance to SSPC-SP 13/NACE No.6 "Surface Preparation of Concrete," to provide a strong bond between the coating and the substrate.
4. Submittals -- The following submittals shall be provided:
    a. Manufacturer's descriptive data fully describing each product, including solids by volume and volatile organic compound (VOC) content.
    b. Manufacturer's application instructions, surface preparation and installation information
    c. If alternate products are proposed, appropriate ASTM testing results, as identified by the Engineer, shall be submitted for review.
    d. Safety Data Sheets (SDS) for each product proposed that includes recommendations on handling and storage.
    e. Chemical resistance information.
    f. Satisfactory evidence that the Contractor and/or any lower tier Subcontractors have not less than five years of experience in the installation of similar coating systems and are trained and specialized in grouting/sealing active leak repair, surface preparation and application.
5. Prior to installation, pipe anchors, supports and other carbon steel components, fasteners and hardware (other than roof hatches) shall be coated with manufacturer's standard corrosion resistant coating system.
6. All materials shall remain in their original containers with manufacturer's label intact.
7. OSHA Confined space entry training will be required for all workers working in confined spaces.
8. OSHA 40-hour HAZWOPER training with current annual refresher will be required for all workers entering the site.

C. Frames and Covers
   1. Access hatches for wells and valve vaults shall be of the material type and size as scheduled, with factory installed fiberglass fall protection safety grating under each door, as manufactured by Bilco, or equal.
   2. Access hatch cover shall be constructed of material type scheduled with diamond pattern plate and reinforced for a H-20 loading. Frame shall be 316 stainless steel. Non-gasketed access hatch shall include material type scheduled hinges with stainless steel pins, 316 stainless steel latch, 316 SS compression spring operators, automatic hold open arms and other hardware, 316 stainless steel drain coupling to be provided.
   3. Fall protection grating shall be vinyl ester resin fiberglass frame and grating panels and 316 stainless steel hardware rated for 300 psf live load. Fall protection grating panels shall operate independently of the access covers, and be equipped with material type scheduled lift assistance, automatic hold open arms, and hardware.
   4. Access hatch and frame and safety grating shall be installed in accordance with manufacturer recommendations.

D. Vault Ladder
   1. Structure access ladders are not required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Precast concrete structures shall be installed level on a flat stable subgrade in accordance with the Specification entitled "Structural Excavation and Fill".

B. See Part 2.1A of this section for coating requirements prior to backfilling.

3.2 FIELD TESTING

A. Perform leakage tests in accordance with the applicable provisions of the Section entitled "Leakage Tests".

END OF SECTION

SECTION 31 01 01
EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes excavation and backfilling including the loosening, removing, refilling, transporting, storage and disposal of all materials classified as "earth" necessary to be removed for the construction and completion of all work under the Contract, and as shown on the Contract Drawings, specified or directed.

B. Where certain features related to Earthwork are shown on the Contract Drawings, the Subcontractor shall be entirely responsible for final sequencing, scheduling, coordinating and planning the actual areas and their implementation in accordance with all laws and property ownership. These may include storage and staging areas, temporary stock pile areas, vehicle parking areas, temporary haul roads for construction ingress and egress, and other similar zones and land uses

1.2 REFERENCES

A. Comply with the latest revision of the following codes, standards and specifications, except where more stringent requirements have been specified herein:

1. American Society for Testing and Materials (ASTM)
   a. A328 Specification for Steel Sheet Piling
   b. D1556 Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
   c. D1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3) (2,700 kN-m/m^3)
   d. D1760 Specification for Pressure Treatment of Timber Products
   e. D6398 Test Methods for Density of soil and Soil-aggregate in Place by Nuclear Methods (Shallow Depth)

1.3 DEFINITIONS

A. Excavation (including Trenching)

1. Grubbing, stripping, removing, storing and re-handling of all materials of every name and nature necessary to be removed for all purposes incidental to the construction and completion of all the work under construction.
2. All sheeting, sheet piling, bracing and shoring, and the placing, driving, cutting off and removing of the same.
3. All diking, ditching, fluming, coffer-damming, pumping, bailing, draining, well pointing, or otherwise disposing of water.
4. The removing and disposing of all surplus materials from the excavations in the manner specified.
5. The maintenance, accommodation and protection of traffic and pedestrian travel and the temporary paving of highways, roads and driveways.
6. The supporting and protecting of all tracks, rails, buildings, curbs, sidewalks, pavements, overhead wires, poles, trees, vines, shrubbery, pipes, sewers, conduits or other structures or property in the vicinity of the work, whether over or underground or which appear within or adjacent to the excavations, and the restoration of the same in case of settlement or other injury.

7. All temporary bridging and fencing and the removing of same

B. Earth

1. All materials such as sand, gravel, clay, loam, ashes, cinders, pavements, muck, roots or pieces of timber, soft or disintegrated rock, not requiring blasting, barring, or wedging from their original beds, and specifically excluding all ledge or bedrock and individual

C. Backfill

1. The refilling of excavation and trenches to the line of filling indicated on the Contract Drawings or as directed using materials suitable for refilling of excavations and trenches; and the compacting of all materials used in filling or refilling by rolling, ramming, watering, puddling, etc., as may be required.

D. Spoil

1. Surplus excavated materials not required or not suitable for backfills or embankments.

E. Embankments

1. Fills constructed above the original surface of the ground or such other elevation as specified or directed.

F. Limiting Subgrade

1. The underside of the pipe barrel for pipelines
2. The underside of footing lines for structures

G. Excavation Below Subgrade

1. Excavation below the limiting subgrades of structures or pipelines.
2. Where materials encountered at the limiting subgrades are not suitable for proper support of structures or pipelines, the Subcontractor shall excavate to such new lines and grades as required.

1.4 COORDINATION REQUIREMENTS

A. Coordinate layout and installation of all Contract work with earthwork activities and space requirements.

1.5 SUBMITTALS

A. Sheeting and bracing drawings stamped and signed by a Professional Engineer licensed in the State of Illinois, if sheeting and bracing is required.

B. A written Control of Water Management Plan, if removal of water is required.

C. A representative list of satisfactory similar operations, including contact names and telephone numbers, if well point dewatering is required.

PART 2 - PRODUCTS

2.1 WOOD SHEETING AND BRACING

A. Wood sheeting and bracing shall be sound and straight; free from cracks, shakes and large or loose knots; and shall have dressed edges where directed.

B. It shall conform to National Design Specifications for Stress Grade Lumber having a minimum fiber stress of 1200 pounds per square inch.

C. Sheeting and bracing to be left in place shall be reviewed by the Engineer before installation. Sheeting and bracing to be left in place shall be pressure treated in accordance with ASTM D1760 for the type of lumber used and with a preservative approved by the Engineer.

2.2 STEEL SHEETING AND BRACING

A. Steel sheeting and bracing shall be sound.

B. It shall conform to ASTM A328 with a minimum thickness of 3/8 inch.

PART 3 - EXECUTION

3.1 UNAUTHORIZED EXCAVATION

A. Whenever excavations are carried beyond or below the lines and grades shown on the Contract Drawings, or as given or directed by the Engineer, all such excavated space shall be refilled with select fill, controlled low strength material, concrete or other materials as the Engineer may direct.

B. All material which slides, falls or caves into the established limits of excavations due to any cause whatsoever, shall be removed and disposed of and void areas filled in with appropriate select fill

3.2 CONTROL OF WATER

A. General

1. Maintain proper and satisfactory means and devices for the control and removal of all water entering the excavations, and shall remove all such water as fast as it may collect, in such manner as shall not interfere with the prosecution of the work or the proper placing of pipes, structures, or other work.
2. Unless otherwise specified, all excavations which extend down to or below the static groundwater elevations shall be de-watered by lowering and maintaining the groundwater beneath such excavations at all times when work thereon is in progress, during subgrade preparation and the placing of the structure or pipe thereon.
3. Water shall not be allowed to rise over or come in contact with any masonry, concrete or mortar, until at least 24 hours after placement, and no stream of water shall be allowed to flow over such work until such time as the Engineer may permit.
4. Where the presence of fine grained subsurface materials and a high groundwater table may cause the upward flow of water into the excavation with a resulting quick or unstable condition, the subcontractor shall install and operate a well point system to prevent the upward flow of water during construction.
5. Water pumped or drained from excavations, or any sewers, drains or water courses encountered in the work, shall be disposed of in a suitable manner without injury to adjacent property, the work under construction, or to pavements, roads, drives, and water courses. No water shall be discharged to sanitary sewers. Sanitary sewage shall be pumped to sanitary sewers or shall be disposed of by an reviewed method.

6. All dewatering activities shall be conducted in accordance with laws and permits. All such discharges shall be controlled and pre-treated as necessary.
7. Any damage caused by or resulting from dewatering operations shall be the sole responsibility of the Subcontractor.

B. Work Included

1. Preparation and submittal of a written "Control of Water Management Plan" to manage and control dewatering activities.
2. The construction and removal of cofferdams, sheeting and bracing, and the furnishing of materials and labor necessary thereof.
3. The excavation and maintenance of ditches and sluiceways.
4. The furnishing and operation of pumps, well points, and appliances needed to maintain control of water related to the work in a satisfactory manner.
5. The installation and removal of temporary sediment and discharge control devices.

C. Well Point Dewatering Systems

1. Installation
   a. The well point system shall be designed and installed by or under the supervision of an organization whose principal business is well pointing and which has at least five consecutive years of similar experience and can furnish a representative list of satisfactory similar operations, including contact names and telephone numbers.
   b. Well point headers, points and other pertinent equipment shall not be placed within the limits of the excavation in such a manner or location as to interfere with the laying of pipe or trenching operations or with the excavation and construction of other structures.
   c. Detached observation wells of similar construction to the well points shall be installed at intervals of not less than 50 feet along the opposite side of the excavation from the header pipe and line of well points, to a depth of at least 5 feet below the proposed excavation. In addition, one well point in every 50 feet shall be fitted with a tee, plug and valve so that the well point can be converted for use as an observation well. Observation wells shall be not less than 1 inches in diameter.
   d. Standby gasoline or diesel-powered equipment shall be provided so that in the event of failure of the operating equipment, the standby equipment can be readily connected to the system. The standby equipment shall be maintained in good order and actuated regularly not less than twice a week.
2. Operation
   a. Where well points are used, the groundwater shall be lowered and maintained continuously (day and night) at a level not less than 2 feet below the bottom of the excavation. Excavation will not be permitted at a level lower than 2 feet above the water level as indicated by the observation wells.
   b. The effluent pumped from the well points shall be examined periodically by qualified personnel to determine if the system is operating satisfactorily without the removal of fines.
   c. The water level shall not be permitted to rise until construction in the immediate area is completed and the excavation backfilled.

3.3 STORAGE OF MATERIALS

A. Topsoil

1. Topsoil suitable for final grading shall be removed and stored separately from other excavated material.
2. Control erosion run-off from stockpiles by installing silt fencing. Maintain silt fence during construction and remove upon completion of work.

B. Excavated Materials

1. All excavated materials shall be stored in locations so as not to endanger the work, and so that easy access may be had at all times to all parts of the excavation. Stored materials shall be kept neatly piled and trimmed, so as to mitigate impact to public travel and to adjoining property owners.
2. Special precautions shall be taken to permit access at all times to fire hydrants, fire alarm boxes, police and fire department driveways, and other points where access may involve the safety and welfare of the general public.
3. Details regarding temporary staging and material characterization shall be detailed in the "Subcontractors Work Plan."

3.4 DISPOSAL OF MATERIALS

A. Spoil Material

1. Spoil material shall be transported, staged, characterized, and managed in accordance with the 02 60 00 – Contaminated Site Material Removal. Characterization sampling will be performed by the Engineer.

3.5 SHEETING AND BRACING

A. Installation

1. The Subcontractor shall furnish, place and maintain such sheeting, bracing and shoring as may be required to support the sides and ends of excavations in such manner as to prevent any movement which could, in any way, injure the pipe, structures, or other work; diminish the width necessary for construction; otherwise damage or delay the work of the Contract; endanger existing structures, pipes or pavements; or cause the excavation limits to exceed the right-of-way limits.
2. In no case will bracing be permitted against pipes or structures in trenches or other excavations.
3. Sheeting shall be driven as the excavation progresses, and in such manner as to maintain pressure against the original ground at all times. The sheeting shall be driven vertically with the edges tight together, and all bracing shall be of such design and strength as to maintain the sheeting in its proper position. Seepage that carries fines through the sheeting shall be plugged to retain the fines.
4. Where breast boards are used between soldier pile, the boards shall be back packed with soil to maintain support.
5. The Subcontractor shall be solely responsible for the adequacy of all sheeting and bracing.

B. Removal

1. In general, all sheeting and bracing, whether of steel, wood or other material, used to support the sides of trenches or other open excavations, shall be withdrawn as the trenches or other open excavations are being refilled. That portion of the sheeting extending below the top of a pipe or structural foundation shall not be withdrawn, unless otherwise directed, before more than 6 inches of earth is placed above the top of the pipe or structural foundation and before any bracing is removed. The voids left by the sheeting shall be carefully refilled with selected

material and rammed tight with tools especially adapted for the purpose or otherwise as may be approved.

2. The Subcontractor shall not remove sheeting and bracing until the work has attained the necessary strength to permit placing of backfill.

C. Left in Place

1. If, to serve any purpose of his own, the Subcontractor files a written request for permission to leave sheeting or bracing in the trench or excavation, the Engineer may grant such permission, in writing, on condition that the cost of such sheeting and bracing be assumed and paid by the Subcontractor.
2. The Subcontractor shall leave in place all sheeting, shoring and bracing which are shown on the Contract Drawings or specified to be left in place or which the Engineer may order, in writing, to be left in place.
3. In the case sheeting is left in place, it shall be cut off or driven down as directed so that no portion of the same shall remain within 12 inches of the subgrade or finished ground surface.

3.6 BACKFILLING

A. General

1. All excavations shall be backfilled to the original surface of the ground or to such other grades as may be shown, specified or directed.
2. Backfilling shall be done with suitable excavated materials that can be satisfactorily compacted during refilling of the excavation. In the event the excavated materials are not suitable, Select Fill as specified or ordered by the Engineer shall be used for backfilling.
3. Any settlement occurring in the backfilled excavations shall be refilled and compacted

B. Unsuitable Materials

1. Stones and pieces of rock greater than six inches in any single dimension shall not be used in any portion of the backfill.
2. All stones and pieces of rock shall be distributed through the backfill and alternated with earth backfill in such a manner that all interstices between them shall be filled with earth.
3. Stone and pieces of rock greater than 1.5-inches in any single dimension shall not be used in the initial backfill (centerline of pipe to 12-inches above the top of pipe).
4. Pieces of pavement, frozen earth, or other miscellaneous debris shall not be allowed in any part of the backfill.

C. Compaction and Density Control

1. The compaction shall be as specified for the type of earthwork, i.e., structural, trenching or embankment.
   a. The compaction specified shall be the percent of maximum dry density.
   b. The compaction equipment shall be suitable for the material encountered.
2. Where required, to assure adequate compaction, in-place density test shall at the expense of the Subcontractor be made by an acceptable testing laboratory.
   a. The moisture-density relationship of the backfill material shall be determined by ASTM D1557.
      1) Compaction curves for the full range of materials used shall be developed.

b. In-place density shall be determined by the methods of ASTM D1556 or ASTM D6398 and shall be expressed as a percentage of maximum dry density.

3. Where required, to obtain the optimum moisture content add sufficient water during compaction to assure the specified maximum density of the backfill. If, due to rain or other causes, the material exceeds the optimum moisture content, it shall be allowed to dry, assisted if necessary, before resuming compaction or filling efforts.

3.7 OTHER REQUIREMENTS

A. Drainage

1. All material deposited in roadway ditches or other water courses shall be removed immediately after backfilling is completed and the section, grades and contours of such ditches or water courses restored to their original condition, in order that surface drainage will be obstructed no longer than necessary.

B. Unfinished Work

1. When, for any reason, the work is to be left unfinished, all trenches and excavations shall be filled and all roadways, sidewalks and watercourses left unobstructed with their surfaces in a safe and satisfactory condition. The surface of all roadways and sidewalks shall have a temporary pavement.

C. Hauling Material over Public Roads and Streets

1. When it is necessary to haul material over public streets or pavements, provide suitable, tight vehicles so as to prevent deposits on the streets or pavements shall be used. In all cases where any materials are dropped from the vehicles, clean up the same as often as required to keep the crosswalks, streets and pavements clean and free from dirt, mud, stone and other hauled material.

D. Dust Control

1. Calcium chloride and petroleum products shall not to be used for dust control.

E. Test Pits

1. For the purpose of obtaining detail locations of under-ground obstructions, make excavations in advance of the work.

END OF SECTION

SECTION 31 05 14
SELECT FILL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes select fill materials used as either embedment or special backfill, as specified, as directed by the Owner's Representative, or as shown on the Contract Drawings.

1.2 REFERENCES

A. Materials and installation shall comply with the latest revision of the following codes, standards and specifications, except where more stringent requirements have been specified herein:

1. American Society for Testing and Materials (ASTM)
   a. D422 - Method for Particle-Size Analysis of Soil
2. Illinois Department of Transportation (IDOT), Standard Specifications for Road and Bridge Construction, current edition.

1.3 SUBMITTALS

A. Submit the following as specified in the CQAP:

1. The name and location of the source of each material.

1.4 DEFINITIONS

A. Embedment or Lining

1. Any type granular material specified or directed to be placed below an imaginary line drawn one foot above the inside diameter of the pipe crown and within the trench limits.

B. Special Backfill

1. Pipelines
   a. Any select fill material specified or directed to be placed above an imaginary line drawn one foot above the inside diameter of the pipe crown and within the trench limits.
2. Structures
   a. Any select fill material specified or directed to be placed within the excavation limits, either in, under or adjacent to the structure.

C. Special Granular Material

1. Special granular material shall mean any of the granular materials listed below or other materials ordered by the Owner.
2. Any type granular material specified or directed to be placed below an imaginary line drawn one foot above the inside diameter of the pipe crown and within the trench limits.

1.5 MATERIALS TESTING

A. The Engineer shall perform Select Fill testing as specified in the CQAP.

1. Subcontractors will be permitted to procure Select Fill from sources accepted by the Engineer per said testing.

PART 2 - PRODUCTS

2.1 SELECT FILL MATERIALS

A. Type A Select Fill

1. Crushed Gravel
   a. Thoroughly washed crushed, durable, sharp angled fragments of gravel free from coatings. Crushed particles shall be a minimum of 85% by weight of the particles with at least two fractured faces. The total area of each fractional face shall exceed 25% of the maximum cross-sectional area of the particle.
   b. Crushed Gravel shall have the following gradation by weight:

% PASSING	SIEVE
100	1½-inch
0-25	¾-inch
0-5	½-inch

B. Type B Select Fill

1. Crushed Stone
   a. Thoroughly washed clean, sound, tough, hard crushed limestone or equal free from coatings. Gradation for crushed stone shall be the same as specified for Type A Select Fill.

C. Type C Select Fill (IDOT CA-1 or similar)

1. Crushed Stone
   a. Thoroughly washed, clean, sound, tough, hard, crushed limestone or equal free from coatings. It shall have the following gradation by weight.

% PASSING	SIEVE
100	1-1/2-inch
90-100	1-inch
0-15	1/4-inch

D. Type D Select Fill (IDOT FA-2 or similar)

1. Washed Sand
   a. Washed coarse sand having the following gradation by weight:

% PASSING	SIEVE
100	3/8-inch

% PASSING	SIEVE
95–100	No. 4
80–100	No. 8
50-85	No. 16
25–60	No. 30
10–30	No. 50
0–10	No. 100

E. Type E Select Fill

1. Run-of-Bank Gravel

a. Run-of-bank gravel or other acceptable granular material free from organic matter with the following gradation by weight, as determined by washing through the sieve in accordance with ASTM D422.

% PASSING	SIEVE
100	1½-inch
30–65	¼-inch
0–10	No. 200

F. Type F Select Fill (IDOT CA-6 or similar)

1. Run-of-crusher Stone

a. Run-of-crusher hard durable limestone, or equal, having the following gradation by weight:

% PASSING	SIEVE
100	2- inch
30–65	¼-inch
5-40	No. 40
0–10	No. 200

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install special granular material for pipeline embedment in accordance with the Section entitled "Pipeline Installation" as specified or directed.

B. Install special backfill in accordance with the backfilling provisions of the Section entitled "Excavation and Fill", "Structural Excavation and Fill", and the Section entitled "Earthwork", where specified or directed.

3.2 SETTLEMENTS

A. Settlements in the finished work shall be repaired to establish the proposed or existing grade, as the case may be.

END OF SECTION

SECTION 31 11 00
CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section covers the clearing of an area as shown on the Contract Drawings or as required by the Work. The Subcontractor shall coordinate with the Engineer to determine the extent of removals and clearing to be performed.

1.2 PROTECTION

A. The Subcontractor shall maintain and protect all bench marks, monuments, and reference points. If the bench marks, monuments, or reference points are disturbed or destroyed, they shall be replaced to the satisfaction of the Owners Representative, at the Subcontractor 's expense.

B. The Subcontractor shall protect and barricade, where necessary, existing trees, shrubs, drainage swales, pavement, and other features outside the work limits from damage due to this construction.

C. The Subcontractor shall protect and barricade, where necessary, those features inside the work limits that are designated for special protection by the Contract Drawings.

D. The Subcontractor shall protect existing trees and other vegatation indicated to remain in place against unnecesary cutting, breaking, or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling of materials within dripline.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. 31 25 00 Erosion and Sediment Control

B. 32 01 00 Restoration of Surfaces

1.4 REGULATORY AGENCIES

A. State and local requirements shall govern the disposal of materials from all clearing operations.

B. The Subcontractor is prohibited from burning on or off the job site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. None Required.

PART 3 - EXECUTION

3.1 SITE CLEARING

A. The limits of clearing shall be as indicated on the Contract Drawings. The Subcontractor

shall verify these limits with the Engineer in the field prior to the start of work.

B. All trees regardless of caliper and brush shall be cut and/or removed unless specifically directed to remain within clearing limits. All trees shall be cut 6" above grade, all stumps are to be left in place except those required to be removed to suit excavation requirements.

C. No stump removal outside of earthwork areas is required.

D. Trees and other miscellaneous features damaged or removed during the performance of the Work that are not designated for removal shall be replaced by the Subcontractor to the satisfaction of the Engineer at no cost to the Owner.

3.2 GRUBBING

A. The limits of grubbing shall coincide with the clearing limits as shown on the Contract Drawings.

B. The Subcontractor shall remove and dispose of all stumps, including roots and matted roots, to suit excavation requirements only. The removal shall be to a depth not less than 18 inches below original ground level, as required. Unless further excavation is required, depressions made by grubbing shall be filled and compacted with common earth to the density of the surrounding soil such that the surface conforms to the contour of the adjacent ground.

C. All stumps shall be completely removed when located within the limits of the access drive, pipe trenches, and within ten (10) feet of the footprint of the dewatering pad and other structures.

D. Topsoil shall be removed to its full depth, stockpiled separately from other excavated materials, and preserved for reuse.

E. The Subcontractor shall provide silt fence as shown to control water-borne sediments.

3.3 TRIMMING

A. None Required.

3.4 REMOVALS

A. Cleared trees, branches, and brush may be chipped/shredded and used as mulch or left on-site in a separate stockpile area to be designated by the Engineer.

B. All other cleared and grubbed material shall be disposed of off-site to an approved location by the Subcontractor .

3.5 DISPOSAL

A. All timber and other material not suitable for chipping/shredding resulting from clearing operations shall be removed from the site and legally disposed.

B. The materials to be removed from the site shall be removed daily as it accumulates.

C. Burning of waste materials is prohibited both on-site and off-site.

D. The Subcontractor shall obtain all required permits for off-site disposal and submit copy of permit(s) to the Owner. Unless indicated otherwise, legally dispose of material removed during clearing to an off site location.

E. Solvents, oils, and other materials used in the course of the Work which may be harmful to the environment shall be properly disposed of in appropriate containers and removed from

the site. Any soils contaminated by the Subcontractor 's operation shall be removed and replaced with topsoil at the Subcontractor 's expense. Such materials and contaminated soils shall be disposed of in accordance with state and local requirements.

Consistent with the Enginer's Spill Prevention, Control, and Countermeasure Plan, any person with the knowledge of a leak or spill must report it immediately to the Engineer.

END OF SECTION

SECTION 31 23 00
EXCAVATION AND FILL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes excavation and backfill as required for pipe installation or other construction in the excavation or trench, and removal and disposal of water, in accordance with the applicable provisions of the Section entitled "Earthwork" unless modified herein, or as shown on the Contract Drawings.

B. Traffic shall be maintained at all times.

1.2 SUBMITTALS

A. None.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXCAVATION

A. The trench excavation shall be located as shown on the Contract Drawings or as specified. Under ordinary conditions, excavation shall be by open cut from the ground surface. Where the depth of trench and soil conditions permit, tunneling may be required beneath cross walks, curbs, gutters, pavements, trees, driveways, railroad tracks and other surface structures. No additional compensation will be allowed for such tunneling over the price bid for open cut excavation of equivalent depths below the ground surface unless such tunnel excavation is specifically provided for in the Contract Documents.

B. Trenches shall be excavated to maintain the depths as shown on the Contract Drawings or as specified for the type of pipe to be installed.

C. The alignment and depth shall be determined and maintained by the use of a string line installed on batter boards above the trench, a double string line installed along side of the trench or a laser beam system.

D. The minimum width of trench excavation shall be 6 inches on each side of the pipe hub for 21-inch diameter pipe and smaller and 12 inches on each side of the pipe hub for 24-inch diameter pipe and larger.

E. Trenches shall not be opened for more than 300 feet in advance of pipe installation nor left unfilled for more than 100 feet in the rear of the installed pipe when work is in progress without the consent of the Engineer. Open trenches shall be protected and barricaded as required.

F. Bridging across open trenches shall be constructed and maintained where required.

3.2 SUBGRADE PREPARATION FOR PIPE

A. Where pipe is to be laid on undisturbed bottom of excavated trench, mechanical excavation shall not extend lower than the finished subgrade elevation at any point.

B. Where pipe is to be laid on special granular material the excavation below subgrade shall be to the depth specified or directed. The excavation below subgrade shall be refilled with special granular material as specified or directed, shall be deposited in layers not to exceed 6 inches and shall be thoroughly compacted prior to the preparation of pipe subgrade.

C. The subgrade shall be prepared by shaping with hand tools to the contour of the pipe barrel to allow for uniform and continuous bearing and support on solid undisturbed ground or embedment for the entire length of the pipe.

D. Pipe subgrade preparation shall be performed immediately prior to installing the pipe in the trench. Where bell holes are required they shall be made after the subgrade preparation is complete and shall be only of sufficient length to prevent any part of the bell from becoming in contact with the trench bottom and allowing space for joint assembly.

3.3 STORAGE OF MATERIALS

A. Where conditions do not permit storage of materials adjacent to the trench, the material excavated from a length as may be required, shall be removed by the Subcontractor, at his cost and expense, as soon as excavated. The excess material shall be removed to locations selected and obtained by the Subcontractor.

1. The Subcontractor shall, at his cost and expense, bring back adequate amounts of satisfactory excavated materials as may be required to properly refill the trenches.
2. If directed by the Engineer, the Subcontractor shall refill trenches with Select Fill or other suitable materials and excess excavated materials shall be disposed of as spoil.

3.4 REMOVAL OF WATER AND DRAINAGE

A. The Subcontractor shall at all times provide and maintain proper and satisfactory means and devices for the removal of all water entering the trench, and shall remove all such water as fast as it may collect, in such manner as shall not interfere with the prosecution of the work.

B. The removal of water shall be in accordance with the Section entitled "Earthwork".

3.5 PIPE EMBEDMENT

A. All pipe shall be protected from lateral displacement and possible damage resulting from superimposed backfill loads, impact or unbalanced loading during backfilling operations by being adequately embedded in suitable pipe embedment material. To ensure adequate lateral and vertical stability of the installed pipe during pipe jointing and embedment operations, a sufficient amount of the pipe embedment material to hold the pipe in rigid alignment shall be uniformly deposited and thoroughly compacted on each side of each pipe as laid.

B. Embedment materials placed above the centerline of the pipe or above the concrete cradle to a depth of 12 inches above the top of the pipe barrel shall be deposited in such manner as to not damage the pipe. Compaction shall be as required for the type of embedment being installed.

3.6 BACKFILL ABOVE EMBEDMENT

A. The remaining portion of the pipe trench above the embedment shall be refilled with suitable materials compacted as specified.

1. The trench shall be refilled in horizontal layers not more than 8 inches in thickness, and compacted to obtain 95% maximum density, and determined as set forth in the Section entitled "Earthwork".
2. Where trenches are in open fields or unimproved areas outside of the ditch limits of roads, the trench shall be refilled in horizontal layers not more than 8 inches in thickness, and compacted to obtain 90% maximum density, and determined as set forth in the Section entitled "Earthwork".
3. Hand tamping shall be required around buried utility lines or other subsurface features that could be damaged by mechanical compaction equipment.

B. Backfilling of trenches beneath, across or adjacent to drainage ditches and water courses shall be done in such a manner that water will not accumulate in unfilled or partially filled trenches and the backfill shall be protected from surface erosion by adequate means.

1. Where trenches cross waterways, the backfill surface exposed on the bottom and slopes thereof shall be protected by means of stone or concrete rip-rap or pavement.

C. All settlement of the backfill shall be refilled and compacted as it occurs.

D. Surfaces shall be restored as specified or directed.

END OF SECTION

SECTION 31 23 01
STRUCTURAL EXCAVATION AND FILL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes excavation, backfill and compaction as required for the construction of structures in accordance with the applicable provisions of the Section entitled "Earthwork" unless modified herein, or as shown on the Contract Drawings.

1.2 REFERENCES

A. Comply with the latest revision of the following codes, standards and specifications, except where more stringent requirements have been specified herein:

1. Refer to the Section entitled “Earthwork”.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 LIMITS OF EXCAVATION

A. Excavations shall be made to the elevations or subgrades specified and shall be only of sufficient size to allow suitable room for the proper construction of structures and appurtenances, including allowances for sheeting, de-watering, and other similar work necessary for completion of the Contract.

B. Normal subgrade for structures shall be the underside of footing lines or mud mats, if installed.

C. In no case will undercutting excavation faces be permitted.

3.2 SUBSURFACE REINFORCEMENT

A. Where an unstable subgrade is encountered and subject to the discretion of the Engineer, Select Fill may be used for subgrade reinforcement if satisfactory results can be obtained thereby. Such material shall be applied in thin layers, each layer being entirely embedded in the subsoil by thorough tamping.

B. All excess material shall be removed to compensate for the displacement by the Select Fill and the finished elevation shall not be above the specified subgrade.

C. Where subgrade reinforcement is unsatisfactory, a concrete mud mat of sufficient thickness to withstand subsequent construction operations shall be installed below the specified elevation and the structural concrete deposited thereon.

3.3 SUBSURFACE

A. Subsurface for all concrete structures shall be undisturbed original earth or, mud mat on undisturbed original earth, or where excavation below subgrade is ordered, it shall be

thoroughly compacted special backfill or concrete mudmat as specified or directed and shall be sufficiently stable to remain firm and intact during the preparation for the placing of concrete, structure or pipe thereon.

3.4 REMOVAL OF WATER

A. The Subcontractor shall at all times provide and maintain proper and satisfactory means and devices for the removal of all water entering the excavations, and shall remove all such water as fast as it may collect, in such manner as shall not interfere with the prosecution of the work or the proper placing of pipes, structures, or other work.

B. The removal of water shall be in accordance with the Section entitled "Earthwork".

3.5 BACKFILLING

A. Backfilling shall be with suitable excavated materials which can be compacted as specified. In the event the excavated materials are not suitable, Select Fill as specified or ordered by the Engineer shall be used for backfilling.

B. Backfilling around structures shall not be commenced before the structure has developed sufficient strength to withstand the loads applied. No backfill material shall be allowed to fall directly on a structure, until at least 12 inches of material has been hand-placed and compacted nor shall any material be pushed directly against a structure in backfilling.

C. Backfill shall be deposited in horizontal layers and at no greater thickness than can be compacted to obtain the specified minimum densities.

3.6 COMPACTION

A. Backfill shall be compacted to obtain 95% maximum density.

B. The density shall be determined as set forth in the Section entitled "Earthwork".

END OF SECTION

SECTION 31 25 00
EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Erosion control measures necessary to prevent runoff, tracking, or loss of soil materials by water or mechanical action from areas at the Site.
2. Erosion and sedimentation control measures used to prevent erosion during and after construction.

1.2 RELATED SECTIONS

A. Section 02 01 00 – Site Preparation and Maintenance of Existing Conditions

B. Section 02 72 11 – MGP Contact Water Management

C. Section 31 20 00 – Earthwork

D. Section 32 91 15 – Topsoil, Seeding, and Site Restoration

1.3 REFERENCES

A. Association of Illinois Soil and Water Conservation Districts, Illinois Urban Manual, Current Edition

B. Illinois Department of Transportation, Standard Specifications for Road and Bridge Construction, Current Edition

C. Lake County Stormwater Management Commission, Watershed Development Ordinance.

1.4 QUALITY ASSURANCE

A. All Work shall be in accordance with applicable manufacturer's instructions and local, state, and federal codes, regulations, laws, and ordinances.

B. Subcontractor shall comply with applicable requirements of Section 404 of Clean Water Act and Navigable Waters Protection.

C. During construction and until final acceptance, Subcontractor shall respond to erosion and sediment control maintenance requirements or implement additional measures to control erosion ordered by Owner, Engineer, or governing authorities within 48 hours, or sooner if required, at no additional cost to the Owner.

1.5 SUBMITTALS

A. In accordance with Section 01 30 00.

B. Product data: Manufacturer’s information verifying that materials meet the specifications of this section and the Contract Drawings.

C. Submit for documentation, certificates, and/or test results for one sample of each material obtained from on- and off-site sources indicating compliance with Specifications and Contract Drawings prior to start of construction.

D. Submit as part of the Draft Work Plan (Section 01 30 00) an Erosion Control and Surface Water Management Plan including, but not limited to, locations of temporary berms that will contain/divert stormwater from entering the removal action areas and divert run-on water from excavations and grading and/or temporary management areas for stockpiled areas. Plan shall also identify proposed water pumping equipment, rates, and locations. Measures shall be taken to minimize surface water intrusion into exposed areas where possible.

E. Engineer shall document condition of erosion control measures during inspections (Part 3.3 A) and maintain the copies of erosion control inspection records; conditions of erosion controls and inspection results will be discussed at each weekly progress meeting, or as needed and required by the Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refer to Section 31 05 14 – Select Fill and the Contract Drawings for tracking pad, silt fence, inlet protection, and other erosion control materials.

B. Other Materials

1. Straw Bale Barriers: Straw, rectangular surfaces, and tightly bound with twine, not wire.
2. Sediment Log: Provide a product that exhibits the following properties: minimum 9-inch diameter, porous, interlocked fiber log matrix. American Excelsior Company Type III - 23cm (9in) sediment log or similar.
3. Temporary Mulches: Shall be hay, straw, fiber mats, netting, wood cellulose, bark, wood chips, or other suitable material acceptable to Engineer and shall be reasonably clean and free of noxious weeds and deleterious materials.
4. Erosion Control Mat shall exhibit the following properties, or as approved by the Engineer: 100 Percent degradable composition (photo-degradable, bio-degradable) sufficient to stabilize 4H:1V (maximum) slopes. Erosion control mat (ECM) shall conform to meet the requirements of the Illinois Urban Manual Practice Standard 830 for Erosion Control Blanket. Anchoring devices shall be biodegradable. Anchoring devices shall substantially degrade within 3 to 6 months during warm soil conditions. Steel wire pins or staples shall not be allowed.

PART 3 - EXECUTION

3.1 GENERAL

A. The erosion and sediment control measures shown on the Contract Drawings represent a minimum requirement. The Subcontractor is responsible for determining additional erosion and sediment control measures needed to prevent the transfer of sediment from the project area and to prevent the erosion of surfaces during construction, as needed to protect adjacent properties and water bodies.

B. Install silt fence, surface water diversion measures, and other erosion control measures prior to intrusive activities.

1. Inspect, maintain, and replace, as needed, throughout duration of project.

C. Subcontractor shall undertake erosion control and surface water management measures as shown on the Contract Drawings including, but not limited to:

1. Maintain silt fence as indicated in the Contract Drawings.
2. Maintain tracking pad and roads for access to Site and management areas as needed.
3. Cover stockpiles with plastic and secure to prevent wind erosion as directed by the Engineer. Subcontractor shall maintain stockpiles throughout the duration of project.

D. The following general practices shall be used where applicable:

1. Minimize disturbed areas and sequence work to minimize exposure time.
2. Use temporary vegetation, mulch, or other cover to protect areas during construction. Use dikes, wood chips, straw bales, or silt fence to trap sediment.
3. Reduce volume and velocity of water crossing disturbed areas by utilizing diversion dams, straw bales, berms, or other facilities.
4. Remove and replace erosion control measures to accommodate the sequencing and progression of Work.

E. The Owner and the Engineer have authority to limit surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow, and placement operations. Subcontractor shall provide immediate temporary or permanent erosion control measures when directed. Subcontractor shall incorporate all permanent erosion control features into project at earliest practicable time to minimize need for temporary controls.

F. Subcontractor shall manage surface water consistent with the Final Work Plan, as approved by the Engineer (Section 01 30 00) and in accordance with Section 02 72 11.

G. Subcontractor shall maintain erosion control features until project is completed and accepted by Owner.

3.2 ADDITIONAL CONTROL MEASURES

A. Subcontractor shall provide measures daily to prevent tracking of materials from Site onto public or private roadways, parking lots, and paved areas.

B. Soil loss control measures, in addition to those outlined in these documents, deemed necessary by Owner or Engineer shall be implemented immediately.

C. Additional control measures required by regulatory agencies as a result of improper maintenance or installation of the specified control measures will be the responsibility of the Subcontractor.

3.3 MAINTENANCE

A. Engineer shall inspect or arrange for inspection of erosion control measures within 24 hours of the end of each rainfall event of 0.5 inches or more, or daily during periods of prolonged rainfall, and weekly during periods without rainfall. Subcontractor shall immediately repair or replace damaged, failed, or inadequate erosion control measures. Engineer shall document condition of erosion control measures during such inspections and maintain copies of inspection records.

B. Subcontractor shall immediately repair or replace damaged, failed, or inadequate erosion control measures, as instructed by Engineer.

C. Subcontractor shall remove sediment deposits from erosion controls after each storm event.

D. Subcontractor shall inspect planned entrances and adjacent public streets daily when traffic is occurring and remove tracked and eroded soils as deemed necessary by Engineer

and Owner with a commercial street sweeper. At a minimum, the Subcontractor shall clean the streets as necessary during hauling operations.

E. Subcontractor to maintain erosion control measures through completion of the Work and remove materials as directed by Engineer.

END OF SECTION

SECTION 31 74 01
JACK AND BORE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes crossings through grades casing pipes for pipelines installed by jacking and boring method, and installation of the carrier pipe(s) within the casing in the location(s) and to the limits as shown on the Contract Drawings.

B. All work shall be performed in accordance with the applicable rules and regulations of the State and Federal Codes and with the terms and conditions of the permit issued by the railroad or governing body having jurisdiction.

1.2 SUBMITTALS

A. The following items shall be submitted:

1. Method of Installation
    a. Following the award of the Contract, the Contractor shall submit a description of the method and equipment which is proposed to be employed in installing the casing.
    b. All sheeting and bracing shall be designed at the Contractor's expense by a Professional Engineer licensed in the State of Illinois. The seal of the Professional Engineer shall appear on all drawings and design sheets submitted for review.
2. Contractor’s Data
    a. The Contractor shall submit such data as may be required as conditions of the permit.
3. Product Data: “Catalog cuts” and specification sheets marked to specifically indicate the equipment and materials proposed for this project. Indicate selections with arrows, and cross out irrelevant data.
4. Shop Drawings
    a. Drawings and manufacturer’s data of the casing materials showing compliance with this specification.
    b. Drawings and manufacturer’s data of the carrier pipe showing compliance with the Contract Drawings and this specification.
    c. Casing spacers and grout.
    d. Casing end seals.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 57 23 - Construction Water Management

B. Section 31 01 01 - Earthwork

C. Section 31 23 00 - Excavation and Fill

1.4 QUALITY ASSURANCE

A. Qualifications

1. Contractor's Qualifications: The casing shall be installed by a contractor who has experience in this field of construction and can furnish a record of satisfactory performance on at least three projects for work of comparable type.

PART 2 - PRODUCTS

2.1 MATERIALS AND CONSTRUCTION:

A. Casings

1. The casing shall be of the size and type as shown on the Contract Drawings.
    a. Steel pipe of the thickness specified shall have a minimum yield strength of 35,000 psi and a minimum ultimate strength of 60,000 psi. Steel casing pipe shall be uncoated.

B. Carrier Pipes

1. The carrier pipe(s) shall be as specified on the Contract Drawings and in accordance with the Section for the type of pipe.

C. Signs

1. Signs shall be weatherproof and as shown on the Contract Drawings
2. At a minimum, signs shall show the following:
    a. Name and address of owner
    b. Contents of pipe
    c. Pressure in pipe
    d. Pipe depth below grade at point of sign
    e. Emergency telephone number in event of rupture

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install casing, carrier pipe casing spacers, end seals and sign as shown on the Contract Drawings.

B. General

1. The Contractor shall employ the jacking and boring methods within the limits shown on the Contract Drawings for the installation of the casing.
    a. The remaining portion of the casing may be constructed by open cut method in a sheeted trench.
2. Once the jacking and boring operation is started, it shall proceed on a 24-hour basis without interruption until completed.
3. The casing pipe shall be maintained accurately to line and grade during the installation operation
4. The use of water or other liquid, except bentonite slurry with prior approval of the Engineer, to facilitate casing placement or spoil removal is prohibited.

C. Jacking and Boring

1. Boring shall consist of pushing the casing with an augur rotating within to remove the spoil.

2. The auger or cutting head shall not lead the casing and shall be removable from within the casing.
3. The face of the cutting head shall be arranged to provide reasonable obstruction to the free flow of soft or poor materials.

D. Carrier Pipe

1. No contact shall be permitted between the casing and the carrier pipe.
    a. Casing spacers shall be used between the casing pipe and carrier pipe. The spacers shall be installed within the casing in the quantity and at the locations recommended by the manufacturer.
    b. Both ends of the casing pipe shall be sealed with non-shrink grout.

END OF SECTION

SECTION 32 91 15
TOPSOIL, SEEDING, AND SITE RESTORATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General Site restoration
2. Seeding and mulching of disturbed surface areas.
3. Final erosion controls and final cleanup

B. Related Sections:

1. Section 02 01 00 – Site Preparation and Maintenance of Existing Conditions
2. Section 31 20 00 – Earthwork
3. Section 31 25 00 – Erosion and Sedimentation Controls

1.2 REFERENCES

A. Association of Illinois Soil and Water Conservation Districts, Illinois Urban Manual, Current Edition.

B. Illinois, Department of Transportation, Standard Specifications for Road and Bridge Construction, Current Edition.

C. Lake County Stormwater Management Commission, Watershed Development Ordinance.

1.3 SUBMITTALS

A. Topsoil testing results from a commercial soil testing laboratory in accordance with the Engineer's Construction Quality Assurance Plan (CQAP).

1. Nutrient results (available phosphorous, potassium, and nitrogen) with recommended topsoil amendments.
2. Geotechnical results and soil classification.
3. Analytical data, if not from a certified virgin source.
4. Submit to Engineer two weeks prior to deliver to Site a representative topsoil sample and sample certificates and/or test results. Engineer may submit the sample for gradation (ASTM D422) and classification (ASTM D2487) to verify compliance with the technical specifications.

B. Seed information:

1. Proposed seed mix, supplier, application rates, and methods.
2. Submit to Engineer two weeks prior to delivery to Site, certification of seed mix from seed vendor stating the botanical and common name, percentage by weight of each species, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

C. Fertilizer and soil amendment information:

1. Fertilizer type, supplier, and application rate.

2. Submit to Engineer two weeks prior to delivery to Site, certification that fertilizer and soil amendment type and application rate meet the recommendations of the soil testing laboratory, or as approved by the Engineer.

D. Mulches

1. Proposed mulch, supplier, application rates, and methods.
2. Submit to Engineer two weeks prior to delivery to Site, certification of mulch composition from mulch manufacturer.

PART 2 - PRODUCTS

2.1 TOPSOIL

A. The topsoil cover should consist of a 4-inch layer of topsoil, as indicated on the Contract Drawings, obtained from an off-site borrow source of the Subcontractor's choice, approved by the Engineer. The source shall, at a minimum, satisfy the following specifications:

1. Topsoil shall be friable and classified as a natural loam, sandy loam, silt loam, sandy clay loam, clay loam, or as approved by Engineer.
2. Material shall be free of rubble, boulders, cobbles, rubbish, weeds, and other deleterious materials.
3. Recent tests should indicate that percent organic matter is not less than 1.5%, pH is in range 6.0-7.5.

2.2 SEED MIX

A. Seed mixture shall meet the following specification:

Scientific Name	Common Name	% of Seed Mix
Seed Mix (20 lbs/acre)		
Andropogon Gerardii	Big Bluestem	25
Andropogon Scoparius	Little Bluestem	25
Panicum Virgatum	Switch Grass	25
Sorghastrum Nutans	Indian Grass	25
Cover Crop (20 lbs/acre)		
Annual Rye (Spring Seeding)		
Winter Wheat (Fall Seeding)		

B. Seed to be delivered in original, unopened containers showing weight, certified analysis, manufacturer name and address, date of packaging, and indication of conformance with state and federal laws, as applicable.

2.3 FERTILIZERS

A. Fertilizer or lime is generally not suggested unless recommended by soil test results and approved by Engineer. If required, apply in amounts recommended in soil nutrient testing for mixed grasses.

B. Fertilizer to be delivered in manufacturer's original unopened containers bearing manufacturer's guaranteed analysis or on a spreader vehicle with certification of composition from supplier.

2.4 EROSION CONTROL MATERIALS

A. Erosion-Control Blankets: In accordance with Illinois Urban Manual Material Specification 805.

B. Sediment Control Fences (Silt Fences): As indicated in the Contract Drawings.

2.5 MULCHES

A. Straw Mulch shall come from oats, wheat, rye, or barley, and be free of diseased plant residue, weed seeds, and harmful chemical residues, and be suitable for placing with commercial mulch blowing equipment. Hydraulic mulch shall consist of wood, cotton, straw, or paper, or a combination of each.

PART 3 - EXECUTION

3.1 GENERAL SITE RESTORATION

A. Subcontractor shall perform site restoration as specified in this Specification and as shown on the Contract Drawings.

B. Restore sidewalk, topsoil, landscaping, fencing, roads, and utilities that are disturbed during the performance of the Work to pre-construction condition, as necessary, and as directed by Engineer.

C. Subcontractor to remove the tracking pads, and decontamination area. The water treatment plant pad will remain in place. Load MGP impacted materials for transport to the landfill as special waste. Non-MGP impacted material may be reused as backfill within the Excavation Areas, as directed by Engineer. Geotextile shall be transported to an approved construction landfill as construction debris, unless MGP impacted. Then material to be disposed as special waste at approved landfill, as directed by Engineer.

3.2 TOPSOIL

A. Import and place topsoil over area disturbed by construction activities.

B. Do not place or grade topsoil when frozen or saturated.

C. Topsoil shall be placed on loosely compacted subsoil. For compacted subsoil, as identified by the Engineer, Subcontractor shall scarify the top four inches of subsoil prior to placing topsoil.

3.3 SEEDING

A. Prepare the Site and apply seed in accordance with Illinois Urban Manual Practice Standard Code 880 – Permanent Vegetation.

B. Seeding Restrictions: Plant seed during spring or fall periods, or as approved by the Engineer. Proceed with planting only when existing and forecasted weather conditions are favorable for planting according to manufacturer's written instructions.

C. Place seed over all disturbed areas as shown on the Contract Drawings by hydroseeding, or as approved by Engineer.

1. Final seedbed preparation shall leave the soil surface in a slightly roughened condition.

2. Lime and fertilizer, if required based on soil test results, shall be incorporated prior to seeding unless they are to be applied at the same time as the seed. If

fertilizer and seed are mixed together, they should be applied within 2 hours of mixing.

3. A minimum of 1,000 gallons of water per acre shall be used and pumped at a rate no less than 100 gallons per minute and at a pressure no less than 100 pounds per square inch. The hydroseeding equipment shall have a tank with a mechanical agitator powerful enough to keep all materials in a uniform suspension in the water.

3.4 MULCHING/EROSION BLANKET

A. All permanent seedings shall be mulched upon completion of seed application using Method 1, 2, or 3, in accordance with Illinois Urban Manual Practice Standard Code 875 – Mulching.

1. Mulch application shall occur within 24 hours of seeding.
2. Hydraulic mulch shall not be applied when ambient temperature is at or below freezing.

B. Erosion blankets shall be substituted for mulch on all slopes of 10% slope or greater in accordance with Illinois Urban Manual Practice Standard Code 830 – Erosion Blanket.

3.5 FINAL EROSION CONTROLS AND FINAL CLEANUP

A. Streets or drives adjacent to the Site shall be swept and/or high pressure washed to remove any MGP residuals, dust, or debris.

B. Trash, rubbish or other debris shall be removed and transported off-site for disposal.

C. Remove all erosion controls, except at the request of the Engineer or Owner.

D. Subcontractor shall correct, at no expense to the Company, any damage to buildings, telephone or other cables, overhead and underground utilities or their structures as a result of Subcontractor's construction, whether or not the item is shown on the Contract Drawings.

E. All Subcontractor equipment and materials shall be removed from the Site.

END OF SECTION

SECTION 33 00 01
PIPELINE INSTALLATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes installation requirements for metallic and non-metallic pipelines, except special pipelines where installation requirements are specified elsewhere, as shown on the Contract Drawings, complete with fittings.

1.2 REFERENCES

A. Comply with the latest revision of the following codes, standards and specifications, except where more stringent requirements have been specified herein:

1. American Society for Testing and Materials (ASTM).
2. American Water Works Association (AWWA).

1.3 COORDINATION REQUIREMENTS

A. Coordinate layout and installation of proposed work with existing facilities and work by others.

1.4 SUBMITTALS

A. Submit the following:

1. Manufacturer's certifications that materials furnished are in compliance with the applicable requirements of the referenced standards and this specification. Layout drawings are required for pipelines to be installed within structures, showing the location including the support system, sleeves and appurtenances.

PART 2 - PRODUCTS

2.1 PIPE MATERIAL

A. Materials for the piping, joints and fittings shall be as specified in the Technical Specification Section for the type of pipe to be installed, shown in the pipe schedule or on the Contract Drawings.

1. Pipe and appurtenances shall comply with the applicable standards for its type of material.

B. Pipe Joints

1. Type of pipe joints shall be Electrofusion Welded or as scheduled in the pipe schedule, or as shown, or noted on the Contract Drawings.

C. Delivery Inspection

1. Pipe and appurtenances shall be inspected by the Contractor in the presence of the Engineer on delivery and prior to installation for conformance with the standards and specifications.

2. Materials not conforming to the standards and specifications shall not be stored on site but removed at once and replaced with material conforming to the specifications.

2.2 LOCATOR WIRE

A. Direct burial # 12 AWG solid (.0808" diameter) steel core hard drawn extra high strength tracer wire, 1150 # average tensile break load, 45 mil high molecular weight-high density blue polyethylene jacket complying with ASTM 1248, 30 volt rating as manufactured by Copperhead Industries, LLC, Monticello, Minnesota or equal.

2.3 ACCESSORIES

A. Wall Castings and Sleeves

1. All pipelines passing through walls, floors or slabs of structures shall be installed in a wall casting or sleeve as shown on the Contract Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The Contractor shall examine areas and conditions for compliance with manufacturer's installation recommendations and requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION – UNDERGROUND

A. General

1. Install pipelines, fittings, specials, and accessories as shown on the Contract Drawings and in accordance with the manufacturer's installation instructions.
2. Excavation and backfilling shall be in accordance with the applicable provisions of the Technical Specification Section entitled "Excavation and Fill".
3. Blocking will not be permitted under pipe, except where the pipe is to be laid with concrete cradle or encasement.
4. No pipe shall be laid upon a foundation in which frost exists; nor when there is danger of the formation of ice or the penetration of frost at the bottom of the excavation.
5. Temporary bulkheads shall be placed in open ends of pipe whenever pipe laying is not actively in process. The bulkheads shall be designed to prevent the entrance of dirt, debris or water.
6. Precautions shall be taken to prevent the flotation of the pipe in the event of water entering the trench.
7. Locator wire shall be securely attached to the exterior of the pipe prior to installation. The wire shall be secured to the pipe at frequent intervals and secured to the pulling head in a way to prevent cutting or damage.
8. Metallic warning tape shall be placed 24 inches below grade in areas where pipe is installed by open-cut methods. Warning tape shall read "Force Main Below".

B. Location and Grade

1. Pipelines and appurtenances shall be located as shown on the Contract Drawings or as directed and as established from the Contractor's control survey.

2. The alignment and grades shall be determined and maintained by a method acceptable to the Engineer.

C. Subgrade

1. The subgrade for pipelines shall be earth or special embedment as specified or directed and shall be prepared in accordance with the Technical Specification Section entitled "Excavation and Fill".

D. Pipe Joints

1. Joints shall be assembled using gaskets, lubricants and solvents as furnished by the pipe manufacturer and in accordance with the manufacturer's recommendations.
2. Joint deflection shall be in compliance within manufacturer's tolerances or as otherwise specified.

E. Embedment

1. Embedment shall be deposited and compacted in accordance with the Contract Drawings, Technical Specification Section entitled "Excavation and Fill", and the Technical Specification Section or schedule for the type of pipe being installed.

3.3 INSTALLATION – EXPOSED

A. Exposed pipelines shall be carefully erected and neatly arranged.

B. Supports and anchors shall be adequate to support the pipe filled with water with a minimum safety factor of 5 and for the test pressure specified.

C. Special supports shall be as specified in the Section for the type of pipe being installed.

3.4 CUTTING AND SPECIAL HANDLING

A. Field cuts of pipes shall be in accordance with the manufacturer's instructions.

B. Where a pipe requires special handling or installation it shall be in accordance with the schedule for that type of pipe.

3.5 FINAL INSPECTION OF PIPELINES

A. Each section of pipe shall be inspected prior to final acceptance.

1. Where installed by open-cut means, elevations shall be confirmed by topographic survey.
2. The Subcontractor is responsible for inspecting the pipe that the Subcontractor installs.

B. The inspection shall determine the pipeline to be true to line and grade, to show no leaks (in accordance with the section entitled "Leakage Tests"), to have no obstruction to flow, to have no projections or protruding of connecting pipes or joint materials, shall be free from cracks and shall contain no deposits of sand, dirt or other materials.

C. All deficiencies located during the inspection shall be corrected at no cost to the Owner.

END OF SECTION

SECTION 33 08 01
LEAKAGE TESTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes leakage tests of pressure and non-pressure piping and precast concrete structures for leakage as specified.

1. Furnish all labor, equipment, test connections, vents, water and materials necessary for carrying out the pressure and leakage tests.

B. All testing shall be witnessed by the Engineer.

1.2 SUBMITTALS

A. In addition to those submittals identified in the Contract Documents, the following items shall be submitted:

1. Reports of test results.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TESTS ON PRESSURE PIPING FOR TRANSPORT OF GROUND WATER

A. General

1. Pipelines designed to transport ground water under pressure shall be tested hydrostatically and for leakage prior to being placed in service.
2. The length of force main piping and sections included in the tests shall be reviewed by the Engineer.
3. Equipment in or attached to the pipes being tested shall be protected. Any damage to such equipment during the test shall be repaired at no additional expense to the Owner.
4. When piping is to be insulated or concealed in a structure, tests shall be made before the pipe is covered.
5. All fittings and appurtenances must be properly braced and harnessed before the pressure is applied. Thrust restraining devices which will become a part of the system must also be tested at the test pressure.
6. If the line fails the test, the cause of the leakage shall be evaluated and, after repairs have been made, the line shall be retested. This procedure shall be repeated until the pipe complies.

B. Pressure Test

1. Test pressure shall be as scheduled or, where no pressure is scheduled, shall be 150% of the design working pressure as identified by the Engineer.

2. Test pressure shall be held on the piping for a period of at least 2 hours, unless a longer period is requested by the Engineer.

3. Test pressure for HDPE forcemain shall be 125 psi.

C. Leakage Test

1. The leakage test shall be conducted concurrently with the pressure test.

2. The rate of leakage shall be determined at 15-minute intervals by means of volumetric measurement of the makeup water added to maintain the test pressure. The test shall proceed until the rate of leakage has stabilized or is decreasing below an allowable value, for three consecutive 15-minute intervals. After this, the test pressure shall be maintained for at least another 15 minutes.

   a. At the completion of the test, the pressure shall be released at the furthermost point from the point of application.

3. All exposed piping shall be examined during the test and all leaks, defective material, or joints shall be repaired or replaced before repeating the tests.

4. The allowable leakage for pressure pipelines shall not exceed the following in gallons per 24 hours per inch of diameter per mile of pipe:

Type of Pipe	Allowable Leakage
PVC solvent welded	0
PVC with gaskets	0
Steel	0
HDPE	0
FRP	0

5. Any visible leaks shall be permanently stopped prior to re-testing.

3.2 TESTS ON PRESSURE PIPING FOR AIR LINE

1. For the acceptance of air testing in lieu of hydrostatic testing (exfiltration or infiltration), the hydrostatic and air tests shall be performed on at least three sections of pipeline for each type of pipe being used. The Engineer shall select the sections for the corroborative tests. If these duel-tested sections indicate the same results, that is, acceptance under both tests, air testing will be allowed in lieu of hydrostatic testing to meet the project requirements.

2. Air testing for acceptance shall not be performed until the backfilling has been completed.

3. Low pressure air tests shall conform to ASTM C 828 except as specified herein and shall not be limited to type or size of pipe.

4. Air testing of exposed (non-buried) fiberglass, PVC or other plastic or non-metal piping is prohibited.

5. All sections of pipelines shall be cleaned and flushed prior to testing.

6. The air test shall be based on the average holding pressure of 3 psi gauge, a drop from 3.5 to 2.5 psi, within the period of time allowed for the size of pipe and the length of the test section. The time allowed for the 1 psi drop in pressure,

measured in seconds, will be computed by the Engineer and will be based on the limits of ASTM C 828.

a. When groundwater is present the average test pressure of 3 psig shall be above any back pressure due to the groundwater level.

b. The maximum pressure allowed under any condition in air testing shall be 10 psig. The maximum groundwater level for air testing is 13 feet above the top of the pipe.

7. The equipment required for air testing shall be furnished by the Contractor and shall include the necessary compressor, valves and gauges to allow for the monitoring of the pressure, release of pressure and a separable test gauge.

a. The test gauge shall be sized to allow for the measuring of the one psig loss allowed during the test period and shall be on a separate line to the test section.

3.3 TESTS ON LINED PRECAST CONCRETE STRUCTURES AND OTHER MANHOLES, VAULTS AND STRUCTURES

A. General

1. Structures and manholes designed to collect, store, or transport ground water shall be tested hydrostatically and for leakage prior to being placed in service. This includes, but is not necessarily limited to ground water pump stations, valve vaults, and manholes. Lined structures shall be tested only after the lining is applied.

2. Equipment in or attached to the structures being tested shall be protected or removed prior to performance of the testing. Any damage to such equipment during the test shall be repaired at no additional cost to the Owner.

3. All fittings and appurtenances must be properly braced and harnessed before the structure is filled.

4. If the structure fails the test, the cause of the leakage shall be evaluated and after repairs have been made the structure shall be retested. This procedure shall be repeated until the structure complies.

B. Leakage Test

1. Exfiltration test may be performed prior to or after backfilling. The test shall be made by filling the structure with water and observing the level for a minimum of 12 hours.

2. Infiltration tests shall be performed when the groundwater level is above the joint of the top section of a precast manhole.

3. The rate of leakage shall initially be determined at intervals by means of volumetric measurement of the makeup water added to maintain the water level in the structure. Test water shall be added until the rate of leakage has stopped such that the level can be maintained without change. After this, the test water level shall be maintained for at least 12-hours, unless a longer period is determined to be required by the Engineer.

4. All exposed piping shall be examined during the test and all leaks, defective material or joints shall be repaired or replaced before repeating the tests.

5. The allowable leakage for structures shall not exceed the following in gallons per 24 hours per structure:

Type of Structure	Allowable Leakage
Junction Vault	0
Extraction Well Vault	Not Applicable

6. Any visible leaks shall be permanently stopped and the structure will require retesting until it has passed.

3.4 AIR, OIL, GAS, CHEMICAL PIPING

A. All pipelines for air, oil, gas and chemical services (where chemicals are incompatible with water), and that may be tested with water or air, shall be thoroughly drained after completion of the test. After these tests are completed and draining is complete, the lines shall be flushed out and purged with nitrogen or carbon dioxide until all water is removed before they are placed in service.

END OF SECTION

SECTION 33 11 53
WELL INSTALLATION, ABANDONMENT, AND MODIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Well installation, construction, and minimum performance requirements for vertical extraction wells and vertical groundwater monitoring wells.
2. Well installation, construction, and minimum performance requirements for horizontal well construction by means of horizontal directional drilling (HDD).
3. Well development procedures.
4. Well abandonment procedures.
5. Well modification procedures.

1.2 REFERENCES

A. AWWA Well Standards, A100-66

B. AWWA Pipe Standards, A100-66

C. ASTM F1962, Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings

D. Illinois Administrative Code (IAC) Title 77, Chapter 1, Subchapter R, Part 920

1.3 SUBMITTALS

A. Subcontractor shall submit to Engineer a list of equipment to be used for the project.

B. For the following, Subcontractor shall submit to Engineer a complete list of construction materials and supplies, including: manufacturer name, technical data, and mill certification:

1. Casing
2. Filter pack
3. Well screen
4. Bentonite seal
5. Protective sleeve
6. Caps and protective covers

C. Subcontractor shall submit a Quality Assurance/Quality Control Plan which includes the following:

1. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Subcontractor's quality-assurance and quality control responsibilities

2. Address all aspects of construction operations including but not limited to mobilization, Site preparation, erosion control, well installation, well development, and Site restoration.

D. For horizontal wells, Subcontractor shall submit the following to Engineer:

1. Equipment description and written procedures with working drawings describing in detail the proposed boring method and the entire operation to be used. This shall include, but not be limited to, size, capacity, and configuration of entry and exit pits; settlement pit; size, capacity and arrangement of equipment; layout of the pipe; details and spacing of pipe rollers; method of monitoring and controlling line and grade; method of detection of surface movement; and layout of any proposed construction staging areas.
2. Bore Path Plan
    a. Submit a bore path plan to Engineer for review, including entry/exit angles and radius of curvature. After completion of the well, submit a final pipe alignment.

    b. Personnel qualifications

3. Inadvertent Return Control and Containment Plan

    a. Identify methods to prevent inadvertent returns.

    b. Identify methods of rapid detection and containment procedures.

    c. Identify notification procedures and possible remedial actions.

4. Calculations

    a. Submit detailed design calculations for several representative loading conditions for the proposed Work. Design calculations shall be presented in a neat, readable format, with all figures, values, and units included for ease of verification.

    b. Calculations shall address the following loading conditions:

        i. Installation longitudinal stress from pulling force; longitudinal curvature stress at point of entry and in final position; external pressure from drilling fluid, overburden, and other anticipated loads.

5. Prior to Work, provide current calibration certification of drill head tracking system in accordance with manufacturer's specifications.

E. Well driller shall maintain a complete log of well installation that includes the following:

1. Data for all depth measurements
2. Depth at which hole diameter changes
3. Any other pertinent data, as requested by the Engineer

F. A daily driller's report shall be maintained and submitted, as requested by Engineer. The report shall give description of:

1. All formations encountered
2. Number of feet drilled
3. Number hours on the job
4. Any shutdowns due to breakdown

5. Feet of casing set
6. Any other pertinent data, as requested by the Engineer
7. Horizontal well-specific information included in the daily log shall include:
    a. Survey readings taken by the down-hole probe
    b. Distance between down-hole survey points
    c. Total distance and station of down-hole survey points measured from the entry point
    d. Inclination angle of the down-hole probe at each survey point (vertically downward corresponds to zero degrees)
    e. Azimuth angle of the down-hole probe at each survey point (magnetic north corresponds to zero degrees)
    f. Elevation of down-hole survey points based on NAVD88 datum
    g. Distance of downhole survey points from the design path reference line
    h. Magnetic heading of the drilled path reference line
    i. Rig setback as measured between the initial drill bit position to the staked entry point
    j. Length of the bottom-hole assembly (BHA)
    k. Drilling fluid consumption
    l. Drilling fluid rheology properties (shear stress with respect to shear rate, and viscosity and temperature variations with respect to time)
    m. Water consumption
    n. Rig down pressure and torque, and drilling fluid pressures

G. Upon completion of new wells, submit report of well installation, boring log, if applicable, and construction form. Forms should include at a minimum:
1. Total length and depth of the completed well
2. Depth and location of any lost drilling materials or tools
3. Nominal diameter of the borehole
4. Length, depth, and description of the well casing
5. A completion description including length diameter, slot size, and materials used to construct the well screen
6. Depth of the potentiometric surface
7. Any other pertinent data requested by the Engineer

H. During well development, a Development Report shall be maintained and submitted to the Engineer. The Development Report shall include the following minimum information:
1. Method of development utilized

2. Type and volume of chemicals used
3. Duration and description of well developments
4. Dynamic and static water levels
5. Production (pumping) rate
6. Quantity of sand and turbidity with respect to time

I. For modified wells, submit report of repair or modification.

J. Upon completion of well abandonment, submit documentation forms and abandonment report in accordance with IAC 77, Chapter 1R, 920.120.

1.4 GENERAL REQUIREMENTS

A. Subcontractor shall furnish all labor, materials, equipment, and incidentals as required for installation, abandonment, and/or modification of wells within the Site boundaries, as shown in the Contract Drawings.

B. Subcontractor shall review Site conditions, locate and clear utilities, review existing subsurface information, and otherwise become familiar with the site prior to commencing the work. Subcontractor shall be responsible for field verifying well locations prior to commencing Work.

C. Subcontractor shall perform the Work complete in place and ready for continuous use, including repairs and restoration required as a result of damages caused during this construction. The cost for abandoning a damaged well and replacing with a new "equal" well is in addition to the payment deduction (see table below) and shall be the responsibility of the Subcontractor. The cost for repairing wells (if damaged portion is fixable) shall also be the responsibility of the Subcontractor.

D. Work shall be performed by a qualified Subcontractor. The work shall be performed under the direct supervision of an experienced well driller.

E. Subcontractor shall finish and install all materials, equipment, and labor that are reasonably and properly inferable and necessary for the proper completion of the work.

F. Specifications are intended to give a general description of what is required but do not cover all variations that may occur during well installation, repair, or modification.

G. The following table lists payment deductions for destroyed wells (damaged beyond repair). Well replacement costs, in addition to the payment deduction, shall be at the Subcontractor's expense.

Well	**Payment Deduction if Destroyed**
Monitoring Well or Water Level Well $\leq$ 20 ft deep	**-$2,000**
Monitoring Well or Water Level Well > 20 ft deep	**-$3,000**

1.5 USE OF EXISTING WATER SYSTEMS

A. Use of on-site water systems during construction by the Subcontractor shall be allowed with the approval and direction of the Owner. Subcontractor shall use the on-site water system only at locations, times, and conditions as set forth by the Owner.

B. If water is not readily available at the Site or Owner cannot provide the volume of flow required by the Subcontractor, provide potable water, as needed, from an off-site location approved by the Owner and Engineer.

1.6 OPERATING REQUIREMENTS

A. Soil cuttings, if generated, will be containerized and managed as per Section 02 60 00.

B. Excess drilling fluid, if generated, and decontamination water will be containerized and managed as per Section 02 72 11.

C. The Subcontractor will contain all drilling and pipe lubricating fluid by taking special measures to prevent run-off onto adjacent properties and/or waterways.

1.7 HANDLING OF MATERIAL

A. All parts and materials must be properly protected so that no damage, deterioration, or contamination occurs from time of shipment until installation is completed.

B. If any parts or materials are damaged, deteriorated, or contaminated before acceptance of the well, the material will be replaced at the Subcontractor's expense.

1.8 PERFORMANCE REQUIREMENTS

A. The Work shall be performed in accordance with the Contract Drawings.

B. Perform work in conformance with References (1.2) and the latest federal, state, local standards, and industry guidelines.

C. Contours, topography, and profiles of the ground as may be shown on the Drawings are believed to be reasonably correct, but are not guaranteed to be absolutely so and are presented only as an approximation. It is the Subcontractor's responsibility to verify all elevations required to successfully complete the Work.

D. Wells are structurally sound and meets the performance criteria set forth in the Contract Documents.

E. All casings, screens, bentonite seals, and sand packs shall be set to alignment and depths approved by Engineer.

F. Any deviations from the Contract Documents must be approved in writing by the Engineer and Owner. Approval of any aspect of any operation covered by this Specification shall in no way relieve the Subcontractor of ultimate responsibility for satisfactory completion of the Work authorized under the Contract.

G. Horizontal well installation line and grade tolerance:

1. Vertical tolerance: The vertical bore path shall not exceed plus or minus 1.5% between documentation points spaced 25 feet apart.
2. Horizontal tolerance: The horizontal bore path shall not exceed ± 2 feet from the design.

PART 2 - PRODUCTS

2.1 PIPE SIZE

A. Pipe sizes indicated on the Contract Drawings are standard pipe sizes for each material.

2.2 CASING AND COVER

A. Casing and cover material will match products specified on the Contract Drawings for each well type.

2.3 BENTONITE SEAL

A. Bentonite seal shall be used as indicated on the Contract Drawings.

2.4 SAND PACK

A. Sand pack material shall be as indicated on the Contract Drawings

2.5 EQUIPMENT

A. General

1. Equipment shall have the capacity, stability, and necessary safety features required to fully comply with the Contract Documents without showing evidence of undue stress or failure.
2. Equipment shall be in sound operating condition. Backup equipment shall be required in the event of an equipment breakdown and where the condition of the equipment to be used indicates routine component replacement or repair will likely be necessary to complete Work.
3. Directional drilling system shall consist of over-the-road-transportable field power unit, drilling fluid-mixing and recycling unit, a trailer or carriage-mounted drill unit, and all other support accessory vehicles and equipment.
4. System components shall be in sound operating condition with no broken welds, excessively worn parts, badly bent, or otherwise misaligned components.
5. Drill pipe, reamers, pull back heads, swivels, drill heads and collars, pipe cradles, pipe rollers, ropes, cables, clamps, and other non-mechanical but essential items shall be in sound condition and replaced immediately when need is apparent.

B. Directional Drilling System

1. Equipment must be capable of drilling the specified length in a single bore.
2. Directional drill system, drill end fittings, and appurtenances shall permit rapid makeup of the drill sections while meeting the torque, pressure and lineal load requirements of the system.
3. The control console shall contain a calibrated display of inclination, azimuth, tool face location, drilling fluid pump rates, and torque pressures.
4. Drill Head Guidance System

a. The guidance system shall be capable of monitoring the location of the drill head during the drilling operation.

b. The guidance system shall be capable of tracking at all depths up to one hundred feet and in any soil condition.

c. The guidance system shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction).

5.

C. Drilling Fluid-Mixing and Recycle Units

1. The drilling fluid-mixing and recycle unit shall be a self-contained system designed to provide a continuous supply of high-pressure drilling fluid to the drill unit.
2. The drilling fluid-mixing and recycle unit shall contain a fluid storage tank and drilling fluid additive(s) mixing system.
3. The drilling fluid-mixing and recycle unit shall permit changes to be made to the drilling fluid additive(s) concentrations during drilling in response to changing soil conditions.
4. Recycle units shall be of a capacity to minimize the production of new fluid and maximize the reuse and recirculation of original drilling fluid produced.

PART 3 - EXECUTION

3.1 PIPE STORAGE

A. Store pipe on level ground, free from sharp objects, within the fenced Site area shown on the Contract Drawings.

B. Pipe stacking shall be limited to height that will not cause deformation, bending, or warping.

3.2 PIPE JOINING

A. Allow sufficient space to fabricate and lay out pipe to length promoting single pull-back operation, if possible.

B. Inspect and clean pipe ends to be free of debris immediately prior to joining pipe sections.

C. No pipe solvent or glue shall be used in extensions.

3.3 DRILLING EQUIPMENT AND TOOLS

A. Drilling equipment must be steam cleaned and decontaminated prior to drilling a new or replacement well.

B. No thread lubricant shall be used.

3.4 WELL CONSTRUCTION

A. All casings, bentonite seals, and sand packs shall be set to depths as shown on the Contract Drawings and approved by Engineer. Bentonite seal and sand pack installation shall be performed in the presence of Engineer.

B. All wells in shall be constructed with an flush mount cover as indicated on the Contract Drawings.

C. Horizontal well construction shall follow protocol including:

1. The pipe shall be sealed at both ends to prevent foreign material from enter the pipe during pull back
2. Pipe rollers, skates, or other protective devices shall be used to prevent damage to the pipe, eliminate ground drag, reduce pulling force, and reduce stress on the pipe and joints.

3. Support pipe in an elevated position during the pull back operation to prohibit the pipe from bending, deforming, kinking or breaking.

4. Drilling Fluid

a. Drilling fluid shall be used during drilling and back reaming operations.

b. Excess drilling fluid shall be contained within a lined pit, containment pond, or trailer-mounted portable tank until disposed of at the direction of the Owner.

c. Drilling fluid shall be contained to prevent release to drainage systems, including surface water bodies.

d. Provide secondary containment pads for drilling fluid containment for rig, drilling fluid system, rod trailer, and roll-off containers using plastic and temporary berms constructed of soil, timbers, straw "wattles" or other materials

e. Any damage caused by escaping drilling fluid, or the directional drilling operation, shall be immediately restored by the Subcontractor.

3.5 HORIZONTAL WELL FIELD QUALITY CONTROL AND QUALITY ASSURANCE

A. Locating and Tracking

1. Provide continuous monitoring and plotting of pilot drill progress to ensure compliance with the proposed well alignment. Allow for appropriate course corrections to be undertaken

2. Monitoring shall be accomplished by manual plotting based on location and depth readings provided by locating/tracking system or by computer generated boring logs which map the bore path based on information provided by the locating/tracking system.

3. Plot the actual horizontal and vertical alignment of the pilot bore at intervals not exceeding 25 feet. This "as built" plan and profile shall be updated as the pilot bore is advanced.

4. Provide and maintain instrumentation that will accurately locate the pilot bore and measure drilling fluid flow and pressure.

5. Provide Engineer access to all data and readout pertaining to bore head position, fluid pressures, and fluid flows.

B. Monitor pull force to ensure maximum pipe pull rating is not exceeded.

3.6 WELL DEVELOPMENT

A. Well development shall be performed at all wells to accomplish the following:

1. Remove drilling fluids and formation damage caused by the borehole drilling and well completion process.

2. Remove fines and sediment from the well for vertical wells.

3. For horizontal wells, to remove fines and sediment from the formation to increase the hydraulic conductivity along the pipe wall, creating a naturally developed filter pack.

4. Establish optimal hydraulic contact between the well screen and the formation.

5. Provide an acceptable level of sand and turbidity.

6. Provide an appropriate level of drawdown at the production rate.

B. Develop well until production water is visually clear, as determined by the Engineer.

1. Wells will be developed by the no sooner than 24 hours following installation.
2. Remove a minimum of five well volumes of fluid.
3. Target turbidity readings are 25 NTUs
4. Development may cease, at the direction of Engineer, following removal of 10 well volumes.

C. Well development will be conducted through the following pumping methods:

1. Vertical wells: Downhole whaler pump, or equivalent
2. Horizontal wells: Airlifting or sand pumping

3.7 WELL CUT-OFF MODIFICATION

A. Subcontractor shall cut the well casing to the elevation as approved by Engineer and such that the eight (8) inch lockable flush mount cover is slightly above the finished concrete pavement surface. Flush mount cover shall be secured with a fibermesh reinforced concrete collar, sloped to drain away from well cover. The wells should be completed in accordance with these specifications and NR 141.

3.8 PROTECTION OF WELLS

A. During progress of the work, Subcontractor shall use all reasonable precautions to prevent tampering with the wells or entrance of foreign material into them.

B. All monitoring wells located inside and outside of the work limits shall be protected during construction activities. The protected monitoring wells shall be fully supported during grading and excavation to prevent damage to the casing material. Upon completion of grading, well filter and seal materials shall be restored to match existing pre-removal conditions.

3.9 WELL ABANDONMENT

A. Abandon selected monitoring wells as indicated on Contract Drawing Sheet C030. Monitoring well information for abandonment of wells, including depth of borehole is presented in Appendix D.

B. Abandonment activities shall be conducted in accordance with the requirements of NR 141.25.

C. Well Abandonment Because of Well Construction Failure:

1. Should the well be abandoned due to the loss of tools, casing collapse, or the Well Acceptance Criteria not having been met, Subcontractor shall abandon the well.
2. Should anything prevent well completion, the remainder of the well shall be constructed as approved by the Engineer.
3. Subcontractor may salvage as much casing and screen from the initial well as possible and use it in a new well if not damaged.
4. Abandonment of any component of well installation shall only be allowed as approved by the Engineer.
5. Subcontractor will not receive payment for well abandonment.

D. Subcontractor will not receive payment for abandonment of accidentally damaged wells.

END OF SECTION

SECTION 33 31 70
HIGH DENSITY POLYETHYLENE PRESSURE PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes polyethylene pipe, fittings, specials and all accessories of the classification, size, and use as shown or specified.

B. Features of High-Density Polyethylene Pressure (HDPE) pipe shall be as scheduled herein or on the Contract Drawings.

1.2 REFERENCES

A. Comply with the latest revision of the following codes, standards and specifications, except where more stringent requirements have been specified herein:

1. DOT Regulations
2. American Society for Testing and Materials (ASTM)
3. American Water Works Association (AWWA)
4. National Sanitation Foundation (NSF)
5. American National Standards Institute (ANSI)
6. Plastics Pipe Institute (PPI)

1.3 SUBMITTALS

A. The following shall be submitted

1. Product Data:
    a. "Catalog cuts" and spec sheets marked to specifically indicate all materials (including pressure rating and dimensions) proposed for this project. Indicate selections with arrows, and cross out irrelevant data.
2. Shop Drawings:
    a. Layout drawings for HDPE pipe to be installed within structures showing the locations and details of the support system, sleeves and appurtenances.
3. Certificates:
    a. Manufacturer's certifications that all materials furnished are in compliance with the applicable requirements of the referenced standards and this specification.

1.4 QUALITY ASSURANCE

A. Prior to initiating joining of the pipe the pipe installer shall present evidence to the Engineer of having successfully installed HDPE piping using this method on a minimum of three previous projects.

B. All testing, including field services, needed during installation of the pipe shall be provided by the pipe installer.

C. Manufacturer's Factory Qualifications: Manufacturing facilities shall have accreditation to ISO 9000:2000 or an equivalent quality management system acceptable to the Engineer.

1.5 DELIVERY AND HANDLING

A. Coordinate delivery of all materials to allow movement into designated space.

B. Handle all materials according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following manufacturers are named to establish a standard of quality necessary for the Project:

1. Vari-Tech LLC
2. KWH Pipe
3. Performance Pipe
4. Or Equal

2.2 GENERAL

A. The following components of like size and type shall be the product of the same manufacturer for purposes of parts interchangeability.

2.3 PERFORMANCE REQUIREMENTS

A. HDPE pipe and fittings shall comply with the following standards/criteria:

Parameter	Standard	Criteria
Density	ASTM D1505	0.941-0.955 gm/cc
Melt Flow Index Condition E	ASTM D1238	Less than 0.15 gm/ 10 min
Percent Carbon Black	ASTM D3350	2.0% min
Hydrostatic Design Basis	ASTM D3350	Minimum of 1600 psi
Slow Crack Resistance	ASTM F1473	Minimum 100 h PENT
Flexural Modules	ASTM D790	110,000-160,000 psi
Tensile Strength	ASTM D638	3,000-3,500 psi

2.4 MATERIALS AND CONSTRUCTION

A. General

1. High density polyethylene pipe shall be constructed from PE 3408/4710 high molecular weight polyethylene piping having a cell classification of PE 345434C and conforming to ASTM D3350.
2. Pipe and fittings conveying potable water shall be certified by AWWA C906 and NSF/ANSI 61 Standards for public drinking water service.
3. For double contained pipe, the carrier pipe shall be rated for service pressure of 125 psi (minimum).
4. The carrier pipe shall be supported and securely centralized throughout the length of the dual containment piping system. Pipe sections shall be factory assembled by the manufacturer with the carrier (inner) pipe secured to the containment pipe prior to delivery.
5. Dual containment centralizers must be hydraulically installed using a minimum of 120 psi hydraulic pressure on a fusion machine and shall be located 1½" from the end of the containment pipe prior to fusion. Dual containment centralizers shall be back-welded to both the primary and secondary pipe.
6. End seals used for terminating the containment pipe shall be manufactured with a one-foot long section of carrier pipe on one end and simultaneously butt fused pipe on the other end of the dual containment pipe system. Wall anchors will be provided as needed.
7. The manufacturer of the Dual-containment system shall have demonstrated successful installations for no less than 10 years.

B. Fittings and Couplings

1. Fittings and couplings shall have same pressure rating as the pipe.
2. High density polyethylene piping fittings and couplings shall conform to the requirements of HDPE pipe for classification and size.
3. The high density polyethylene pipe fittings and couplings shall be capable of withstanding the pressure required for the leakage test specified.
4. Fittings up to 8-inch in size shall be the molded type. Fittings Larger than 8-inch shall be fabricated. All fabricated fittings shall be a minimum of one (1) class (SDR/DR) stronger than the mainline pipe.
    a. All fittings shall meet the pressure rating of the main line pipe, which may require further increasing the SDR/DR.
5. Where mechanical couplings are called for, a steel sleeve in accordance with the manufacturer's recommendations shall be used.
6. Pipe and fittings shall be joined using simultaneous butt fusion. Electrofusion couplings, up to 28-inches in diameter, shall be used where typical fusion welding is impractical.
7. All dual-containment fittings shall be made with carrier fittings preinstalled inside the containment fittings at the Factory. All fittings must be tested prior to leaving the factory and shall be marked as such. No field fabrication of fittings is allowed. Field assembly of the dual contained pipe shall also not be accepted.

C. Joints

1. Unless otherwise specified, joints for pipe and fittings shall be fusion welded in accordance with the manufacturer's recommendations.

2. All fusion welders shall be qualified per the DOT code of Federal Regulations Title 49 Part 192.285.
3. Flanged joints shall be used for connecting to valves and other appurtenances.
   a. Gaskets shall be the following:
      1) Garlock Stress Saver XP
      2) Or Equal
   b. 316SS bolts and nuts shall be cadmium plated.
   c. Backup (follower) rings shall be Ductile Iron.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all materials as shown on the Contract Drawings and in accordance with the manufacturer's installation instructions.

B. High density polyethylene pipe shall be handled and stored in accordance with the manufacturer's recommendations.

C. Any pipe sections needing field splicing for fit-up purposes shall use press fit centralizers.

3.2 FIELD QUALITY CONTROL

A. Perform tests in accordance with the following:

1. Pipe shall be tested in accordance with Section entitled, "Leakage Tests".

3.3 PROTECTION

A. Protect installed piping systems from damage through Substantial Completion.

END OF SECTION

SECTION 46 07 00
PACKAGED WATER AND WASTEWATER TREATMENT SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes a performance specification for the above-grade packaged water and wastewater treatment system. Included in this section:

1. Characterization of wastewater to be treated
2. Target effluent criteria
3. Key operational parameters for unit processes
4. Control strategy
5. Requirements for shop drawing review and approval

1.2 TREATMENT OBJECTIVES

A. Primary Treatment Objective: To remove Dense Non-Aqueous Phase Liquid (DNAPL) from the groundwater. In addition to DNAPL removal, groundwater is to be removed, treated and re-injected back into the formation. Groundwater is expected to contain metals, volatile organic compounds (VOC), and polycyclic aromatic hydrocarbons (PAH) in concentrations greater than the groundwater remediation objectives and high enough to potentially cause scaling at the well-formation interface.

B. Secondary Treatment Objective: To reduce metals, VOC, and PAH concentrations to below the remediation objective, with resulting metals concentrations low enough to prevent scale formation within the treatment system or within the formation after re-injection. A Light Non-Aqueous Phase Liquid (LNAPL) was found in recent ground water samples. Any LNAPL found is to be removed as well.

PART 2 - CHARACTERIZATION

2.1 DNAPL

A. Pure DNAPL is expected to be extracted at a rate of approximately 20 GPD from the lower section of the extraction wells.

B. Coal Tar Oil is expected to have the following material properties

1. Density ranging from 1.06 – 1.08 g/mL at 50˚F
2. Viscosity ranging from 41.5 cSt – 170 cSt at 50˚F
3. Flash point greater than 73˚F but less than 140˚F in accordance with ASTM Method D93, *Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester*
4. Primarily comprised of benzene, naphthalene, and PAHs

C. All components in contact with free DNAPL or LNAPL shall be in compliance with NFPA 30 for Class IC flammable liquid. The LNAPL has not be characterized. LNAPL and DNAPL tanks shall be placed within a separate enclosure.

2.2 GROUNDWATER

A. Groundwater is expected to be extracted and treated at a continuous maximum rate of 20 gpm 24-hours/day, 7-days/week, excluding down time, during normal plant operation

B. Based on site groundwater characterization, groundwater extracted from the extraction wells is expected to contain some DNAPL. Anticipated concentrations of key parameters and target remediation objectives are identified below. Influent concentrations that exceed effluent criteria are bolded. These data are based on limited sampling and may be greater than or less than that indicated for individual parameters.

Contaminant	Influent Conc. (µg/L) Dissolved | Total		Effluent Criteria (µg/L)
Organics			
Benzene		**689**	5
Ethylbenzene		**2,050**	700
Xylenes, total		1,620	10,000
1-Methylnaphthalene		**3,320**	490
2-Methylnaphthalene		**4,640**	28
Acenaphthene		**2,070**	420
Acenaphthylene		**367**	210
Anthracene		921	2,100
Benzo(a)anthracene		**478**	0.13
Benzo(a)pyrene		**330**	0.2
Benzo(b)fluoranthene		**245**	0.18
Benzo(g,h,i)perylene		121	210
Benzo(k)fluoranthene		**93.2**	0.17
Chrysene		**437**	1.5
Dibenz(a,h)anthracene		**38.1**	0.3
Fluoranthene		**922**	280
Fluorene		**1,080**	280
Indeno(1,2,3-cd)pyrene		**103**	0.43
Naphthalene		**12,100**	140
Phenanthrene		**3,120**	210
Pyrene		**1,230**	210
Phenol		**58.4**	100
GRO (C6-C10)		20,400	NA
DRO (C10-C28)		82,800	NA
Oil & Grease (O&G)		50,600	NA
Metals			
Antimony	0.39	0.3	6
Arsenic	8.1	9.6	50
Barium	209	210	2,000
Boron	708	673	2,000
Cadmium	0.28	0.11	5
Calcium	159,000	155,000	NA
Cobalt	0.39	0.24	1,000
Copper	<1.1	1.5	650
Iron	**6,660**	**9,030**	5,000
Lead	0.39	0.41	8

Contaminant	Influent Conc. (µg/L) Dissolved | Total		Effluent Criteria (µg/L)
Lithium	24.4	24.5	NA
Magnesium	71,300	69,200	NA
Manganese	**276**	**258**	150
Molybdenum	0.5	<0.44	35
Nickel	0.98	0.97	100
Potassium	12,700	11,200	NA
Selenium	0.42	<0.32	50
Silver	0.11	<0.1	50
Sodium	215,000	208,000	NA
Strontium	943	874	4,200
Sulfur		6,400	NA
Thallium	0.3	0.15	2
Tungsten		1.5	NA
Vanadium	1.3	2.3	49
Zinc	5.6	7.1	5,000
Other (mg/L)			
Alkalinity		611	NA
Chloride		420	NA
Sulfate		20.8	400
Total Organic Carbon		22.9	NA
Total Dissolved Solids		1,210	NA
Total Suspended Solids		48.8	NA

PART 3 - UNIT PROCESSES

3.1 OIL WATER SEPARATOR (OWS)

A. OWS shall be designed to remove free DNAPL, LNAPL and Total Suspended Solids (TSS) from the influent/raw groundwater at a design flowrate of 25 gpm (20 gpm from the recovery wells and 5 gpm internal recycle flows).

B. OWS shall be equipped with an upfront DNAPL/Sludge hopper with bottom pump out, and a pump out location for LNAPL

C. OWS shall contain a coalescing plate pack and a coalescing filter for improved separation

D. OWS shall be placed on legs or cribbing to allow gravity flow through the treatment system to the outlet of the inclined plate clarifier.

3.2 DNAPL/LNAPL STORAGE

A. DNAPL from DNAPL collection pumps and separated DNAPL (removed from the OWS) will be combined and stored in a metal tote or vessel located in a separate enclosure in accordance with NFPA 30

B. Similarly, LNAPL from the OWS will be pumped to the DNAPL tote located in the DNAPL tote/tank enclosure.

C. DNAPL and LNAPL will be manually pumped from the OWS using the same Air Operated Double Diaphragm (AODD) pump rated for a maximum of 5 gpm, to be used intermittently.

D. DNAPL/LNAPL enclosure shall be a chemical storage locker, with 2-hour fire-rated walls, containing secondary containment exceeding tote capacity, equipped with explosion proof construction, building heat, exhaust ventilation, R-11 insulation, blow out panel, stopping of active ventilation in event of fire, doors large enough to lift the tote out with a forklift, and in compliance with NFPA 30 for storage of flammable Class IC liquids.

3.3 PH ADJUSTMENT TANK

A. To provide metals precipitation, the pH will be raised to approximately 9.0-9.5 S.U. via addition of 50% Sodium Hydroxide (NaOH)

B. pH adjustment mix tank to be 350-500 gallons and equipped with a top-mounted mixer

C. 50% NaOH drum to be provided with spill containment

D. 50% NaOH metering pump to provide approximately 0-2 gallons per hour

E. 50% NaOH metering pump to be provided with splash protection and secondary containment of tubing that will drain to the secondary containment area in the event of a leak around the pump or of the discharge piping.

F. Include supporting infrastructure: Emergency eyewash/drench hoses, heating, and ventilation of enclosures to atmosphere.

3.4 LAMELLA INCLINED PLATE CLARIFIER

A. Lamella clarifier to be equipped with two up-front mixing (flash mix and flocculation) chambers for polymer addition. Flash mix, flocculation chambers, and mixing elements shall be sized in accordance with the current edition of *Recommended Standards for Wastewater Facilities Policies for the Design, Review and Approval of Plans and Specifications for Wastewater Collection and Treatment Facilities*, commonly referred to as 10 States Standards.

B. Both chambers to be equipped with independent agitation. Second chamber to have slow-speed paddle mixing to prevent disturbing formed flocs

C. Clarifier shall be sized for maximum rise rate of 0.25 gpm/sf based on effective plate settling area at 25 gpm throughput rate.

D. A 2" Air-Operated Double Diaphragm (AODD) pump shall be provided for intermittent pump out of settled solids

3.5 SOLIDS CAPTURE GEOTUBE

A. A geotube will be provided and installed in a covered, dewatering box for solids removal. Dewatering rolloff to be Ader 25 cy dewatering box with hard top or canvas (water tight) top or equal.

B. Geotube to be Watersolve Geotube 22.5 ft. circ. X 22 ft. long GT500D Geotube Container with GFF, or equal, positioned within the dewatering box, on top of the false bottom to allow for liquid accumulation.

C. A 1" AODD pump to be provided for intermittent pump out of filtrate groundwater.

D. Filtrate to be returned to pH adjustment tank

3.6 IN-LINE MIXER FOR PH ADJUSTMENT

A. An in-line mixer to be provided for pH re-adjustment

B. pH to be lowered to approximately 7 S.U. through dosing of 70% Nitric Acid to prevent scaling and solids build-up in downstream treatment.

C. 70% Nitric Acid drum and containment to be provided.

D. Metering pump to be provided to dose 0-2 gpm of 70% Nitric Acid.

3.7 PUMP OUT TANK

A. Pump out tank to be provided with a working capacity of no less than 150 gallons.

B. Rotary lobe pump to be provided to pump through filtration and adsorption beds at approximately 20-25 gpm.

C. Two N2 size bag filters, operated in parallel, to be provided for TSS removal to prevent solids buildup in adsorption beds.

3.8 ORGANOCLAY ADSORPTION

A. An organoclay adsorption bed will be provided for removal of remaining emulsified DNAPL/LNAPL.

B. An oleophilic bag filter to be installed directly following the organoclay bed to gauge when breakthrough has occurred.

C. PAHs may also be removed through the organoclay adsorber.

D. Backwash will be provided by the treated effluent water and effluent pump and will be directed to the geotube for filtration

E. Vessel to be rated for 100 psig minimum.

3.9 CARBON ADSORPTION

A. Three GAC carbon adsorption beds to be provided for removal of PAHs and VOCs. GAC units to be sized for 15-min empty bed contact time for each unit at 25 gpm throughput. Three units to be provided with valving configured so that lead/lag units are sequentially A to B, then B to C, then C to A. Valving also to be configured for isolating any unit (for GAC replacement and backwashing). GAC vessels to be sized for Empty Bed Contact Time (EBCT) of not less than 15 minutes/vessel. Vessels to be rated for 100 psig min.

B. Operation of carbon beds to be lead-lag-spare to limit downtime and allow adequate time for carbon changeout

C. Carbon backwash will be provided by the treated effluent water and effluent pump and will be directed to the geotube for fines removal through filtration

3.10 EFFLUENT STORAGE TANK

A. Effluent storage tank to have capacity to hold sufficient water to backwash a single GAC vessel at 5 to 10 gpm/sf for not less than 10 minutes, and to provide sufficient residence time for final pH polishing

B. Final pH polishing to be accomplished through use of 50% NaOH and 70% Nitric Acid.

C. Dedicated NaOH and acid metering pumps to be used to maintain final target pH from 6.9 – 7.1 S.U.

D. Centrifugal pump rated for 20-50 gpm to be provided for re-injection and adsorption backwash (or greater capacity if GAC backwash requirements dictate). Manual valves will be provided for pump turn-down. A flow meter with flow totalizing capabilities will be installed on the treated discharge to the formation line, as well as on the backwash line.

3.11 AIR COMPRESSOR

A. Air compressor and supporting peripherals to power air-operated pumps in the treatment plant and in in the extraction well network.

B. Minimum capacity of 100 cubic feet per minute with an optimal discharge pressure range between 125 and 145 psig.

C. Air compressor to be rotary-type positive-displacement mechanism with auto load/unload, and stop/start.

D. Supporting peripherals to include a non-heated Desiccant Air Dryer to remove moisture to a -40˚F dew point, a 5-micron particulate filter, and a coalescing oil removal filter.

PART 4 - ENCLOSURE

A. The treatment system shall be constructed within one or a series of enclosure(s), such as a temporary building, shipping container, or semi-trailer.

B. Enclosure shall incorporate heating and ventilation for worker safety. Due to the aromatic properties of coal tar DNAPL, ventilation must be able to be continuously operated.

C. The DNAPL and LNAPL storage tanks shall be housed within a separate enclosure from the remaining treatment system.

PART 5 - CONTROL STRATEGY

5.1 MANUAL OPERATIONS

A. The packaged water and wastewater treatment system will primarily be operated manually.

B. Pumps, excluding caustic and acid pumps, to be operated manually

C. Mixers to be operated manually

D. Valves to be operated manually

E. Instrumentation, excluding pH adjustment instruments, to be observed manually with no digital recording, including adsorption pressure gauges

5.2 AUTOMATED OPERATIONS

A. Key interlocks for process safety and equipment protection will be automated through a program logic controller (PLC). This interlocks will include high-level switches within tanks and high pressure switches associated with pressure vessels (media vessels, bag filters, and geotubes).

B. pH will be controlled using local controllers. Signal from a pH probe will be used to control metering pump speed or stroke.

C. Extraction pumps shall be controlled through a solenoid panel, consisting of three-way solenoid valves connected to a PLC, which will control the pump cycle length and pump cycle frequency.

PART 6 - SAMPLING

6.1 SAMPLING POINTS

A. Sampling points to be provided at the following location for system monitoring

1. OWS Influent
2. OWS Discharge
3. Lamella clarifier liquid discharge
4. Pump out tank following in-line pH adjustment/Organoclay feed
5. Organoclay discharge/Carbon feed
6. Carbon discharge
7. Treated effluent tank

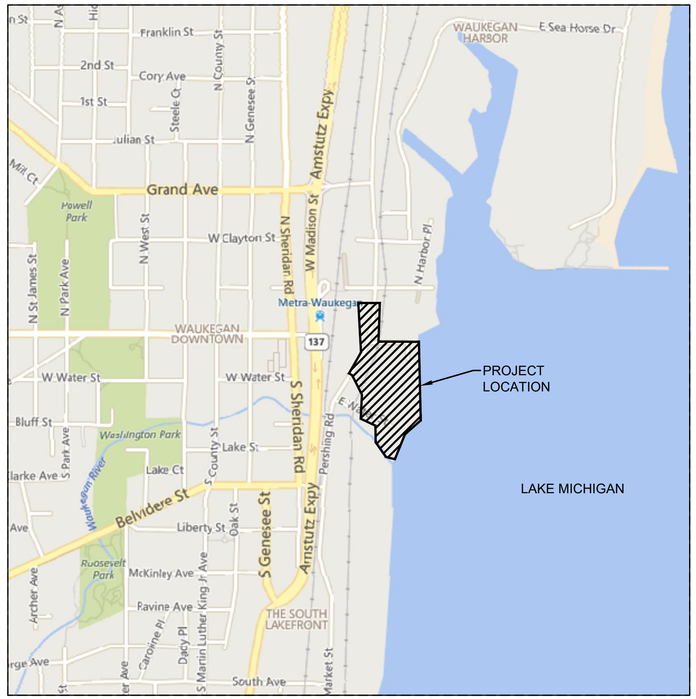
END OF SECTION

Appendix B

Plan Drawings

FINAL DESIGN

FORMER NORTH SHORE GAS SOUTH PLANT MANUFACTURED GAS PLANT REMEDIAL DESIGN PHASE 1



SITE LOCATION MAP

NOT TO SCALE

NORTH

NORTH SHORE GAS
WAUKEGAN, ILLINOIS

MARCH 2019

O'BRIEN & GERE ENGINEERS, INC.

INDEX TO DRAWINGS

31060.67860–000

SURVEY AND UTILITY NOTES:

1. SURVEY IS REFERENCED HORIZONTALLY TO THE NORTH AMERICAN DATUM OF 1983 (NAD83) AND PROJECTED ON THE ILLINOIS STATE PLANE COORDINATE SYSTEM (EAST ZONE) AND VERTICALLY TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
2. VERIFY ALL DIMENSIONS PERTINENT TO THE WORK OF THIS CONTRACT IN THE FIELD. PROPOSED GRADES AND ELEVATIONS SHOWN ARE FINISHED ELEVATIONS. IF DISCREPANCIES ARE FOUND BETWEEN THE PLANS AND PHYSICAL CONDITIONS OF THE SITE, NOTIFY THE OWNER'S REPRESENTATIVE OF DISCREPANCY PRIOR TO PERFORMING WORK.
3. CONTRACTOR SHALL LOCATE ALL UTILITIES PRIOR TO ANY EXCAVATION ACTIVITIES. CONTRACTOR TO CONTACT J.U.L.I.E. (DIAL 811) AND CONTRACT A PRIVATE LOCATOR TO LOCATE PRIVATE UTILITIES. ABIDE BY ALL LOCATING AND TICKET MAINTENANCE REQUIREMENTS OF THE SERVICE. MAINTAIN CLEARANCES AS REQUIRED BY THE PROGRAM WHEN DIGGING AROUND MARKED UTILITIES.
4. COORDINATE AND OBTAIN NECESSARY PERMITS FOR ELECTRICAL SERVICE CONNECTIONS WITH THE CITY OF WAUKEGAN.

SOURCE NOTES:

1. TOPOGRAPHIC AND UTILITY SURVEY PROVIDED BY MCCLURE ENGINEERING ASSOCIATES, INC. DECEMBER 1, 2017.

NOTIFICATIONS:

1. ENGINEER OR OWNER DESIGNATED ALTERNATE SHALL COORDINATE WITH THE CITY OF WAUKEGAN ENGINEER AT 847-625-6858 A MINIMUM OF 30 DAYS PRIOR TO COMMENCING INTRUSIVE CONSTRUCTION ACTIVITIES TO SCHEDULE A PRE-CONSTRUCTION MEETING.
2. ENGINEER OR OWNER DESIGNATED ALTERNATE SHALL COORDINATE WITH DEVIN SPRINKLE, THE WISCONSIN CENTRAL RAILROAD'S REGIONAL ENVIRONMENTAL MANAGER AT 708-332-3850 A MINIMUM OF 3 DAYS PRIOR TO COMMENCING INTRUSIVE CONSTRUCTION ACTIVITIES TO SCHEDULE A PRE-CONSTRUCTION MEETING.
3. ENGINEER OR OWNER DESIGNATED ALTERNATE SHALL COORDINATE WITH THE WAUKEGAN PORT DISTRICT AT 847-244-0055 A MINIMUM OF 15 DAYS PRIOR TO COMMENCING INTRUSIVE CONSTRUCTION ACTIVITIES TO SCHEDULE A PRE-CONSTRUCTION MEETING.

APPLICABLE LAKE COUNTY STORMWATER MANAGEMENT COMMISSION SOIL EROSION AND SEDIMENT CONTROL CONSTRUCTION NOTES:

1. SEDIMENT CONTROL MEASURES SHALL BE INSTALLED PRIOR TO THE COMMENCEMENT OF DISTURBANCE OF UPLAND AREAS.
2. FOR THOSE DEVELOPMENTS THAT REQUIRE A DESIGNATED EROSION CONTROL INSPECTOR (DECI), INSPECTIONS AND DOCUMENTATION SHALL BE PERFORMED, AT A MINIMUM:
   a. UPON COMPLETION OF SEDIMENT AND RUNOFF CONTROL MEASURES (INCLUDING PERIMETER CONTROLS AND DIVERSIONS), PRIOR TO PROCEEDING WITH ANY OTHER EARTH DISTURBANCE OR GRADING.
   b. AFTER EVERY SEVEN (7) CALENDAR DAYS OR STORM EVENT WITH GREATER THAN 0.5 INCH OF RAINFALL OR LIQUID EQUIVALENT PRECIPITATION.
3. SOIL DISTURBANCE SHALL BE CONDUCTED IN SUCH A MANNER AS TO MINIMIZE EROSION. IF STRIPPING, CLEARING, GRADING, OR LANDSCAPING ARE TO BE DONE IN PHASES, THE PERMITTEE SHALL PLAN FOR APPROPRIATE SOIL EROSION AND SEDIMENT CONTROL MEASURES.
4. A TRACKING PAD OF CRUSHED STONE MEETING IDOT GRADATION CA-1 UNDERLAIN WITH FILTER FABRIC AND IN ACCORDANCE WITH THE ILLINOIS URBAN MANUAL (SEE DETAIL 'C', SHEET C-501), OR OTHER APPROPRIATE MEASURE(S) AS APPROVED BY THE ENFORCEMENT OFFICER, SHALL BE INSTALLED AT ANY POINT WHERE TRAFFIC WILL BE ENTERING OR LEAVING A CONSTRUCTION SITE. SEDIMENT OR SOIL REACHING AN IMPROVED PUBLIC RIGHT-OF-WAY, STREET, ALLEY OR PARKING AREA SHALL BE REMOVED BY SCRAPING OR STREET CLEANING AS ACCUMULATIONS WARRANT AND TRANSPORTED TO A CONTROLLED SEDIMENT DISPOSAL AREA.
5. TEMPORARY DIVERSIONS SHALL BE CONSTRUCTED AS NECESSARY TO DIRECT ALL RUNOFF FROM HYDROLOGICALLY DISTURBED AREAS TO AN APPROPRIATE SEDIMENT TRAP OR BASIN.
6. DISTURBED AREAS SHALL BE STABILIZED WITH TEMPORARY OR PERMANENT MEASURES WITHIN SEVEN (7) CALENDAR DAYS FOLLOWING THE END OF ACTIVE HYDROLOGIC DISTURBANCE OR REDISTURBANCE.
7. ALL STOCKPILES SHALL HAVE APPROPRIATE MEASURES TO PREVENT EROSION. STOCKPILES SHALL NOT BE PLACED IN FLOOD PRONE AREAS OR WETLANDS AND DESIGNATED BUFFERS.
8. STORM SEWERS THAT ARE OR WILL BE FUNCTIONING DURING CONSTRUCTION SHALL BE PROTECTED BY AN APPROPRIATE SEDIMENT CONTROL MEASURE (SEE SHEET C-501, DETAILS 'B' AND 'F').
9. ALL TEMPORARY AND PERMANENT EROSION CONTROL MEASURES MUST BE MAINTAINED AND REPAIRED AS NEEDED.
10. ALL TEMPORARY SEDIMENT CONTROL MEASURES SHALL BE REMOVED WITHIN 30 DAYS AFTER FINAL SITE STABILIZATION IS ACHIEVED OR AFTER THE TEMPORARY MEASURES ARE NO LONGER NEEDED.
11. THE EROSION CONTROL MEASURES INDICATED ON THE PLANS ARE THE MINIMUM REQUIREMENTS. ADDITIONAL MEASURES MAY BE REQUIRED, AS DIRECTED BY THE ENGINEER, ENFORCEMENT OFFICER, OR OTHER GOVERNING AGENCY.

RESTORATION NOTES:

1. CONTRACTOR SHALL RESTORE ALL AREAS DISTURBED TO COMPLETE THE WORK TO PRE-CONSTRUCTION CONDITIONS. SEE SPECIFICATION 32 93 13 TOPSOIL AND SEEDING.

GENERAL NOTES:

1. TRUCKS SHALL FOLLOW ALL LOCAL AND STATE REQUIREMENTS WHEN TRANSPORTING MATERIALS TO/FROM THE SITE.
2. PROVIDE FLAGMAN AND BARRICADES AS NECESSARY TO CONTROL TRAFFIC IN ACCORDANCE WITH ILLINOIS DEPARTMENT OF TRANSPORTATION STANDARDS FOR TRAFFIC CONTROL.
3. PROTECT EXISTING SITE FEATURES FROM DAMAGE. ANY DAMAGE SHALL BE REPAIRED OR REPLACED AT NO ADDITIONAL COST BY CONTRACTOR.

ABBREVIATIONS

@	AT
APPROX.	APPROXIMATE
BIT.	BITUMINOUS
BLDG	BUILDING
BM	BENCH MARK
CB	CATCH BASIN
CONC.	CONCRETE
DECI	DESIGNATED EROSION CONTROL INSPECTOR
DNAPL	DENSE NON-AQUEOUS PHASE LIQUID
E	EAST OR ELECTRIC
EX.	EXISTING
FO	FIBER OPTIC
FT	FEET
G	GAS
GAC	GRANULAR ACTIVATED CARBON
HDPE	HIGH DENSITY POLYETHYLENE
INV	INVERT
MH	MANHOLE
MIN.	MINIMUM
N	NORTH
RD	ROAD
S	SOUTH
SAN	SANITARY
ST	STORM
STA.	STATION
T/P	TOP OF PIPE
TYP.	TYPICAL
W	WATER OR WEST
W/	WITH

LEGEND

- PROPERTY LINE
- 588 — EXISTING CONTOUR
- x — EXISTING FENCE LINE
- EXISTING TREE OR TREE LINE
- G — EXISTING GAS
- E — EXISTING ELECTRIC
- E — EXISTING ELECTRIC MANHOLE
- R — EXISTING RECOVERY WELL
- EXISTING OVERHEAD POWER POLE
- W — EXISTING WATER
- EXISTING HYDRANT
- FO — EXISTING FIBER OPTIC
- SAN — EXISTING SANITARY SEWER
- EXISTING SANITARY SEWER MANHOLE
- ST — EXISTING STORM SEWER
- EXISTING STORM SEWER MANHOLE
- EXISTING MONITORING WELL
- EXISTING BUILDING
- SF — PROPOSED SILT FENCE
- PROPOSED TRACKING PAD
- PROPOSED TEMPORARY FENCING
- PROPOSED APPROX. WASTEWATER TREATMENT PAD LOCATION
- PROPOSED SENTRY GROUNDWATER MONITORING WELL
- PROPOSED DNAPL RECOVERY/GROUNDWATER EXTRACTION WELL
- PROPOSED VERTICAL GROUNDWATER INJECTION WELL
- PROPOSED JUNCTION VAULT
- PROPOSED HORIZONTAL GROUNDWATER INJECTION PIPING
- PROPOSED DNAPL RECOVERY SYSTEM PIPING
- GW — PROPOSED GROUNDWATER FORCE MAIN
- PROPOSED MONITORING WELL

NOT FOR CONSTRUCTION

DATE: 03/08/2019

THIS DRAWING WAS PREPARED AT THE SCALE INDICATED. INACCURACIES IN THE STATED SCALE MAY BE INTRODUCED WHEN DRAWINGS ARE REPRODUCED BY ANY MEANS. USE THE GRAPHIC SCALE BAR TO DETERMINE THE ACTUAL SCALE. DRAWING IS NOT SCALABLE IF NO SCALE BAR IS PRESENT.

IN CHARGE OF M. BYKER
DESIGNED BY D. KAHN
CHECKED BY B. PLATT
DRAWN BY S. JOHNSON

NO.	DATE	REVISION	INT.
B	03/08/19	ISSUED FOR USEPA APPROVAL	MDB
A	01/07/19	ISSUED FOR USEPA REVIEW	MDB

O'BRIEN & GERE ENGINEERS, INC

FORMER NORTH SHORE GAS SOUTH PLANT
MANUFACTURED GAS PLANT REMEDIAL DESIGN

WAUKEGAN, ILLINOIS

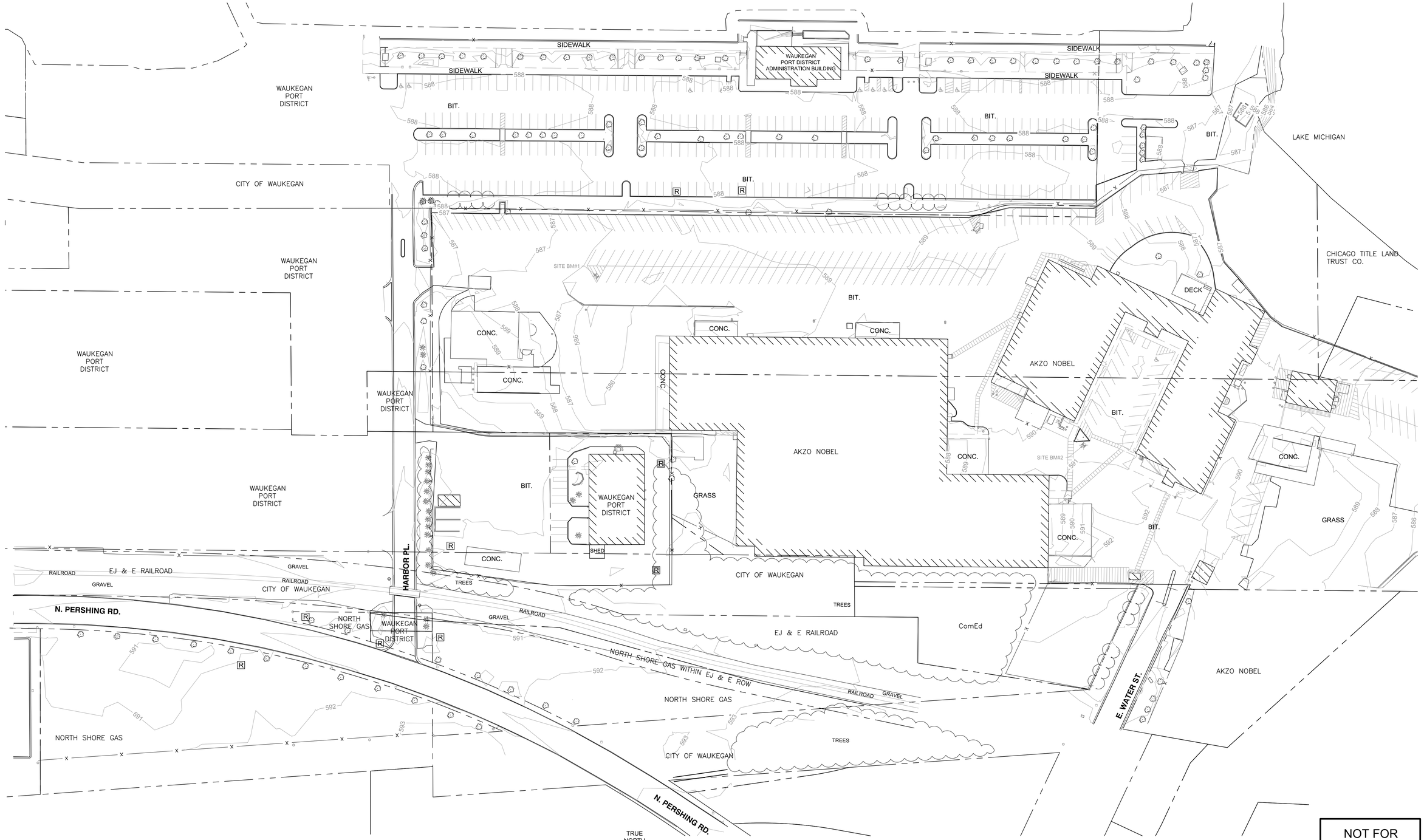
GENERAL

GENERAL NOTES, LEGEND & ABBREVIATIONS

FILE NO. 31060.67860 -001

DATE OCTOBER 2018

G-001



TRUE NORTH

PLAN

SCALE: 1"=50' 50' 0 50'

NOT FOR CONSTRUCTION
DATE: 03/08/2019

IN CHARGE OF M. BYKER
DESIGNED BY D. KAHN
CHECKED BY B. PLATT
DRAWN BY S. JOHNSON

NO.	DATE	REVISION	INT.
B	03/08/19	ISSUED FOR USEPA APPROVAL	MDB
A	01/07/19	ISSUED FOR USEPA REVIEW	MDB

O'BRIEN & GERE ENGINEERS, INC

FORMER NORTH SHORE GAS SOUTH PLANT
MANUFACTURED GAS PLANT REMEDIAL DESIGN

WAUKEGAN, ILLINOIS

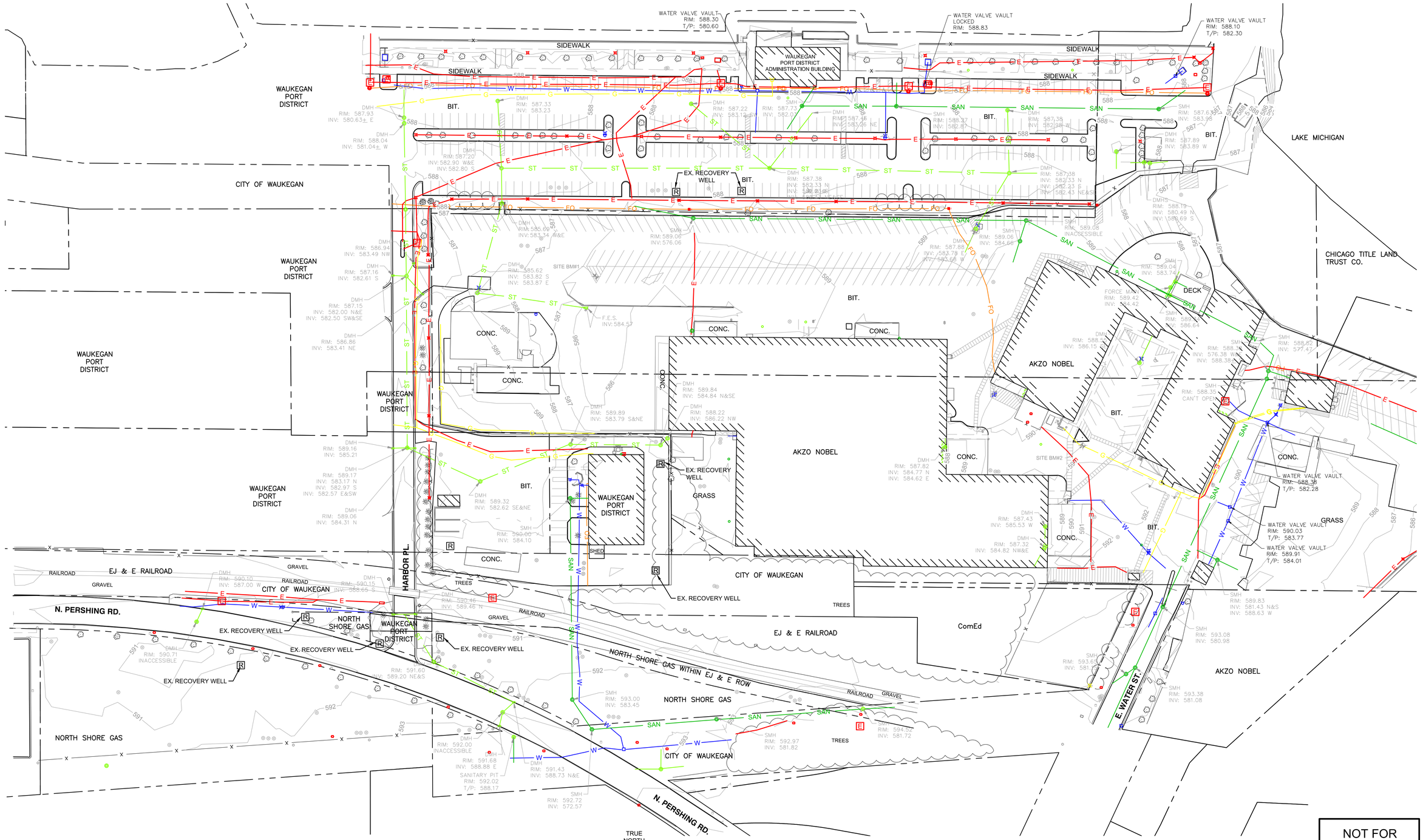
CIVIL

PRE-CONSTRUCTION SITE CONDITIONS

FILE NO. 31060.67860 -101

DATE OCTOBER 2018

C-101



NOT FOR CONSTRUCTION

DATE: 03/08/2019

PLAN

SCALE: 1"=50' 50' 0 50'

IN CHARGE OF	M. BYKER			
DESIGNED BY	D. KAHN			
CHECKED BY	B. PLATT	B	03/08/19	ISSUED FOR USEPA APPROVAL — MDB
DRAWN BY	S. JOHNSON	A	01/07/19	ISSUED FOR USEPA REVIEW — MDB
		NO.	DATE	REVISION — INT.

O'BRIEN & GERE ENGINEERS, INC

FORMER NORTH SHORE GAS SOUTH PLANT
MANUFACTURED GAS PLANT REMEDIAL DESIGN

WAUKEGAN, ILLINOIS

CIVIL

EXISTING SITE UTILITIES

FILE NO. 31060.67860 -102

DATE OCTOBER 2018

C-102

SAVED: 3/6/19 9:19 AM

WATER VALVE VAULT RIM: 588.30 T/P: 580.60
WATER VALVE VAULT LOCKED RIM: 588.83
WATER VALVE VAULT RIM: 588.10 T/P: 582.30
SIDEWALK
WAUKEGAN PORT DISTRICT ADMINISTRATION BUILDING
WAUKEGAN PORT DISTRICT
CITY OF WAUKEGAN
LAKE MICHIGAN
CHICAGO TITLE LAND TRUST CO.
FUTURE WELL FIELD (NOT PART OF CONTRACT)
SEE SHEET C-105 FOR PHASE 1 AREA DESIGN
SITE BM#1
SITE BM#2
BIT.
CONC.
GRASS
GRAVEL
TREES
DECK
AKZO NOBEL
ComEd
SHED
HARBOR PL.
E. WATER ST.
N. PERSHING RD.
EJ & E RAILROAD
RAILROAD
NORTH SHORE GAS
NORTH SHORE GAS WITHIN EJ & E ROW
UTILIZE EXISTING RECOVERY WELL
JV01
JV02
JV03
JV04
JV05
GW
DMH RIM: 587.93 INV: 580.63± E
DMH RIM: 588.04 INV: 581.04± W
DMH RIM: 587.20 INV: 582.90 W&E INV: 582.80 S
DMH RIM: 587.23 INV: 583.23
DMH RIM: 587.38 INV: 582.33 N INV: 582.23 S INV: 582.43 NE&S
DMH RIM: 587.46 INV: 585.76 NE
DMH RIM: 587.38 INV: 582.38 W
DMH RIM: 587.88 INV: 583.78 E INV: 583.24 W
DMH RIM: 588.19 INV: 580.49 N INV: 580.69 S
DMH RIM: 587.89 INV: 583.89 W
DMH RIM: 585.66 INV: 583.34 W&E
DMH RIM: 585.62 INV: 583.82 S INV: 583.87 E
DMH RIM: 586.94 INV: 583.49 NW
DMH RIM: 587.16 INV: 582.61 S
DMH RIM: 587.15 INV: 582.00 N&E INV: 582.50 SW&SE
DMH RIM: 586.86 INV: 583.41 NE
DMH RIM: 589.16 INV: 585.21
DMH RIM: 589.17 INV: 583.17 N INV: 582.97 S INV: 582.57 E&SW
DMH RIM: 589.06 INV: 584.31 N
DMH RIM: 589.84 INV: 584.84 N&SE
DMH RIM: 589.89 INV: 583.79 S&NE
DMH RIM: 588.22 INV: 586.22 NW
DMH RIM: 589.32 INV: 582.62 SE&NE
DMH RIM: 587.82 INV: 584.77 N INV: 584.62 E
DMH RIM: 587.43 INV: 585.53 W
DMH RIM: 587.32 INV: 584.82 NW&E
DMH RIM: 590.10 INV: 588.65 S
DMH RIM: 590.46 INV: 589.46 N
DMH RIM: 591.68 INV: 588.88 E
DMH RIM: 591.43 INV: 588.73 N&E
DMH RIM: 590.71 INACCESSIBLE
DMH RIM: 592.00 INACCESSIBLE
SMH RIM: 589.06 INV: 576.06
SMH RIM: 589.06 INV: 584.66
SMH RIM: 589.08 INACCESSIBLE
SMH RIM: 589.04 INV: 583.74
SMH RIM: 587.66 INV: 583.96
SMH RIM: 588.37 INV: 582.87
SMH RIM: 589.00 INV: 584.10
SMH RIM: 593.00 INV: 583.45
SMH RIM: 592.97 INV: 581.82
SMH RIM: 594.52 INV: 581.72
SMH RIM: 589.83 INV: 581.43 N&S INV: 588.63 W
SMH RIM: 593.08 INV: 580.98
SMH RIM: 593.38 INV: 581.08
SMH RIM: 592.72 INV: 572.57
SMH RIM: 588.35 CAN'T OPEN
SMH RIM: 588.62 INV: 577.47
SMH RIM: 588.38 INV: 576.38 W INV: 588.38 E
FORCE MAIN RIM: 589.42 INV: 584.42
WATER VALVE VAULT RIM: 588.38 T/P: 582.28
WATER VALVE VAULT RIM: 590.03 T/P: 583.77
WATER VALVE VAULT RIM: 589.91 T/P: 584.01
SANITARY PIT RIM: 592.02 T/P: 588.17

IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS ACTING UNDER THE DIRECTION OF A LICENSED ENGINEER, TO ALTER THIS DOCUMENT.

THIS DRAWING WAS PREPARED AT THE SCALE INDICATED. INACCURACIES IN THE STATED SCALE MAY BE INTRODUCED WHEN DRAWINGS ARE REPRODUCED BY ANY MEANS. USE THE GRAPHIC SCALE BAR TO DETERMINE THE ACTUAL SCALE. DRAWING IS NOT SCALABLE WHEN NO SCALE BAR IS PRESENT.

TRUE NORTH

PLAN

SCALE: 1"=50' 50' 0 50'

NOT FOR CONSTRUCTION
DATE: 03/08/2019

IN CHARGE OF	M. BYKER			
DESIGNED BY	D. KAHN			
CHECKED BY	B. PLATT			
DRAWN BY	S. JOHNSON			
NO.	DATE	REVISION	INT.	
B	03/08/19	ISSUED FOR USEPA APPROVAL	MDB	
A	01/07/19	ISSUED FOR USEPA REVIEW	MDB	

O'BRIEN & GERE ENGINEERS, INC

FORMER NORTH SHORE GAS SOUTH PLANT
MANUFACTURED GAS PLANT REMEDIAL DESIGN

WAUKEGAN, ILLINOIS

CIVIL
FULL SCALE
CONCEPTUAL WELL
FIELD DESIGN

FILE NO. 31060.67860 -103
DATE OCTOBER 2018

C-103

\\SERVER27-01\PROJECTS\WBS.31060\67860.1983-WBS - NSGS\DOCS\DWG\PILOT STUDY\67860.C103.DWG

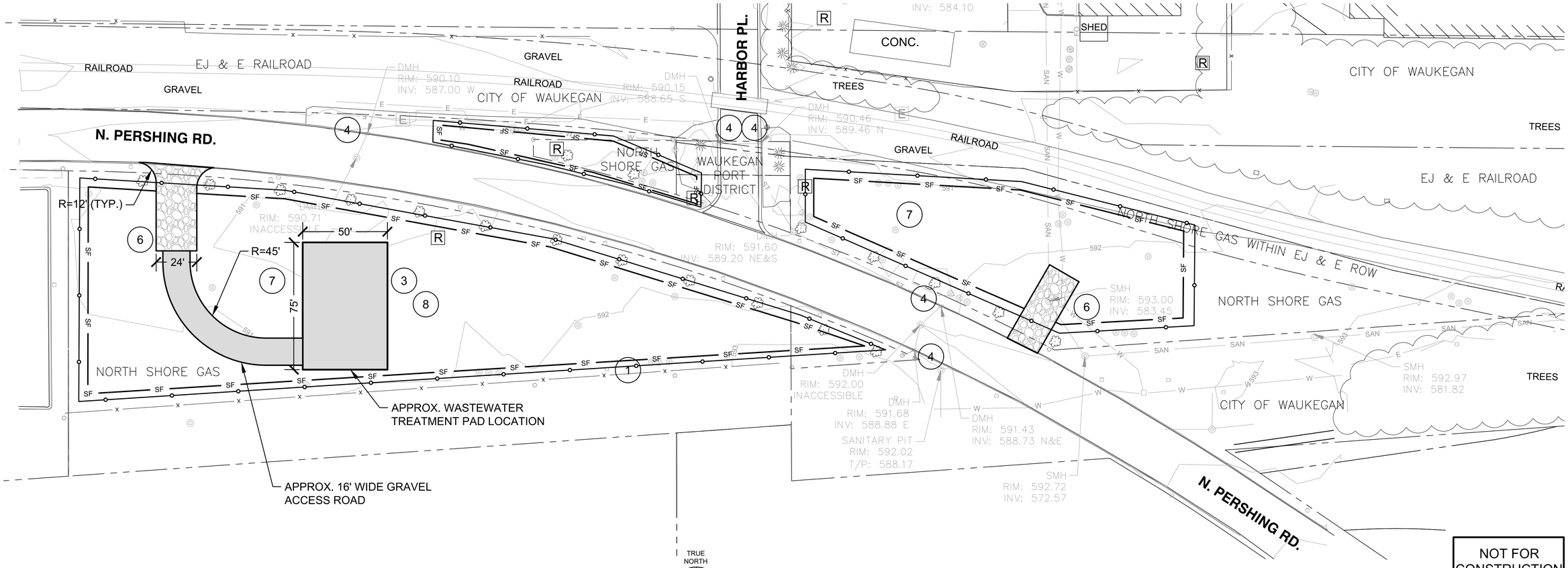
SAVED: 3/6/19 9:27 AM

NOTES:

1. CONTRACTOR SHALL LOCATE AND INSTALL THE PROPOSED TEMPORARY CHAIN LINK FENCE IN THE SHOWN LOCATION. SEE DETAIL 'E', SHEET C-501.
2. CONTRACTOR SHALL NOTIFY ENGINEER OF ANY CONFLICTS WITH BETWEEN TEMPORARY FENCE AND UTILITIES OR STRUCTURES.
3. INSTALL TEMPORARY ELECTRICAL SERVICE FOR PROJECT USE IN ACCORDANCE WITH CITY OF WAUKEGAN MUNICIPAL CODE. SEE DESIGN NOTE (THIS SHEET).
4. PLACE AND MAINTAIN INLET PROTECTION ABOVE STORM SEWER CATCH BASINS LOCATED ON PROPERTY AND IN ADJACENT STREETS. CONTRACTOR TO MAINTAIN AND REPAIR SEDIMENT CONTROLS THROUGHOUT DURATION OF WORK. SEE DETAIL 'B' AND 'F', SHEET C-501.
5. PERFORM EROSION CONTROL INSPECTIONS AND MAINTAIN INSPECTION RECORDS AS REQUIRED BY THE CITY OF WAUKEGAN AND OBTAINED WATERSHED DEVELOPMENT PERMITS. SUBMIT TO ENGINEER IN DAILY REPORT. REPAIR ANY DAMAGED EROSION CONTROLS AND MAINTAIN CONTROLS FOR THE ENTIRE DURATION OF THE WORK.
6. CONSTRUCT TRACKING PAD AT SITE ENTRANCE/EXIT(S) IN LOCATIONS SHOWN ON CONTRACT DRAWING. MAINTAIN TRACKING PADS FOR THE ENTIRE DURATION OF THE WORK. SEE DETAIL 'C', SHEET C-501.
7. PERSONAL VEHICLES AND STAGING OF EQUIPMENT IS LIMITED TO FENCED IN WORK AREA.
8. CLEAR, GRUB, AND REMOVE TOPSOIL WITHIN WORK AREA, AS NECESSARY TO COMPLETE THE WORK.

DESIGN NOTES:

1. ELECTRICAL POWER DROP AND CORRESPONDING ELECTRICAL DESIGN WILL BE COMPLETED IN COLLABORATION WITH COMMONWEALTH EDISON BASED ON ANTICIPATED LOAD FROM VENDOR-PROVIDED RENTAL GROUNDWATER TREATMENT PLANT EQUIPMENT.



TRUE NORTH

PLAN
SCALE: 1"=30'
30' 0 30'

NOT FOR CONSTRUCTION
DATE: 03/08/2019

IN CHARGE OF	M. BYKER
DESIGNED BY	D. KAHN
CHECKED BY	B. PLATT
DRAWN BY	S. JOHNSON

NO.	DATE	REVISION	INT.
B	03/08/19	ISSUED FOR USEPA APPROVAL	MDB
A	01/07/19	ISSUED FOR USEPA REVIEW	MDB

O'BRIEN & GERE ENGINEERS, INC

FORMER NORTH SHORE GAS SOUTH PLANT
MANUFACTURED GAS PLANT REMEDIAL DESIGN

WAUKEGAN, ILLINOIS

CIVIL

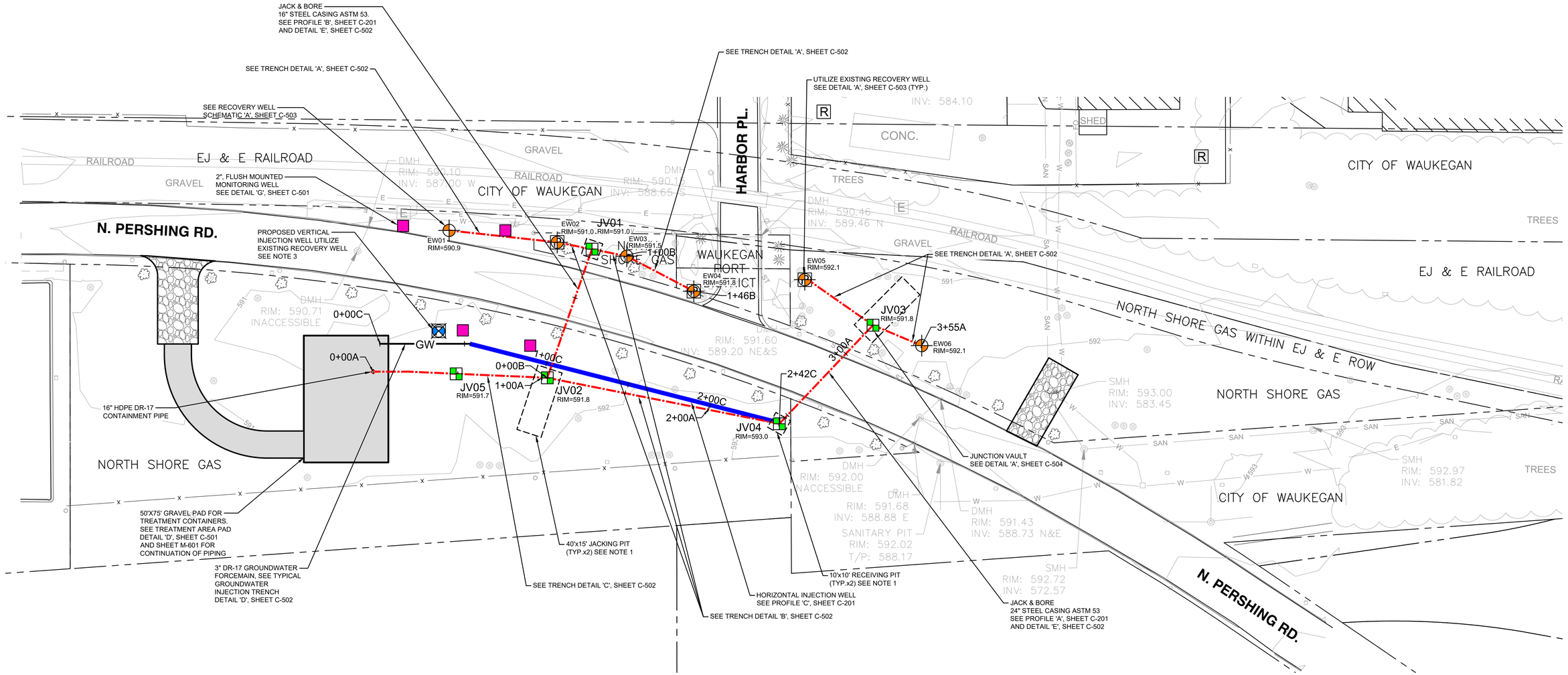
PHASE 1
SITE PREPARATION PLAN

FILE NO. 31060.67860 -104

DATE OCTOBER 2018

C-104

\\SERVER27-01\PROJECTS\WBS.31060\67860.1983-WBS - NSG\DOCS\DWG\PILOT STUDY\67860.C104.DWG



DESIGN NOTES:

1. EQUIPMENT LAYOUT ON TREATMENT AREA TO BE DETERMINED PRIOR TO INITIATION OF CONSTRUCTION ACTIVITIES.
2. ELECTRICAL POWER DROP AND CORRESPONDING ELECTRICAL DESIGN WILL BE COMPLETED IN COLLABORATION WITH COMMONWEALTH EDISON BASED ON ANTICIPATED LOAD FROM VENDOR-PROVIDED RENTAL GROUNDWATER TREATMENT PLANT EQUIPMENT.

NOTES:

1. LAUNCH AND RECEIVING PIT DIMENSIONS ARE APPROXIMATE. FOR LAYOUT PURPOSES ONLY.
2. HORIZONTAL WELL SHALL BE 3" DR-17 HDPE PIPE WITH #20 SLOTS 1.5" TALL. SLOTS SHALL BE SPACED 5.0' AT THE BOTTOM OF THE PIPE (0°) AND 2.5' AT THE TOP OF THE PIPE (180°).
3. VERTICAL INJECTION WELL TO BE INJECTED WITH TEMPORARY ABOVE-GROUND PIPING AS PART OF PILOT TESTING.

TRUE NORTH

PLAN

SCALE: 1"=30' 30' 0 30'

NOT FOR CONSTRUCTION
DATE: 03/08/2019

IN CHARGE OF M. BYKER
DESIGNED BY D. KAHN
CHECKED BY B. PLATT
DRAWN BY S. JOHNSON

NO.	DATE	REVISION	INT.
B	03/08/19	ISSUED FOR USEPA APPROVAL	MDB
A	01/07/19	ISSUED FOR USEPA REVIEW	MDB

O'BRIEN & GERE ENGINEERS, INC

FORMER NORTH SHORE GAS SOUTH PLANT
MANUFACTURED GAS PLANT REMEDIAL DESIGN

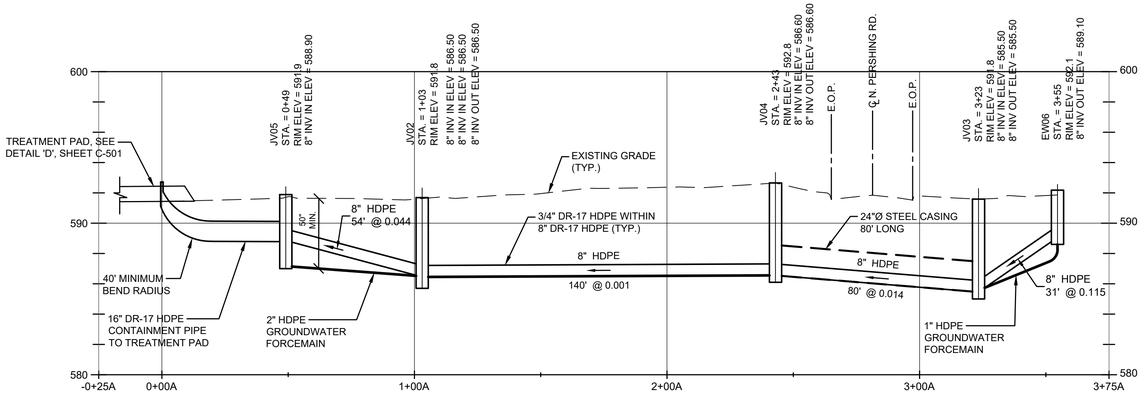
WAUKEGAN, ILLINOIS

CIVIL

PHASE 1
WELL FIELD DESIGN

FILE NO. 31060.67860 -105
DATE OCTOBER 2018

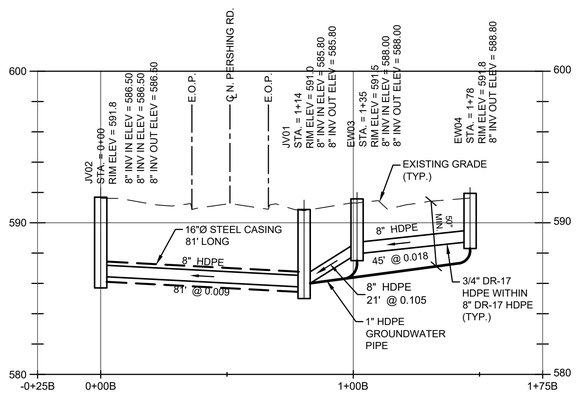
C-105



PROFILE - A

SCALE: HORIZ. 1"=30'
VERT. 1"=5'

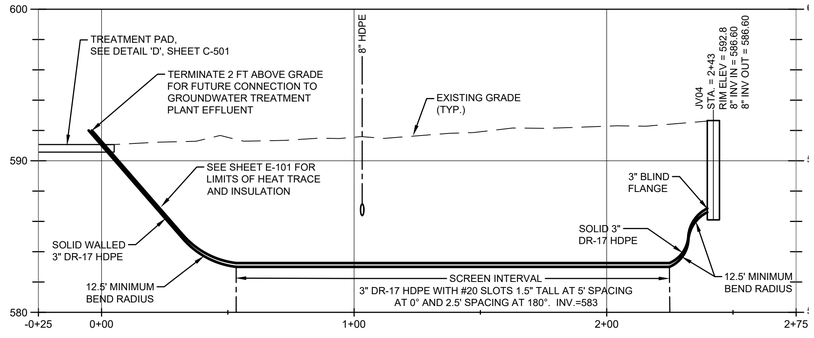
30' 0 30'
5' 0 5'



PROFILE - B

SCALE: HORIZ. 1"=30'
VERT. 1"=5'

30' 0 30'
5' 0 5'



PROFILE - C

SCALE: HORIZ. 1"=30'
VERT. 1"=5'

30' 0 30'
5' 0 5'

NOT FOR CONSTRUCTION
DATE: 03/08/2019

IN CHARGE OF M. BYKER
DESIGNED BY D. KAHN
CHECKED BY B. PLATT
DRAWN BY S. JOHNSON

NO.	DATE	REVISION	INT.
B	03/08/19	ISSUED FOR USEPA APPROVAL	MDB
A	01/07/19	ISSUED FOR USEPA REVIEW	MDB

O'BRIEN & GERE ENGINEERS, INC

FORMER NORTH SHORE GAS SOUTH PLANT
MANUFACTURED GAS PLANT REMEDIAL DESIGN

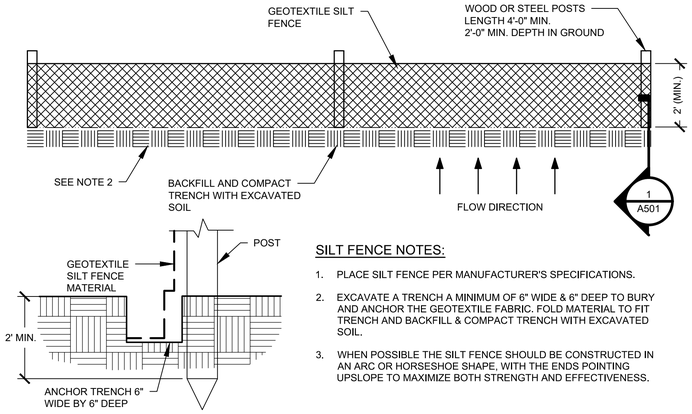
WAUKEGAN, ILLINOIS

CIVIL

PROFILES

FILE NO. 31060.67860 -201
DATE OCTOBER 2018

C-201

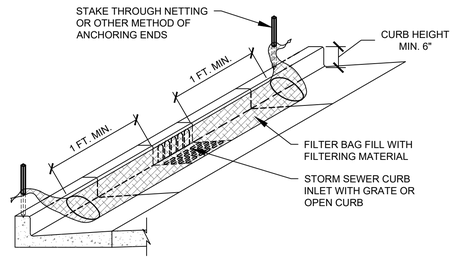


1 SECTION
NOT TO SCALE

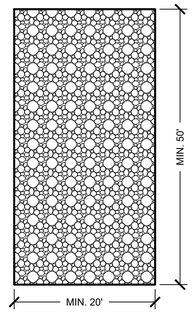
SILT FENCE NOTES:

1. PLACE SILT FENCE PER MANUFACTURER'S SPECIFICATIONS.
2. EXCAVATE A TRENCH A MINIMUM OF 6" WIDE & 6" DEEP TO BURY AND ANCHOR THE GEOTEXTILE FABRIC. FOLD MATERIAL TO FIT TRENCH AND BACKFILL & COMPACT TRENCH WITH EXCAVATED SOIL.
3. WHEN POSSIBLE THE SILT FENCE SHOULD BE CONSTRUCTED IN AN ARC OR HORSESHOE SHAPE, WITH THE ENDS POINTING UPSLOPE TO MAXIMIZE BOTH STRENGTH AND EFFECTIVENESS.

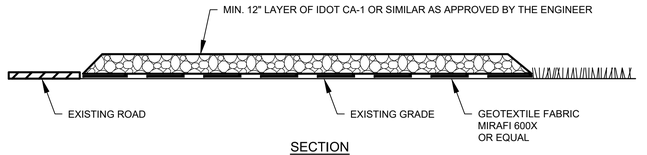
A SILT FENCE DETAIL
NOT TO SCALE



B INLET PROTECTION - PAVED AREAS
CURB PROTECTION
NOT TO SCALE



PLAN

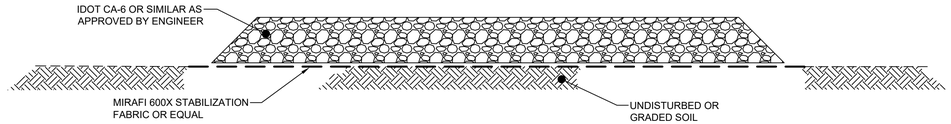


SECTION

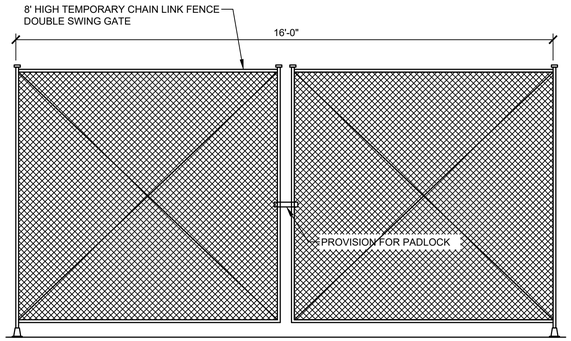
TRACKING PAD NOTES:

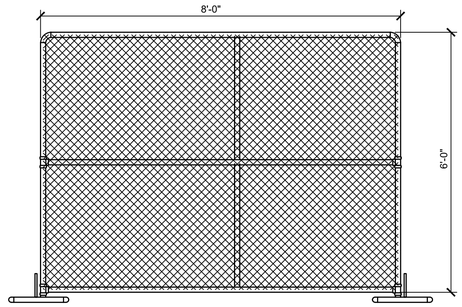
1. DETAILS OF CONSTRUCTION, MATERIALS AND WORKMANSHIP NOT SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE STANDARD SPECIFICATIONS AND THE APPLICABLE SPECIAL PROVISIONS.
2. TRACKING PAD SHALL BE INSPECTED DAILY. DEFICIENT AREAS SHALL BE REPAIRED OR REPLACED IMMEDIATELY.
3. TRACKING PAD TO BE REMOVED AFTER CONSTRUCTION IS COMPLETED.
4. TRACKING PAD SHALL BE THE FULL WIDTH OF THE INGRESS/EGRESS POINT AT A MINIMUM.
5. SURFACE WATER MUST BE PREVENTED FROM PASSING THROUGH THE TRACKING PAD. FLOWS SHALL BE DIVERTED AWAY, AROUND OR CONVEYED UNDER THE TRACKING PAD.

C TRACKING PAD DETAIL
NOT TO SCALE



D TREATMENT AREA PAD DETAIL
NOT TO SCALE

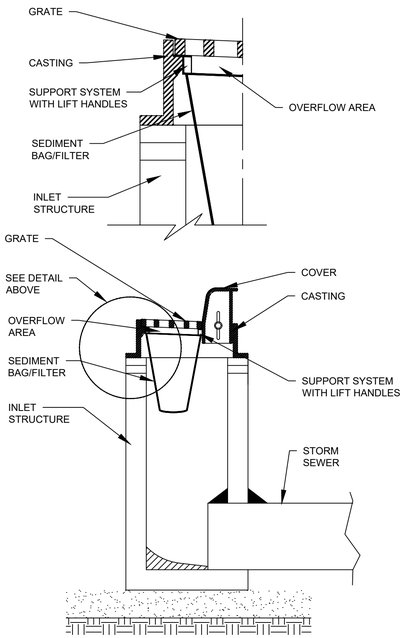




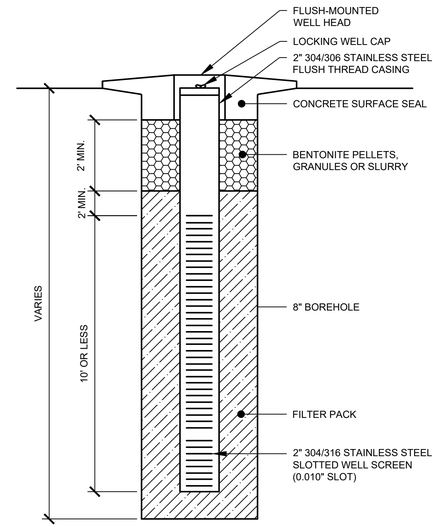
NOTES:

1. TEMPORARY FENCE SHALL BE CONSTRUCTED AS FOLLOWS:
   - CONSTRUCTED OF GALVANIZED 1-3/8" DIAMETER, 065 WALL TUBING.
   - 11-1/2" GAUGE GALVANIZED FENCE FABRIC WITH 2-1/4" MESH.
   - ALUMINUM TIE WIRES USED FOR SECURING FABRIC TO FRAME.
   - GALVANIZED SADDLE CLAMPS, NUTS, BOLTS USED TO ATTACH PANELS TOGETHER.
   - STANDS SHALL MEASURE APPROXIMATELY 16" X 36".
   - STANDS MADE OF SAME 1-3/8" DIAMETER TUBING WITH SLIGHTLY SMALLER UPRIGHTS FOR PANELS TO FIT OVER.
   - ALL JOINTS SHALL BE WELDED AND SPRAYED WITH A GALVANIZED PAINT TO COVER ANY EXPOSED METAL.
   - CHAIN LINK PANELS SHALL BE 6' HIGH X 8' WIDE WITH ONE VERTICAL AND ONE HORIZONTAL BRACE.
2. THE CONTRACTOR SHALL PROVIDE TEMPORARY CONSTRUCTION SECURITY, FOR EACH SEQUENCE OF WORK, TO THE LIMITS OF WORK SHOWN OR AS SPECIFIED BY THE ENGINEER.
3. ALL CHAIN LINK FENCING TO BE COVERED WITH ENVIROSCREEN PRIVACY SCREEN (OR EQUAL).
4. THE CONTRACTOR SHALL PROVIDE SAND BAGS AS WEIGHT, AT ALL JOINTS, TO PREVENT THE FENCE FROM OVER TURNING.

E TEMPORARY FENCE DETAIL
NOT TO SCALE



F INLET PROTECTION - PAVED AREAS
DROP-IN PROTECTION
NOT TO SCALE



G TYPICAL MONITORING WELL DETAIL
NOT TO SCALE

NOT FOR CONSTRUCTION
DATE: 03/08/2019

IN CHARGE OF M. BYKER
DESIGNED BY D. KAHN
CHECKED BY B. PLATT
DRAWN BY S. JOHNSON

NO.	DATE	REVISION	INT.
B	03/08/19	ISSUED FOR USEPA APPROVAL	MDB
A	01/07/19	ISSUED FOR USEPA REVIEW	MDB

O'BRIEN & GERE ENGINEERS, INC

FORMER NORTH SHORE GAS SOUTH PLANT
MANUFACTURED GAS PLANT REMEDIAL DESIGN

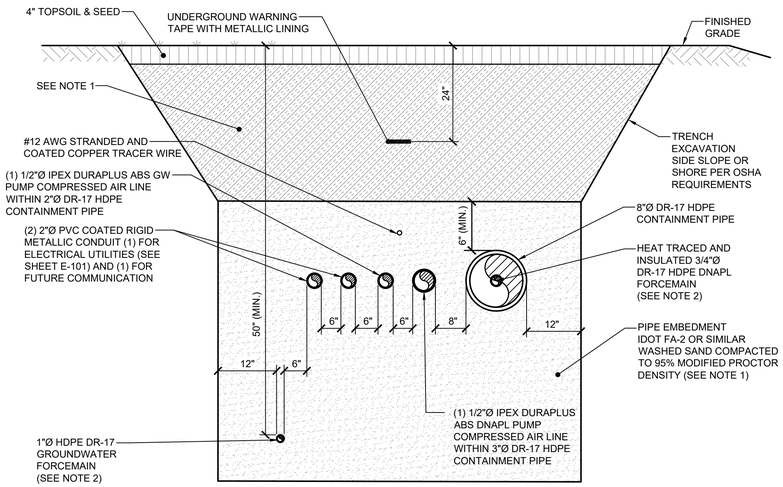
WAUKEGAN, ILLINOIS

CIVIL

MISCELLANEOUS DETAILS

FILE NO. 31060.67860 -501
DATE OCTOBER 2018

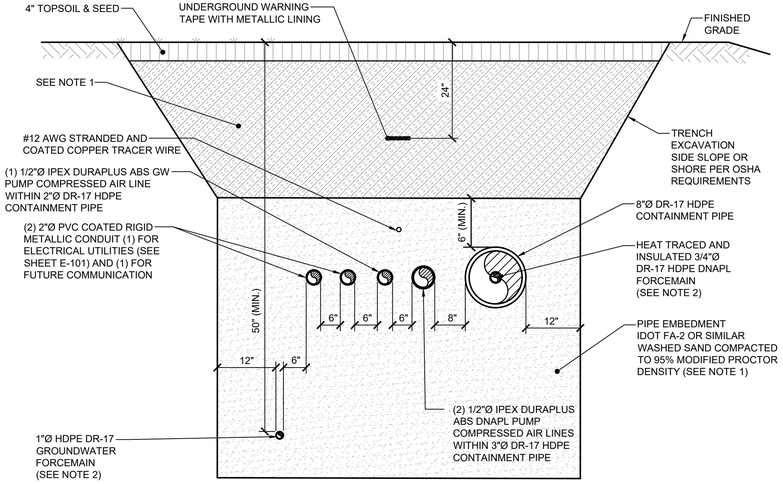
C-501



NOTE:

1. SUITABLE EXCAVATED MATERIAL MAY BE USED AS BACKFILL ABOVE THE PIPE EMBEDMENT AND AS BACKFILL FOR THE PIPE EMBEDMENT AT THE DISCRETION OF THE ENGINEER.
2. INSULATE PORTION OF GROUNDWATER FORCEMAIN LESS THAN 50-INCHES BELOW GRADE TO TOP OF PIPE AND DNAPL FORCEMAIN AT ALL DEPTHS WITH 2-INCH THICK FOAMGLAS INSULATION WITH PITTWRAP JACKETING BY PITTSBURGH CORNING CORPORATION OR APPROVED EQUAL.

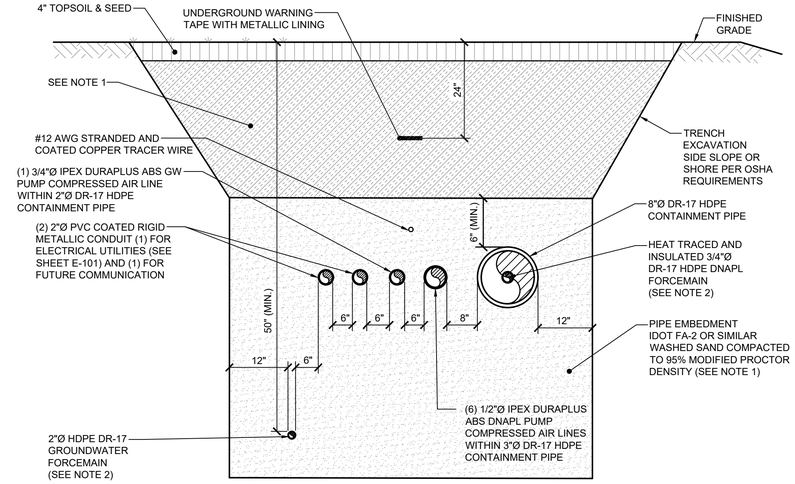
A TRENCH-A DETAIL
NOT TO SCALE



NOTE:

1. SUITABLE EXCAVATED MATERIAL MAY BE USED AS BACKFILL ABOVE THE PIPE EMBEDMENT AND AS BACKFILL FOR THE PIPE EMBEDMENT AT THE DISCRETION OF THE ENGINEER.
2. INSULATE PORTION OF GROUNDWATER FORCEMAIN LESS THAN 50-INCHES BELOW GRADE TO TOP OF PIPE AND DNAPL FORCEMAIN AT ALL DEPTHS WITH 2-INCH THICK FOAMGLAS INSULATION WITH PITTWRAP JACKETING BY PITTSBURGH CORNING CORPORATION OR APPROVED EQUAL.

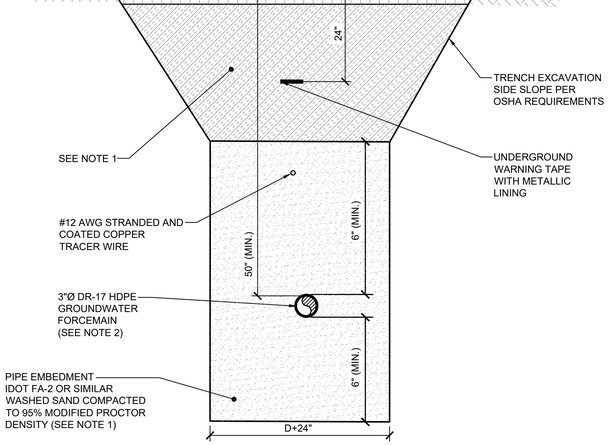
B TRENCH-B DETAIL
NOT TO SCALE



NOTE:

1. SUITABLE EXCAVATED MATERIAL MAY BE USED AS BACKFILL ABOVE THE PIPE EMBEDMENT AND AS BACKFILL FOR THE PIPE EMBEDMENT AT THE DISCRETION OF THE ENGINEER.
2. INSULATE PORTION OF GROUNDWATER FORCEMAIN LESS THAN 50-INCHES BELOW GRADE TO TOP OF PIPE AND DNAPL FORCEMAIN AT ALL DEPTHS WITH 2-INCH THICK FOAMGLAS INSULATION WITH PITTWRAP JACKETING BY PITTSBURGH CORNING CORPORATION OR APPROVED EQUAL.

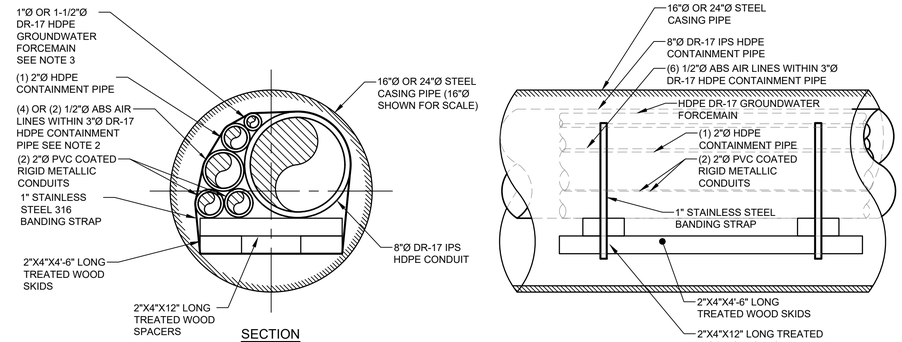
C TRENCH-C DETAIL
NOT TO SCALE



NOTE:

1. SUITABLE EXCAVATED MATERIAL MAY BE USED AS BACKFILL ABOVE THE PIPE EMBEDMENT AND AS BACKFILL FOR THE PIPE EMBEDMENT AT THE DISCRETION OF THE ENGINEER.
2. INSULATE PORTION OF GROUNDWATER FORCEMAIN LESS THAN 50-INCHES BELOW GRADE TO TOP OF PIPE WITH 2-INCH THICK FOAMGLAS INSULATION WITH PITTWRAP JACKETING BY PITTSBURGH CORNING CORPORATION OR APPROVED EQUAL.

D GROUNDWATER INJECTION TRENCH DETAIL
NOT TO SCALE



NOTES:

1. PIPE CONFIGURATION SHOWN AS AN EXAMPLE. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS OF PLANNED CONFIGURATION TO THE ENGINEER BEFORE INSTALLING PIPES WITHIN CASING. ONE SUBMITTED FOR EACH CASING.
2. THE 24"Ø CASING SHALL HAVE TWO AIRLINES WITHIN 3"Ø HDPE PIPE AND THE 16"Ø CASING WILL HAVE FOUR AIRLINES.
3. THE 24"Ø CASING SHALL HAVE 1"Ø HDPE DR-17 GROUNDWATER FORCEMAIN AND THE 16"Ø CASING SHALL HAVE 1-1/2"Ø HDPE DR-17 GROUNDWATER FORCEMAIN.

E CASING DETAIL
NOT TO SCALE

NOT FOR CONSTRUCTION
DATE: 03/08/2019

IN CHARGE OF M. BYKER
DESIGNED BY D. KAHN
CHECKED BY B. PLATT
DRAWN BY S. JOHNSON

NO.	DATE	REVISION	INT.
B	03/08/19	ISSUED FOR USEPA APPROVAL	MDB
A	01/07/19	ISSUED FOR USEPA REVIEW	MDB

O'BRIEN & GERE ENGINEERS, INC

FORMER NORTH SHORE GAS SOUTH PLANT
MANUFACTURED GAS PLANT REMEDIAL DESIGN

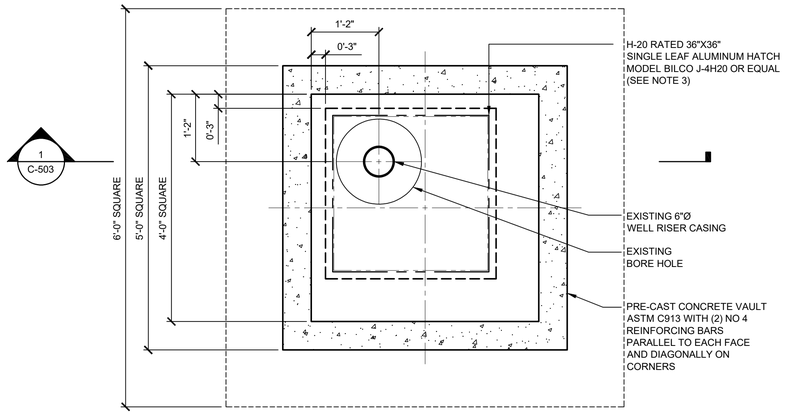
WAUKEGAN, ILLINOIS

CIVIL

MISCELLANEOUS DETAILS

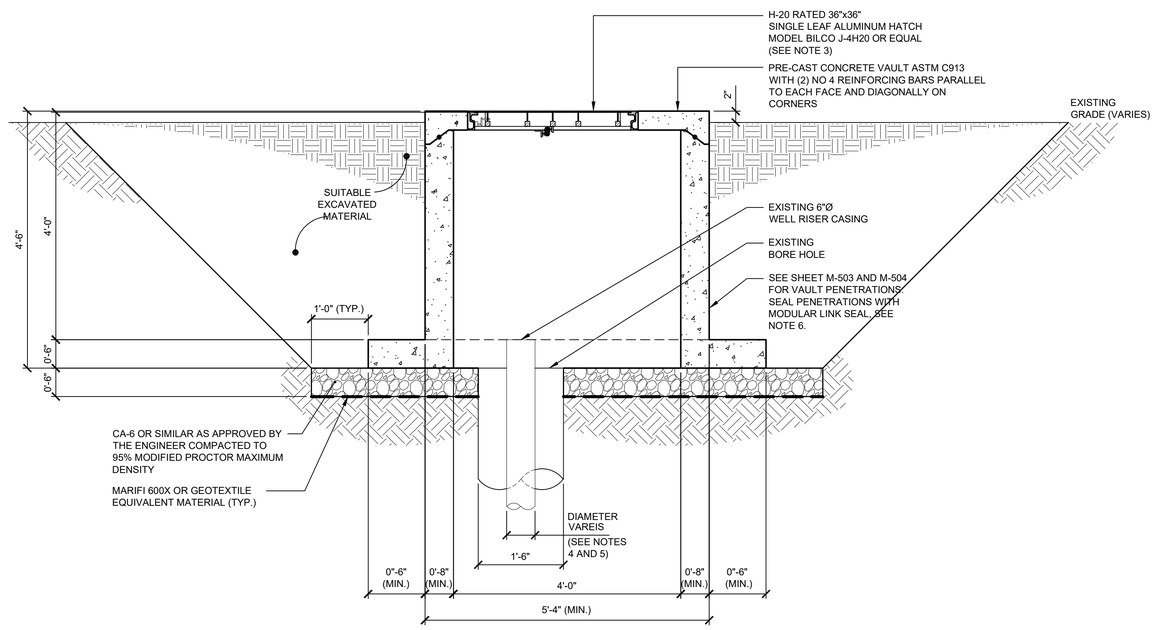
FILE NO. 31060.67860 -502
DATE OCTOBER 2018

C-502



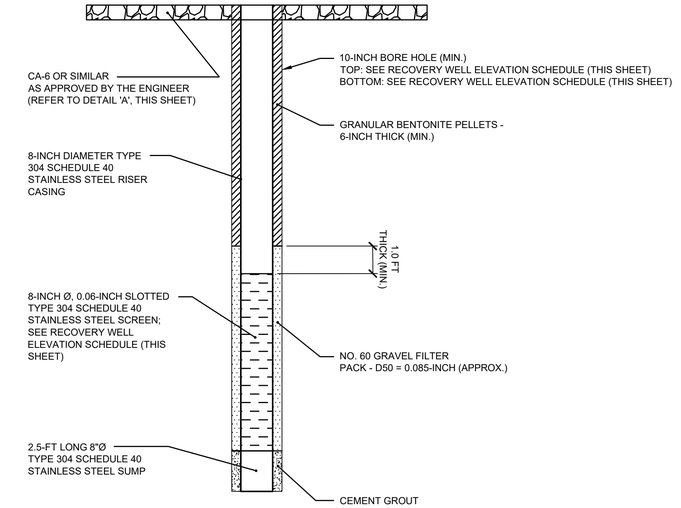
PLAN

NOT TO SCALE



SECTION

1 / C-502 — NOT TO SCALE



B RECOVERY WELL SCHEMATIC

NOT TO SCALE

NOTES:

1. WELL VAULT IS A CLASS 1, DIV. 2, GROUP D HAZARDOUS AREA.
2. FOR RECOVERY WELL VAULT PIPING LAYOUT SEE SHEET M-503 AND M-504. SEAL PENETRATION WITH MODULAR LINK SEAL. SEE "RECOVERY WELL ELEVATION SCHEDULE" ON THIS SHEET, FOR SPECIFIC WELL DETAILS.
3. ALL HATCHES FOR DNAPL WELL VAULTS SHALL HAVE METAL-ENCLOSED INSULATION, RECESSED HINGES, LOCKING DEVICE, AND CAST INTO TOP OF SLAB, WITH BITUMEN COATING BETWEEN ALUMINUM AND CONCRETE SURFACES.
4. EW02, EW04, AND EW-05 ARE EXISTING 6" DIA. WELLS. REMOVE AND REPLACE VAULT AND KEEP EXISTING WELL CASING.
5. EW01, EW03, AND EW-06 SHALL BE 8" DIA. WELLS.
6. ALL PLASTIC PIPE VAULT PENETRATIONS - PSI LINK SEAL TYPE WALL CENTURY-LINE SLEEVE WITH LINK SEALS MODEL L EPDM (OR EQUAL)

A TYPICAL RECOVERY WELL VAULT DETAIL

NOT TO SCALE

RECOVERY WELL ELEVATION SCHEDULE						
WELL IDENTIFICATION	EW01	EW02	EW03	EW04	EW05	EW06
VAULT RIM ELEVATION	590.6	590.9	591.2	591.8	592.1	592.1
EXISTING GRADE	590.4	590.7	591.0	591.6	591.9	591.9
DNAPL CONDUIT INVERT	587.6	587.4	588.0	588.8	589.1	589.1
GROUNDWATER FORCEMAIN INVERT	BOT	BOT	BOT	BOT	BOT	BOT
TOP OF RISER	587.6	588.5	588.0	590.9	590.0	589.1
TOP OF WELL SEAL	586.6	586.9	587.0	588.3	588.8	588.1
TOP OF FILTER PACK	585.7	585.1	586.5	587.1	587.0	587.6
TOP OF WELL SCREEN	583.7	583.1	584.8	585.1	585.0	585.9
BOTTOM OF WELL SCREEN	573.7	573.1	574.8	575.6	575.0	575.9
GROUNDWATER RECOVERY INLET	578.0	578.0	578.0	578.0	578.0	578.0
DNAPL RECOVERY INLET	570.7	572.7	571.8	575.2	575.0	572.9
BOTTOM OF SUMP	571.2	572.9	572.3	575.4	574.8	573.4

BOLD - ELEVATION PROVIDED FOR EXISTING INSTALLED INFRASTRUCTURE

BOT = GROUNDWATER FORCEMAIN EXITS THROUGH THE BOTTOM OF THE VAULT TO REACH ADEQUATE FROST DEPTH OF 50" (MIN.).

NOT FOR CONSTRUCTION

DATE: 03/08/2019

IN CHARGE OF M. BYKER
DESIGNED BY D. KAHN
CHECKED BY B. PLATT
DRAWN BY J. GEORGE

NO.	DATE	REVISION	INT.
B	03/08/19	ISSUED FOR USEPA APPROVAL	MDB
A	01/07/19	ISSUED FOR USEPA REVIEW	MDB

O'BRIEN & GERE ENGINEERS, INC

FORMER NORTH SHORE GAS SOUTH PLANT
MANUFACTURED GAS PLANT REMEDIAL DESIGN

WAUKEGAN, ILLINOIS

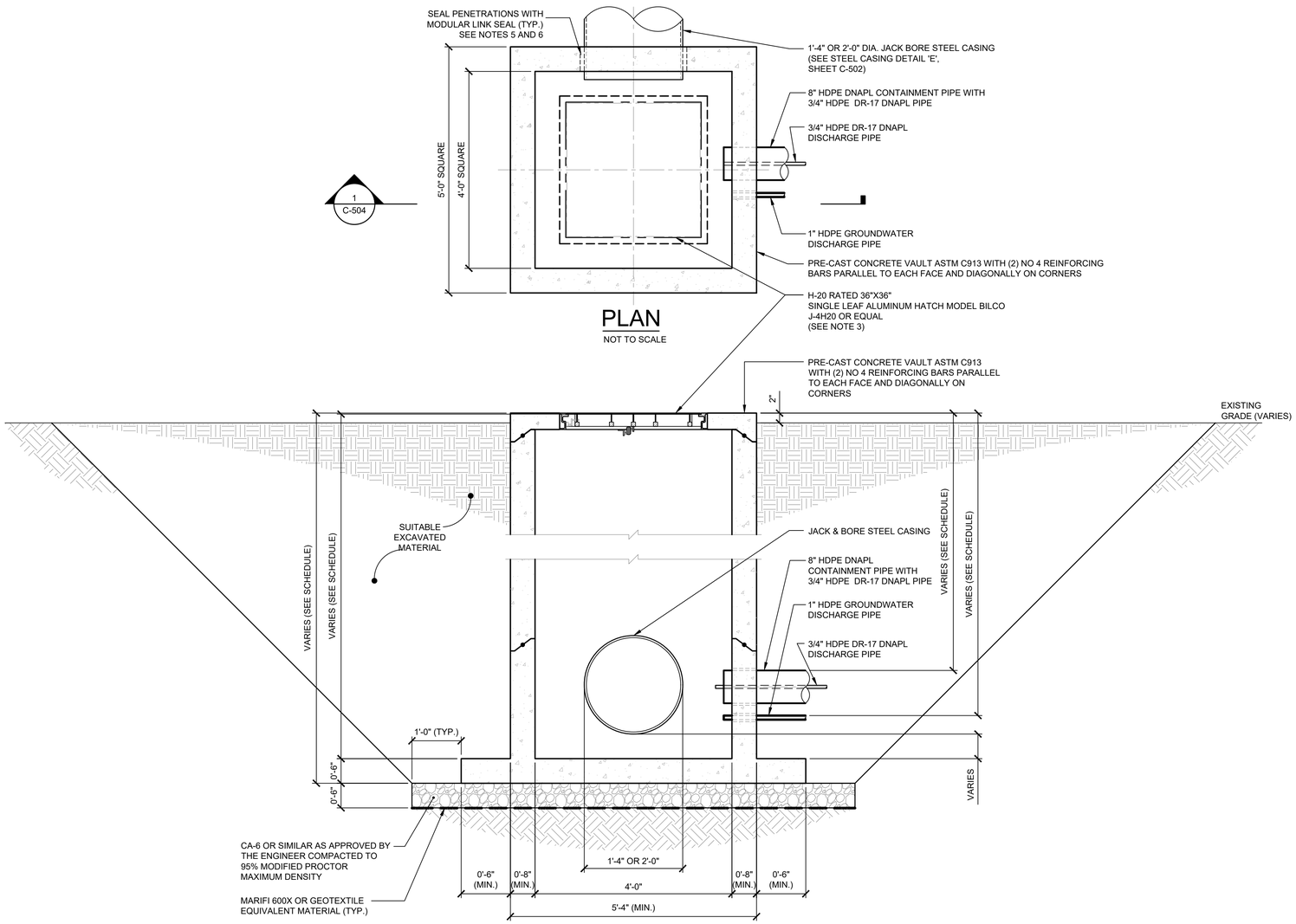
CIVIL

MISCELLANEOUS RECOVERY WELL DETAILS

FILE NO. 31060.67860 -503

DATE OCTOBER 2018

C-503



JUNCTION VAULT ELEVATION SCHEDULE					
STRUCTURE IDENTIFICATION	JV01	JV02	JV03	JV04	JV05
VAULT RIM ELEVATION	591.2	591.9	591.9	593.0	591.9
EXISTING GRADE	591.0	591.7	591.7	592.8	591.7
DNAPL PIPE INVERT	585.5	586.2	585.5	586.6	588.9
GROUNDWATER INVERT	585.5	586.2	585.5	586.6	587.5
BOTTOM OF VAULT	585.0	585.7	585.0	586.1	587.0

NOTES:

1. WELL VAULT IS A CLASS 1, DIV 2, GROUP D HAZARDOUS AREA.
2. SEE "JUNCTION VAULT ELEVATION SCHEDULE" ON THIS SHEET, FOR SPECIFIC VAULT DETAILS.
3. ALL HATCHES FOR DNAPL WELL VAULTS SHALL HAVE METAL-ENCLOSED INSULATION, RECESSED HINGES, LOCKING DEVICE, AND CAST INTO TOP OF SLAB, WITH BITUMEN COATING BETWEEN ALUMINUM AND CONCRETE SURFACES.
4. SEE DRAWING C-105 FOR JUNCTION VAULTS JV01 THROUGH JV05 , DNAPL / GROUNDWATER PIPING LOCATIONS .
5. ALL PLASTIC PIPE VAULT PENETRATIONS - PSI LINK SEAL TYPE WALL CENTURY-LINE SLEEVE WITH LINK SEALS MODEL L EPDM (OR EQUAL)
6. ALL STEEL PIPE VAULT PENETRATIONS - PSI LINK SEAL TYPE WALL CENTURY-LINE SLEEVE WITH LINK SEALS MODEL C EPDM (OR EQUAL)

A
TYPICAL JUNCTION VAULT DETAIL
NOT TO SCALE

NOT FOR CONSTRUCTION
DATE: 03/08/2019

IN CHARGE OF M. BYKER
DESIGNED BY D. KAHN
CHECKED BY B. PLATT
DRAWN BY J. GEORGE

NO.	DATE	REVISION	INT.
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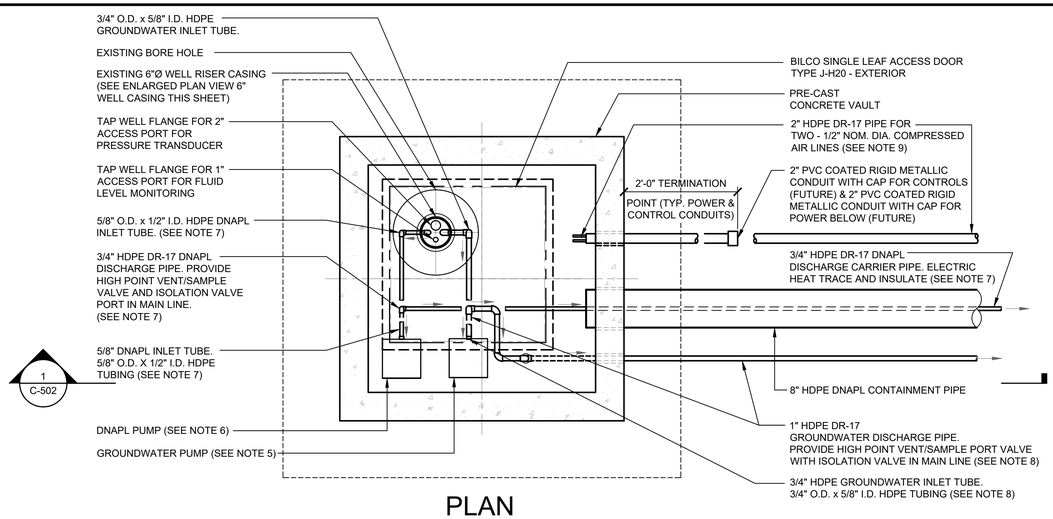
O'BRIEN & GERE ENGINEERS, INC

FORMER NORTH SHORE GAS SOUTH PLANT
MANUFACTURED GAS PLANT REMEDIAL DESIGN
WAUKEGAN, ILLINOIS

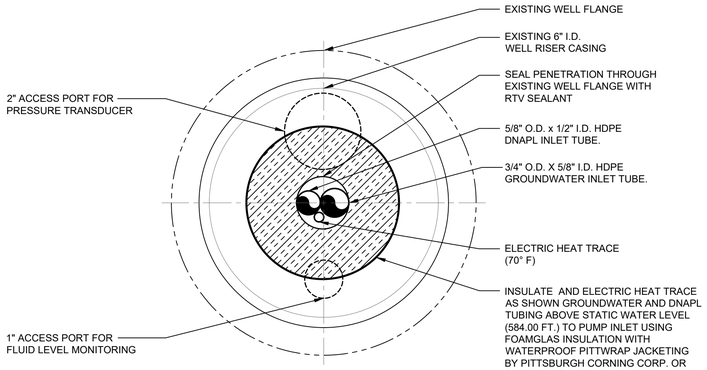
CIVIL
MISCELLANEOUS JUNCTION VAULT DETAILS

FILE NO. 31060.67860 -504
DATE OCTOBER 2018
C-504



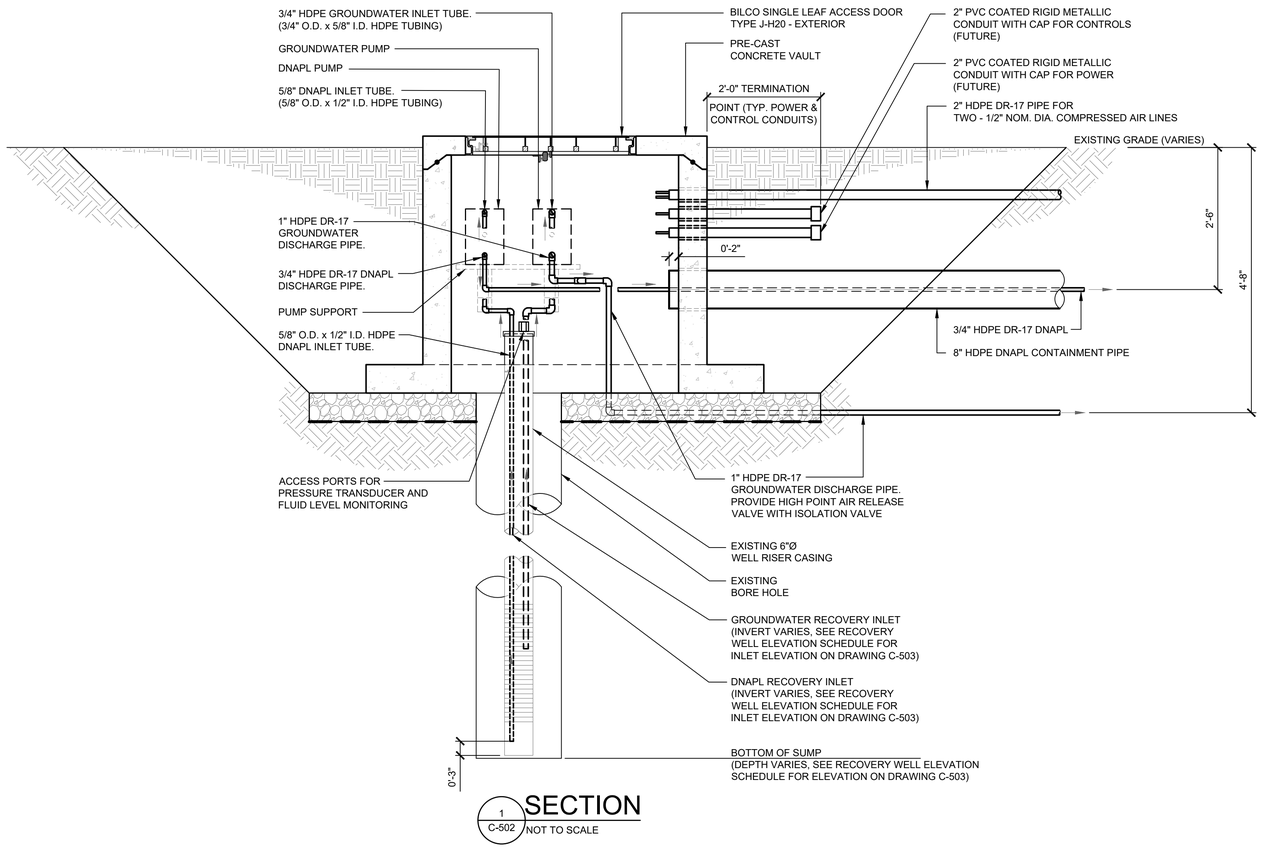
PLAN

NOT TO SCALE



ENLARGED PLAN VIEW 6" WELL CASING

NOT TO SCALE



SECTION

1 C-502 NOT TO SCALE

A TYPICAL RECOVERY WELL DETAIL

NOT TO SCALE

NOTES:

1. WELL VAULT ELECTRICAL HAZARD CLASSIFICATION IS CLASS 1, DIV 2.
2. SEE "RECOVERY WELL ELEVATION SCHEDULE ON SHEET C-503, FOR SPECIFIC WELL AND VAULT DETAILS.
3. PENETRATIONS INTO CONCRETE VAULT SHALL BE MADE WATER TIGHT WITH MODEL "L" EPDM LINK SEAL WITH CENTURY LINE SLEEVE AND NON-SHRINK GROUT.
4. EW02, EW04, AND EW-05 ARE EXISTING WELLS AND EW01, EW03, AND EW-06 SHALL BE NEW WELLS.
5. GROUNDWATER PUMP SHALL BE ARO PRO SERIES DIAPHRAGM PUMP. 1/2" MODEL PDO5A. PROVIDE ELECTRIC HEAT TRACE AND REMOVABLE INSULATION BLANKET FOR FREEZE PROTECTION. PROVIDE FILTER/REGULATOR AND AIR PULSE COUNTER.
6. DNAPL PUMP SHALL BE ARO PRO SERIES DIAPHRAGM PUMP. 1/2" MODEL PDO5A. PROVIDE ELECTRIC HEAT TRACE AND REMOVABLE INSULATION BLANKET FOR 70° F. INSULATION NOT SHOWN FOR CLARITY.
7. INSULATE AND ELECTRIC HEAT TRACE (70° F) DNAPL PUMP DISCHARGE AND INLET PIPING. 2 - INCH THICK FOAMGLAS INSULATION WITH PITTWRAP JACKETING BY PITTSBURGH CORNING CORP. OR APPROVED EQUAL. INSULATION NOT SHOWN FOR CLARITY.
8. INSULATE AND ELECTRIC HEAT TRACE (FREEZE PROTECTION) GROUNDWATER PUMP DISCHARGE AND INLET PIPING WITHIN VAULT. USE 2" THICK FOAMGLAS INSULATION WITH WATERPROOF PITTWRAP JACKETING BY PITTSBURGH CORNING CORP. OR APPROVED EQUAL. INSULATION NOT SHOWN FOR CLARITY.
9. AIR SUPPLY PIPING TO GROUNDWATER AND DNAPL PUMPS SHALL BE IPEX DURAPLUS ABS SYSTEM. AIR SUPPLY TO GROUNDWATER AND DNAPL PUMPS SHALL INCLUDE ISOLATION VALVE, FILTER/REGULATOR, AND PNEUMATIC COUNTER.

NOT FOR CONSTRUCTION
DATE: 03/08/2019

IN CHARGE OF M. BYKER
DESIGNED BY T. SNYDER
CHECKED BY T. KOMAR
DRAWN BY J. GEORGE

NO.	DATE	REVISION	INT.
B	03/08/19	ISSUED FOR USEPA APPROVAL	MDB
A	01/07/19	USEPA REVIEW	

O'BRIEN & GERE ENGINEERS, INC

FORMER NORTH SHORE GAS SOUTH PLANT
MANUFACTURED GAS PLANT REMEDIAL DESIGN

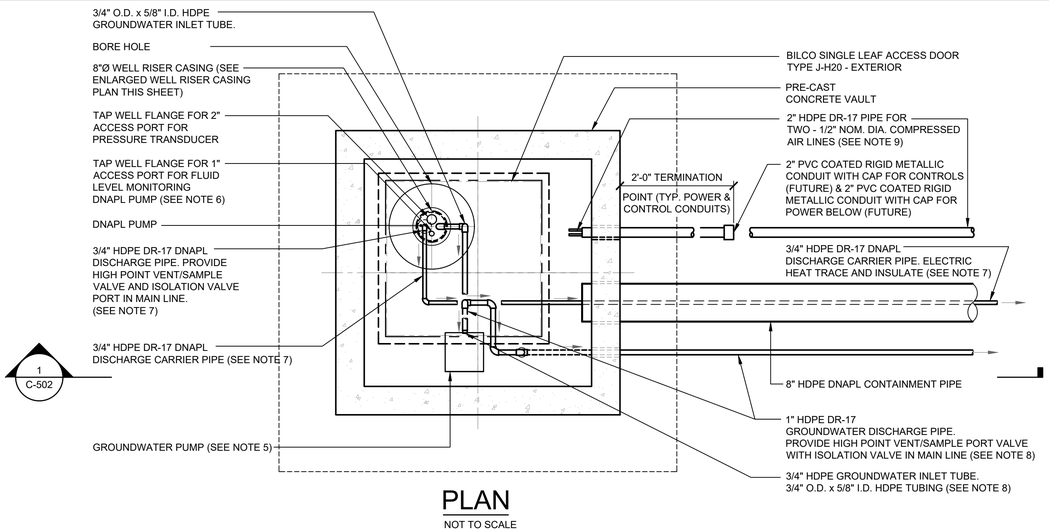
WAUKEGAN, ILLINOIS

PROCESS MECHANICAL

TYPICAL EXISTING RECOVERY WELLS EW02, EW04 & EW05 PIPING DETAILS

FILE NO. 31060.67860 -
DATE OCTOBER 2018

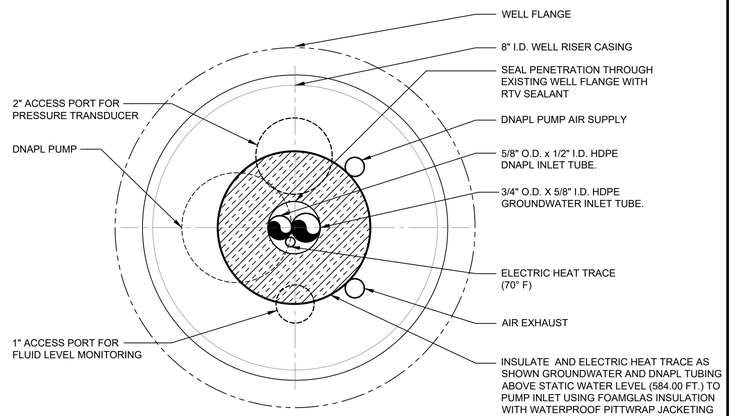
M-503



1 / C-502

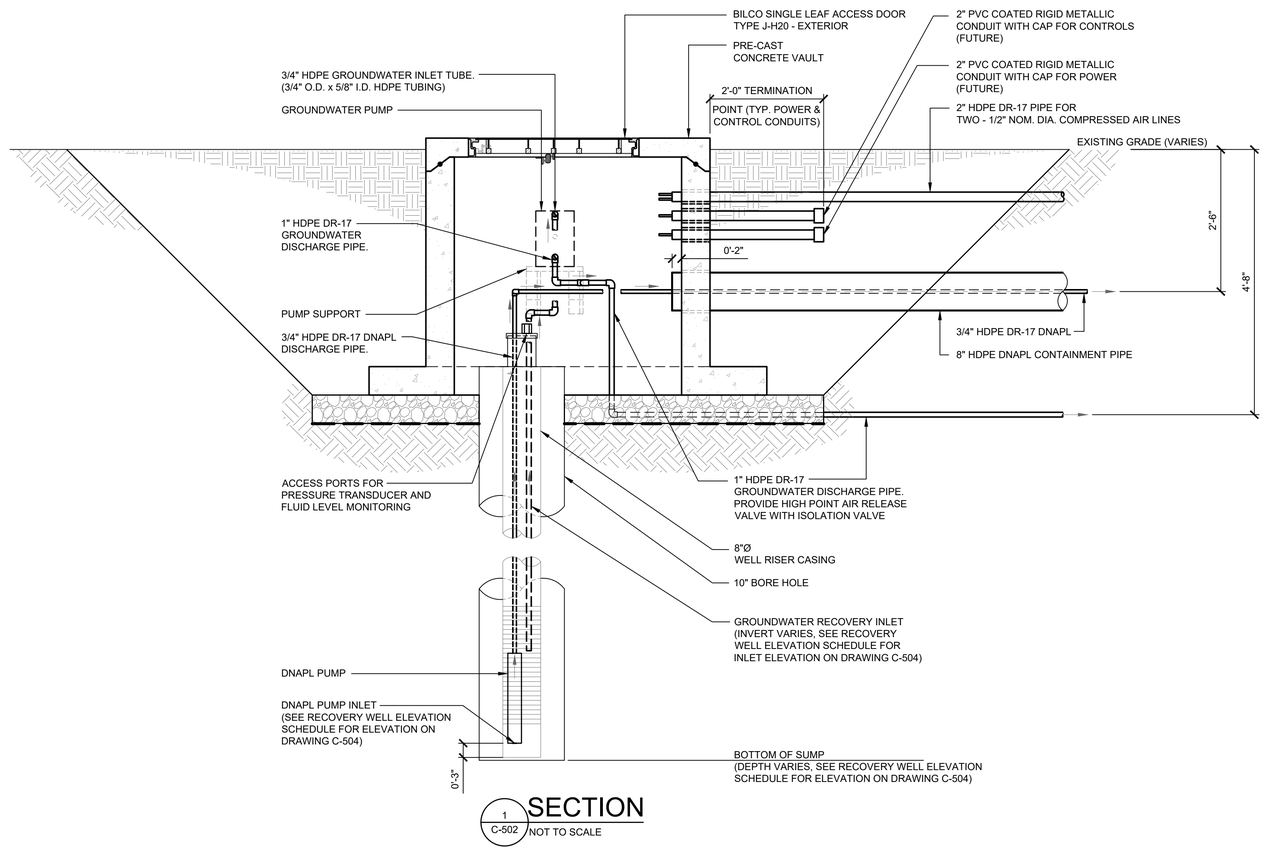
PLAN

NOT TO SCALE



ENLARGED PLAN VIEW 8" WELL CASING

NOT TO SCALE



1 / C-502

SECTION

NOT TO SCALE

A TYPICAL RECOVERY WELL DETAIL

NOT TO SCALE

NOTES:

1. WELL VAULT ELECTRICAL HAZARD CLASSIFICATION IS CLASS 1, DIV 2.
2. SEE "RECOVERY WELL ELEVATION SCHEDULE ON SHEET C-504, FOR SPECIFIC WELL AND VAULT DETAILS.
3. PENETRATIONS INTO CONCRETE VAULT SHALL BE MADE WATER TIGHT WITH MODEL "L" EPDM LINK SEAL WITH CENTURY LINE SLEEVE AND NON-SHRINK GROUT.
4. EW01, EW03, AND EW-06 SHALL BE NEW WELLS.
5. GROUNDWATER PUMP SHALL BE ARO PRO SERIES DIAPHRAGM PUMP. 1/2" MODEL PDO5A. PROVIDE ELECTRIC HEAT TRACE AND REMOVABLE INSULATION BLANKET FOR FREEZE PROTECTION. PROVIDE FILTER/REGULATOR AND AIR PULSE COUNTER.
6. DNAPL PUMP SHALL BE QED ELIMINATOR PUMP MODEL LP1602. PROVIDE L353 EXTERNAL QUICK EXHAUST VALVE. INSTALL PER MANUFACTURER'S INSTRUCTIONS.
7. INSULATE AND ELECTRIC HEAT TRACE (70° F) DNAPL PUMP DISCHARGE AND INLET PIPING. 2 - INCH THICK FOAMGLAS INSULATION WITH PITTWRAP JACKETING BY PITTSBURGH CORNING CORP. OR APPROVED EQUAL. INSULATION NOT SHOWN FOR CLARITY.
8. INSULATE AND ELECTRIC HEAT TRACE (FREEZE PROTECTION) GROUNDWATER PUMP DISCHARGE AND INLET PIPING WITHIN VAULT. USE 2" THICK FOAMGLAS INSULATION WITH WATERPROOF PITTWRAP JACKETING BY PITTSBURGH CORNING CORP. OR APPROVED EQUAL. INSULATION NOT SHOWN FOR CLARITY.
9. AIR SUPPLY PIPING TO GROUNDWATER AND DNAPL PUMPS SHALL BE IPEX DURAPLUS ABS SYSTEM. AIR SUPPLY TO GROUNDWATER PUMP SHALL INCLUDE ISOLATION VALVE, FILTER/REGULATOR, AND PNEUMATIC COUNTER. AIR SUPPLY TO DNAPL PUMP SHALL INCLUDE ISOLATION VALVE. AIR EXHAUST FROM DNAPL PUMP TO WELL CASING.

NOT FOR CONSTRUCTION

DATE: 03/08/2019

IN CHARGE OF	M. BYKER
DESIGNED BY	T. SNYDER
CHECKED BY	T. KOMAR
DRAWN BY	J. GEORGE

NO.	DATE	REVISION	INT.
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O'BRIEN & GERE ENGINEERS, INC

FORMER NORTH SHORE GAS SOUTH PLANT
MANUFACTURED GAS PLANT REMEDIAL DESIGN

WAUKEGAN, ILLINOIS

PROCESS MECHANICAL

TYPICAL NEW RECOVERY WELLS EW01, EW03 & EW06 PIPING DETAILS

FILE NO. 31060.67860 -

DATE OCTOBER 2018

M-504

SAVED: 3/6/19 9:50 AM

NaOH METERING PUMP

NaOH DRUM
(WITH SPILL CONTAINMENT)

COAGULANT METERING PUMP

COAGULANT DRUM
(TBD)
(WITH SPILL CONTAINMENT)

FLOCCULANT METERING PUMP

FLOCCULANT DRUM
(WITH SPILL CONTAINMENT)

ACID (NITRIC) PUMP

ACID (NITRIC) DRUM
(WITH SPILL CONTAINMENT)

GROUNDWATER
NO P&ID
FROM RECOVERY WELLS (6 TOTAL)

20 GPM (MAX.)

INLET

DNAPL HOPPER

OUTLET

RECTANGULAR OIL / WATER SEPARATOR
25 GPM MIX RATING
(ON LEGS OR CRIBBING)

pH ADJUST STORAGE TANK
(WORKING VOLUME
350-500 GALLONS)

LAMELLA INCLINED PLATE CLARIFIER

FLASH MIX TANK

FLOC TANK

IN-LINE MIXER

PUMP OUT TANK
(100-200 GALLONS)

ROTARY LUBE PUMP
(15-25 GPM)

BAG FILTER NO. 2

BAG FILTER NO. 1

ORGANO CLAY

BAG FILTER NO. 3

BACKWASH

BACKWASH

AIR OPERATED DIAPHRAGM SLUDGE PUMP
(5 GPM MAX. INTERMITTENT)

BACKWASH

DNAPL
NO P&ID
FROM DNAPL PUMPS (6 TOTAL)

20 GPD (EST.)

AIR OPERATED DIAPHRAGM DNAPL / LNAPL PUMP
(5 GPM MAX. INTERMITTENT)

BACKWASH

GEOTUBE

AIR OPERATED DIAPHRAGM GEOTUBE DUMPSTER PUMP OUT PUMP
(5 GPM MAX. INTERMITTENT)

NaOH METERING PUMP

ACID (NITRIC) METERING PUMP

NaOH DRUM
(WITH SPILL CONTAINMENT)

ACID (NITRIC) DRUM
(WITH SPILL CONTAINMENT)

TREATED EFFLUENT TANK
(500-600 GALLONS)

SPARE GAC NO. 3

LAG GAC NO. 2

LEAD GAC NO. 1

BACKWASH

TREATED GROUNDWATER
NO P&ID
TO INJECTION WELLS

TREATED EFFLUENT PUMP
(15-50 GPM)

METAL DNAPL STORAGE TOTE
(SEPARATE ENCLOSURE)

METAL LNAPL STORAGE TOTE
(SEPARATE ENCLOSURE)

PROCESS FLOW DIAGRAM

NOT TO SCALE

NOT FOR CONSTRUCTION
DATE: 03/08/2019

THIS DRAWING WAS PREPARED AT THE SCALE INDICATED. INACCURACIES IN THE STATED SCALE MAY BE INTRODUCED WHEN DRAWINGS ARE REPRODUCED BY ANY MEANS. USE THE GRAPHIC SCALE BAR TO DETERMINE THE ACTUAL SCALE. DRAWING IS NOT SCALABLE WHEN NO SCALE BAR IS PRESENT.

IN CHARGE OF M. BYKER
DESIGNED BY T. KOMAR
CHECKED BY E. SCHAYEK
DRAWN BY J. GEORGE

NO.	DATE	REVISION	INT.
B	03/08/19	ISSUED FOR USEPA APPROVAL	MDB
A	01/07/19	USEPA REVIEW	

O'BRIEN & GERE ENGINEERS, INC

FORMER NORTH SHORE GAS SOUTH PLANT
MANUFACTURED GAS PLANT REMEDIAL DESIGN

WAUKEGAN, ILLINOIS

PROCESS MECHANICAL

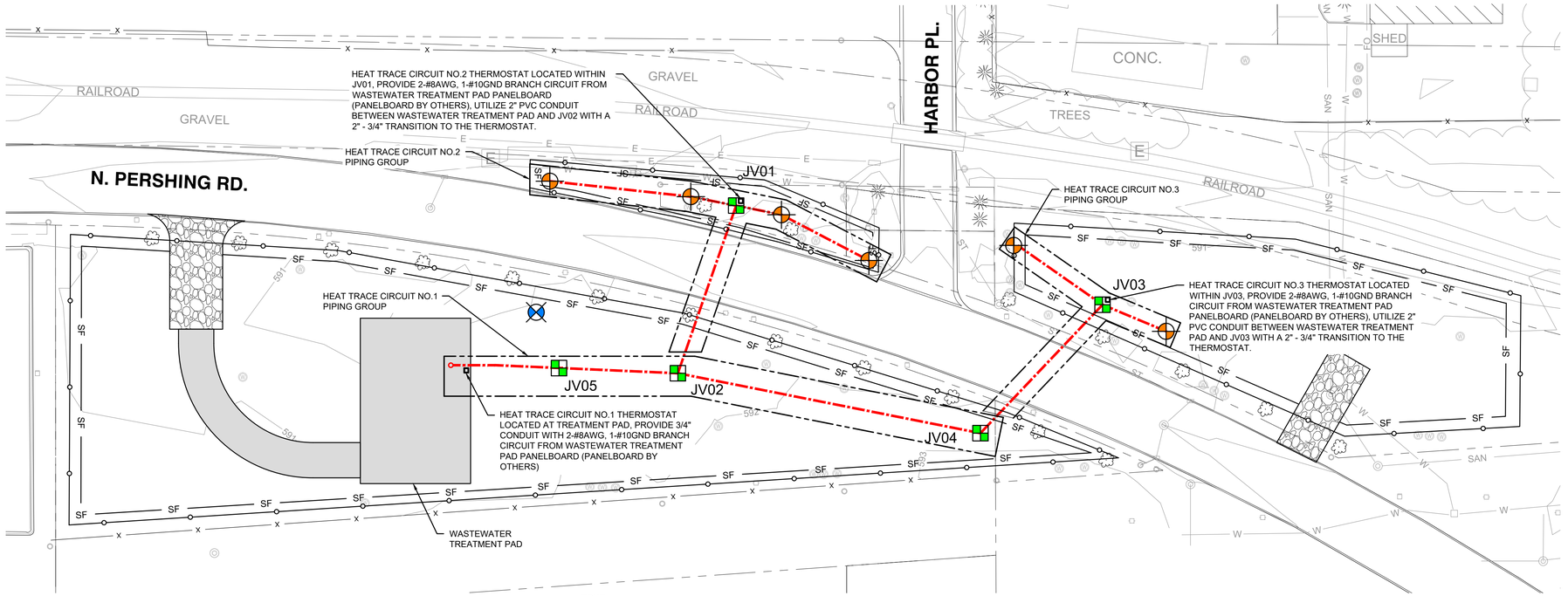
PROCESS FLOW DIAGRAM

FILE NO. 31060.67860 -

DATE OCTOBER 2018

M-601

\\SERVER27-01\PROJECTS\WBS.31060\67860.1983-WBS - NSG\DOCS\DWG\PILOT STUDY\67860.M601.DWG



TRUE NORTH

PLAN

SCALE: 1"=30' 30' 0 30'

ELECTRICAL INSTALLATION NOTES:

1. ALL ELECTRICAL EQUIPMENT IS NEW UNLESS OTHERWISE INDICATED.
2. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND ALL LOCAL CODES.
3. ALL ELECTRICAL WORK SHALL BE INSTALLED IN A WORKMAN LIKE ORDER.
4. ALL CONDUITS AND FITTINGS INSTALLED WITHIN THE RECOVERY VAULTS AND JUNCTION VAULTS CLASS 1, DIV 2 HAZARDOUS AREA SHALL BE PVC COATED RIGID STEEL EXTENDING FROM THE VAULT TO THE CONDUIT SEALOFF.
5. ALL BELOW GRADE CONDUIT AND FITTINGS NOT INSTALLED IN CLASSIFIED AREAS SHALL SCHEDULE 40 PVC CONDUIT.
6. ALL WORK IN CLASSIFIED HAZARDOUS AREAS SHALL BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE ARTICLE 500 AND 501.

HEAT TRACING NOTES:

1. PROVIDE ELECTRIC HEAT TRACING OF THE ENTIRE LENGTH OF ALL RUNS OF ¾" HDPE DNAPL CARRIER PIPING WITHIN 8" HDPE CONTAINMENT PIPE. HEAT TRACING OF PIPING SHALL ALSO EXTEND INTO THE RECOVERY WELL VAULT AND INCLUDE ALL THE EXPOSED PIPING, VALVES, FITTINGS AND THE PIPING INTO THE WELL RISER CASING DOWN BELOW THE FROST LINE, APPROXIMATELY 50" BELOW GRADE. THE DNAPL PUMP LOCATED IN THE RECOVERY WELL VAULT SHALL ALSO BE HEAT TRACED.

   PROVIDE ELECTRIC HEAT TRACING OF THE 1" HDPE GROUNDWATER DISCHARGE PIPING. HEAT TRACING OF PIPING SHALL EXTEND INTO THE RECOVERY WELL VAULT AND INCLUDE ALL THE EXPOSED PIPING, VALVES, FITTINGS, AND THE PIPING INTO THE WELL RISER CASING DOWN BELOW THE FROST LINE, APPROXIMATELY 50" BELOW GRADE. THE GROUNDWATER PUMP LOCATED IN THE RECOVERY WELL VAULT SHALL ALSO BE HEAT TRACED.

   D. HEAT TRACING CABLE SHALL BE SIZED TO PROVIDE A PIPE MAINTENANCE TEMPERATURE OF 70°F WITH AN AMBIENT TEMPERATURE OF -20°F. HEAT TRACING SHALL BE RATED AT 5W/FT MINIMUM. REFER TO CIVIL AND MECHANICAL DRAWINGS FOR PIPE SIZES, MATERIALS, INSULATION TYPE AND MATERIAL.

   E. HEAT TRACING SHALL BE ARRANGED FOR CONNECTION ON THREE SEPARATE 30A, 277 VAC BRANCH CIRCUITS WITH A CONTROLLING THERMOSTAT FOR EACH CIRCUIT. PIPE GROUPING FOR EACH CIRCUIT SHALL BE AS SHOWN ON THE PLAN, THIS SHEET. HEAT TRACING CIRCUIT SHALL BE FED WITH 30mA GFI TYPE EPD CIRCUIT BREAKERS LOCATED AT THE WASTEWATER TREATMENT PAD AREA.

   F. HEAT TRACING CABLE SHALL BE SELF REGULATING, 277 VAC WITH TINNED COPPER BRAID AND HIGH TEMPERATURE FLUOROPOLYMER OUTER JACKET. HEAT TRACING SHALL BE RATED FOR USE IN CLASS I, DIV 1, GROUP D HAZARDOUS AREAS. HEAT TRACING CABLE SHALL BE MANUFACTURED BY CHROMALOX TYPE HSRL OR EQUAL.

   G. HEAT TRACING THERMOSTATS SHALL BE CAPILLARY BULB LINE SENSING TYPE WITH ADJUSTABLE SET POINT BETWEEN 15°F TO 140°F. THERMOSTAT HOUSING SHALL BE NEMA RATED FOR INSTALLATION IN CLASS 1, DIV 2 GROUP D AREAS. THERMOSTATS AND HOUSING SHALL BE MANUFACTURED BY CHROMOLOX OR EQUAL.

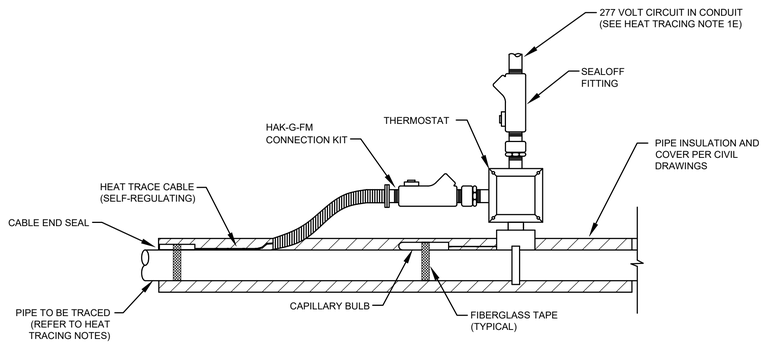
   H. PROVIDE POWER CONNECTION BOXES, TEES, FIBERGLASS TAPE AND ALL OTHER HARDWARE NECESSARY FOR A COMPLETE INSTALLATION.

   I. ADHESIVE BACKED ALUMINUM HEAT TRANSFER TAPE SHALL BE INSTALLED BETWEEN THE HEATING CABLE AND THE HDPE PIPING.

   J. PROVIDE WARNING LABELS ON THE EXTERIOR OF THE PIPE INSULATION INDICATING "CAUTION - ELECTRICAL HEAT TRACING" OR SIMILAR TEXT. LABELS SHALL BE INSTALLED AT 20 FOOT INTERVALS.

ELECTRICAL SPECIFICATION NOTES:

1. PVC COATED CONDUIT SHALL BE RIGID GALVANIZED STEEL EXTERIOR COATED IN PVC AND URETHANE ON THE INTERIOR. MANUFACTURER SHALL BE CALBOND OR EQUAL.
2. SCHEDULE 40 PVC CONDUIT FITTINGS SHALL BE UL LISTED FOR ELECTRICAL USE. MANUFACTURER SHALL BE CARLON OR EQUAL.
3. LOW VOLTAGE POWER, CONTROL AND EQUIPMENT GROUND CONDUCTORS SHALL BE STRANDED COPPER WITH 600 VOLT THHN/THWN THERMOPLASTIC INSULATION AND NYLON JACKET. MANUFACTURER SHALL BE GENERAL CABLE, SOUTHWIRE, ANIXTER OR EQUAL.



TYPICAL HAZARDOUS AREA HEAT TRACE INSTALLATION DETAIL

NOT TO SCALE

NOT FOR CONSTRUCTION

DATE: 03/08/19

THIS DRAWING WAS PREPARED AT THE SCALE INDICATED. INACCURACIES IN THE STATED SCALE MAY BE INTRODUCED WHEN DRAWINGS ARE REPRODUCED BY ANY MEANS. USE THE GRAPHIC SCALE BAR TO DETERMINE THE ACTUAL SCALE. DRAWING IS NOT SCALABLE WHEN NO SCALE BAR IS PRESENT.

IN CHARGE OF	J. DOMANSKI
DESIGNED BY	B. NICHOLS
CHECKED BY	B. NICHOLS
DRAWN BY	B. NICHOLS

NO.	DATE	REVISION	INT.
B	03/08/19	ISSUED FOR USEPA APPROVAL	MDB
A	01/07/19	ISSUED FOR USEPA REVIEW	MDB

O'BRIEN & GERE ENGINEERS, INC

FORMER NORTH SHORE GAS SOUTH PLANT
MANUFACTURED GAS PLANT REMEDIAL DESIGN

WAUKEGAN, ILLINOIS

ELECTRICAL

SITE PLAN

FILE NO. 31060.67860 -E001

DATE OCTOBER 2018

E-101

Appendix C

Quality Assurance Project Plan

Refer to Multi-Site Quality Assurance Project Plan Former Manufactured Gas Plant Sites - Integrys Business Support, September 2007

Appendix D

Health and Safety Plan

SITE-SPECIFIC HEALTH AND SAFETY PLAN

North Shore Gas Company's
Former South Plant Manufactured Gas Plant
Waukegan, Illinois

WEC Business Services, LLC

October 2018

OBG

OCTOBER 15, 2018 | PROJECT #67860

Site-Specific Health and Safety Plan

Former South Plant MGP
Waukegan, Illinois

Prepared for:

North Shore Gas Company
200 East Randolph Street
Chicago, IL, 60606

MARCUS BYKER, PE
Project Manager

STEVEN G. WISKES
Health & Safety Ambassador

SECTION A
SITE-SPECIFIC HEALTH AND SAFETY PLAN SUMMARY

A copy of this Health and Safety Plan (HASP) will be maintained on site during field activities and updated as deemed necessary by the Project Manager.

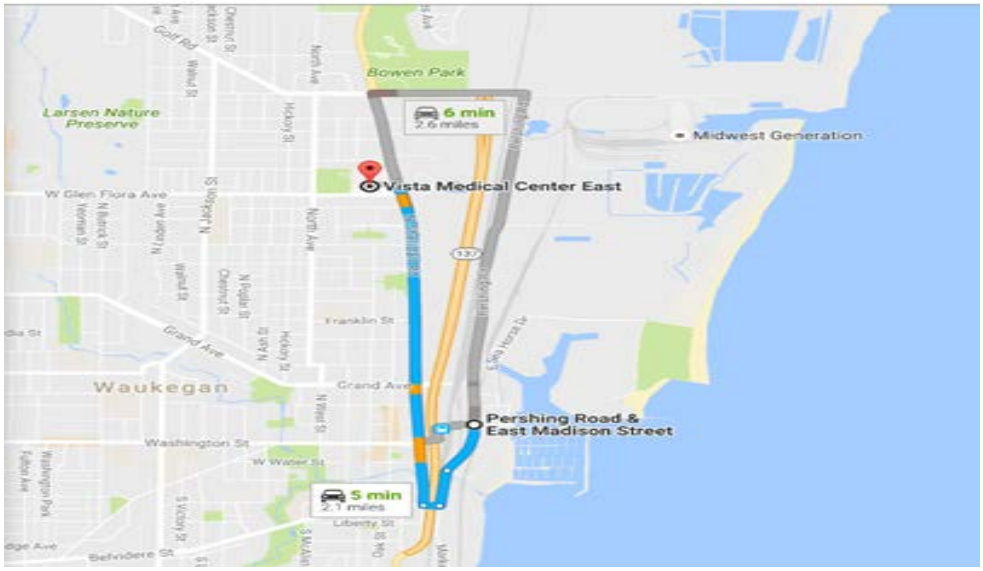
SITE INFORMATION

Business or Site Name	Former South Plant MGP – Pershing Rd at E Madison St., Waukegan, IL
Site Address:	60085
Municipality / County:	Lake County
Major Cross Roads and/or Geographic Features:	Near Waukegan Harbor and Marina

HOSPITAL INFORMATION

Hospital Name:	Victory Memorial Hospital
Hospital Address:	1324 N. Sheridan Rd., Waukegan, IL
Hospital Phone Number	847.369.0400

ROUTE TO HOSPITAL MAP



HOSPITAL ROUTE DESCRIPTION

1. Head South on Pershing Rd. toward E. Water St. (0.2 mi)
2. Continue onto Market St. (0.2 mi)
3. Turn Right onto Belvidere St. (259 ft)
4. Turn Right at the 1st cross street onto S. Sheridan Rd. (1.0 Miles)
5. Arrive at Hospital – 1324 N. Sheridan Road

Estimated Drive Time – 5 Minutes; Approximate Distance – 2.1 Miles

EMERGENCY CONTACT LIST

	Agency Name and Address (if applicable)	Contact Number(s)
Fire Department	Waukegan Fire Administration	911 / 847.249.5410
Police	Waukegan Police Department	911 / 847.360.9000
Sheriff	Lake County Sheriff's Department	911 / 847.377.4000
Local Utilities	JULIE – 1 Call	811 or 1.800.892.0123
OBG Project Manager	Marcus Byker	Cellular: 616.340.8982
Ambulance	911	911
Hospital	Victory Memorial Hospital	911 Emergency General (847.360.3000)

DESCRIPTION OF SITE

The former South Plant MGP property is located at 2 North Pershing Road and 1 South Pershing Road in City of Waukegan, Illinois. The former MGP is located in an industrial/commercial area and is currently vacant and covered with grass. The property is approximately 1.9 acres in area and is generally rectangular, though it tapers to the south. Pershing Road, an asphalt-paved right-of-way maintained by the City of Waukegan, was constructed through the middle of the former MGP property in 1970. The portion of the former MGP currently owned by the Waukegan Port District is landscaped with a sign welcoming visitors to the Waukegan South Harbor Marina. Adjacent properties where MGP residuals have been identified include the following: Waukegan Port District, Akzo Nobel Aerospace Coatings, Inc., Elgin, Joliet and Eastern Railroad, and the City of Waukegan.

The RI Report (NRT, January 2014) identified soil, groundwater, and indoor air as media of concern. The RI report also identified a DNAPL plume as the primary and ongoing source of groundwater and indoor air contamination.

ACTIVITY(S):

- Drilling/installing/developing vertical extraction, horizontal injection, and monitoring wells.
- Construction oversight.
- Assembly of water treatment system.
- Installation of underground conveyance infrastructure, including air lines and electrical, via one-pass trenching, directional drilling, or jack and bore.
- Trucking of materials on and off the Site.
- Operations and Maintenance.
  - Inspection of recovery vaults. The main recovery vaults are not considered confined spaces; however, confined space entry will be required if the horizontal well vault needs to be accessed.
  - Maintenance of pumps, conveyance, and electrical infrastructure.
  - Overseeing and maintaining water treatment plant.
- Collection of groundwater samples.

HEALTH AND SAFETY MONITORING AND LABORATORY AND FIELD ANALYSIS

Air will be monitored for VOCs using a 10.6 eV PID. Typical compounds associated with MGP sites include: BTEX, PAHs, metals, and cyanide

Groundwater, soil, and vapor samples may be analyzed for:

- VOCs
- PAHs
- Cyanide
- Metals

EQUIPMENT, PRESERVATIVES, CALIBRATION MATERIAL, DECONTAMINATION CHEMICALS:

- Air Monitoring Equipment – with lithium ion battery
- Samples preserved with ice

  Water samples may be preserved with ice and hydrochloric acid (HCL) for VOCs, sodium hydroxide (NaOH) for cyanide, nitric acid for metals, sulfuric acid (H_2SO_4) for nitrates
- Soil samples collected for VOCs may be preserved with methanol
- Isobutylene gas will be used to calibrate the PID
- Field Chemicals including bug repellent spray or cream (e.g., Off) and sun screen
- First Aid Kit including eye wash sterile solution, rapid aid instant cold pack, PVP iodine scrub solution, burn spray, hydrocortisone cream 1%, neomycin antibiotic ointment, antiseptic spray
- Equipment decontamination with Alconox

Safety Data Sheets (SDSs) for the materials listed above are included in Appendix A.

CHEMICAL HAZARDS ON SITE

Chemical / Material	Media	Maximum Concentration	Routes of Exposure
Coal Tar	Soil and water	DNAPL	Inhalation, ingestion, dermal contact
Benzene	Water	Varies	Inhalation, ingestion, dermal contact
Naphthalene	Water	Varies	Inhalation, ingestion, dermal contact

PHYSICAL HAZARDS ON SITE

Slip, trip and fall hazards are present at every site. Please watch where you are walking. Use traction devices (yaktracs or crampons) for the bottoms of your boots when walking on snow or ice. Stay at least two feet from the edge of an excavation. Do not carry heavy items by yourself this could cause a fall or strain muscles.

Working around a trucks or heavy equipment presents struck-by hazards – always make eye contact with the driver of a truck and operator when approaching a piece of machinery. In addition, stay out of the swing radius of the backhoe bucket.

Working near roadways, parking lots or medians presents struck-by hazards – use the proper PPE (Class 2 high visibility vest or article of clothing and equipment ("Workers Ahead" sign, orange cones and amber strobe light) when working in these areas. In addition, keep your work vehicle between you and traffic and keep equipment and personnel within the width of the vehicle.

Working near a drill rig presents rotating hazards whereby a piece of loose clothing could get caught -by the rotating auger. In addition struck-by hazards are also considered when the drill rig tower is up and objects could fall from it. Stand back from the drill rig when in operation. Drill rigs and hydraulic probes also present noise hazards – wear hearing protection when working close to operating equipment.

Whenever drilling or excavating (any intrusive activities) underground utility clearance must be performed prior to the start of the intrusive activity. Striking a buried electric or gas line is very dangerous. The drilling or excavating subcontractor is responsible for utility clearance. If OBG personnel are performing the intrusive activity (hand augers) OBG is responsible for utility clearance. In most cases a private utility locate (scheduled by OBG) is required in addition to the JULIE-1 call locate.

Driving a UTV on a site presents potential hazards of a roll-over and struck-by. Seat belts are to be worn when the UTV is moving and a hard hat is also required. The UTV should not be driven over 20 miles per hour. Care should be taken when driving on steep or uneven surfaces. Do not overload the maximum hauling capacity of the UTV.

Confined space entry may be required for inspection/maintenance of the horizontal well vault. Both the confined space entrant and attendant will require specialized confined space training as this is not covered in the 8-hr HAZWOPER refresher course. **No OBG personnel (entrant and/or attendant) or subcontractor will enter a confined space without the proper training**. A confined space entry permit will also likely be required.

The safety coordinator/emergency coordinator will be the OBG staff personnel supervising the field investigation/work. Refer to Appendix D for task specific activity hazard analysis forms.

PROTECTIVE EQUIPMENT/INSTRUMENTS

In general, personal protective equipment (PPE) will be used as specified on Table 1 for the anticipated project tasks. The health and safety manager, project manager or client may require additional PPE based on field conditions or additional data collection.

Safety Equipment:

A first aid kit and fire extinguisher are located in field vehicles. If you rent a vehicle or use your own vehicle take a first aid kit and fire extinguisher from the warehouse.

DISTRACTED DRIVING ACTIVITY PROHIBITIONS

In Illinois an electronic communication device means an electronic device, including but not limited to a hand-held wireless telephone, hand-held personal digital assistant, or a portable or mobile computer while being used for the purpose of composing, reading, or sending an electronic message, but does not include a global positioning system or navigation system or a device that is physically or electronically integrated into the motor vehicle. Use of any electronic device is limited to hands free use.

OBG prohibits driving distraction activities; including eating, grooming, reading, text messaging, taking notes, internet access, and media viewing related activities when driving OBG owned or rented vehicles, whether driving for business or personal reasons.

The use of cellular phones for conversation should be reserved as a non-driving activity or limited with the following guidelines:

- The first priority during cell phone use is safe driving. Do not allow a phone conversation to distract you from concentrating on driving.
- Follow restrictions and bans for the state and municipality you're traveling in; the following link has a summary of State laws http://www.ghsa.org/html/stateinfo/laws/cellphone_laws.html.
- If it's unsafe for you to answer a call, let your voice-mail pick it up.

- Use a headset while driving, or pull over to use a handheld phone. OBG will provide a hands-free accessory of OBG's choosing, for your cell phone if the accessory did not come with your cell phone.
- Keep conversations short and suspend the call in serious circumstances (e.g., heavy traffic, stop-and-go traffic, maneuvering around hazards, severe weather conditions).
- Avoid placing calls while moving; use speed dialing when making calls and strive to plan calls before driving is started. When dialing manually without the speed-dialing feature, dial only when the vehicle is stationary.
- When receiving a call, inform the caller that you are driving and will suspend/end the call without notice if traffic conditions become hazardous in any way. If possible, ask a passenger to make the call for you or at least dial the number for you.
- If you're talking while driving, keep your head up, your eyes on the road, and frequently check the side and rearview mirrors.
- To obtain roadside assistance or report emergencies, use 911 and give exact location, nature of emergency, name, and number.

REPORTING

The Incident and Vehicle Accident Report forms are included as Appendix B, along with WorkCare and OBG corporate contacts information. Near Miss Reporting is done online within 3 days.

TABLE 1. SUMMARY OF PPE BY SAMPLING ACTIVITIES

PPE Required	Site Reconnaissance / Field Mobilization	Drilling (monitoring wells / bore holes)	Monitoring Well Development and Conductivity Testing	Groundwater Levels and Sampling	Soil Sampling (by hand)	Pump and Treatment System Maintenance	Recovery Vault Inspection	Soil Sampling (heavy equipment or drill rig)	O&M recovery vault inspection and pump maintenance
Steel-Toed Boots (Rubber		Av	Av	Av				Av	
Steel-Toed Boots (Leather)	X	X	X	X	X	X	X	X	X
Hard Hat		X				X	X	X	X
Safety Glasses/Goggles	X	X	X	X	X	X	X	X	X
Gloves-Inner (Nitrile)	Av	X	X	X		X	X	X	X
Gloves-Outer (Nitrile)		X	X	X	X	X	X	X	X
Hi Vis Vest	X	X	X	X	X	X	X	X	X
Personal Floatation Device (b)									
Tyvek Coverall		Av			Av			Av	Av
Half-Face Respirator (a)					Av	Av	Av	Av	Av
Respirator Cartridge (Hepa or Org. Vapor) (a)					X	Av	Av	X	Av
Photoionization Detector (PID)		Av	AV	Av	X		X	Av	X
4 Gas Meter							Av		X
Hearing Protection	Av	X	Av	Av			Av	X	Av
Other									

Key: X = PPE Required
Av = Have available at work site
Glove types may be altered based on field conditions to include: vinyl, neoprene, and/or latex.
"Other" required or to be available PPE will be identified for each task in the Site-Specific Work Plan.
(a) Refer to Appendix C for the Air Monitoring and Respirator Use Flow Chart.

(b) A PFD is required to be worn when working over water and within 10 feet of a water body.

FIELD HEALTH & SAFETY PLAN REVIEW

I HEREBY CERTIFY THAT I HAVE READ AND UNDERSTOOD ALL HEALTH AND SAFETY PROCEDURES AS STATED HEREIN:

Name and Affiliation (printed)	Signature	Date

Daily Health and Safety Tailgate Meeting

Date: _____ Site: _____

Time: _____ Job Number: _____

Work to be Performed: _____

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Health and Safety Topics Discussed: _____

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Attendees

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Site safety leader Conducting Meeting

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Site safety leader Conducting Meeting

Name (print)	Signature	Company
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SECTION B
HEALTH AND SAFETY PLAN

TABLE OF CONTENTS

LIST OF APPENDICES

1 INTRODUCTION

1.1 PURPOSE AND SCOPE

This document describes the health and safety procedures and requirements for the installation of borings/wells, test pit excavations, sampling of soil (surface and subsurface), groundwater, surface water and sediment and subsurface structure review (from ground surface). This document is intended to serve as a Multi-Site Health and Safety Plan (HASP) to try to ensure that the fieldwork performed by OBG is done in compliance with applicable federal, state, and local occupational safety and health regulations. Subcontractors shall be made aware of the requirements of this plan; however, subcontractors **need to have their own plan for the health and safety of their own employees** and for following applicable federal, state, and local regulations.

In compliance with HAZWOPER, a comprehensive work plan will be developed for each site to evaluate the logistics and resources needed to reach work objectives for site operations. The work plan will identify key individuals and their responsibilities, site activities, methods for accomplishing the objectives (sampling plans), and normal operating procedures. Site-specific work plan(s) will be available on location at the site.

1.2 HEALTH AND SAFETY PLAN MODIFICATION PROCEDURES

Due to varying site conditions or encountering unanticipated hazards, it may be necessary to revise the health and safety plan. Necessary plan changes that call for more stringent procedures or a higher level of personal protective equipment (PPE) may be made at any time by the Health and Safety Manager, Project Manager (PM) or Task Leader in cooperation with the Site Safety Leader (SSL). The PM should be notified at the soonest available opportunity.

Plan changes that would make safety procedures or PPE requirements less stringent may be made only upon approval of the HSM and PM). Plan changes must be put in writing and communicated to field personnel.

2 KEY PERSONNEL/IDENTIFICATION OF H&S PERSONNEL

2.1 KEY PERSONNEL

Responsibilities for health and safety compliance issues associated with hazardous waste operations are primarily vested in the project organization, with support from appropriate health and safety professionals on OBG's technical and administrative staffs.

2.2 SITE-SPECIFIC HEALTH AND SAFETY PERSONNEL AND ORGANIZATIONAL RESPONSIBILITY

2.2.1 Corporate Health and Safety Manager

The Corporate Health and Safety Manager (HSM) acts as a technical resource to OBG offices on health and safety matters. This person is responsible for ensuring that OBG health and safety programs comply with applicable federal, state, and local statutes for safety and health protection; executive orders; operating orders; permits and regulations; and company policies and procedures. The HSM is also responsible for review and approval of site-specific Health and Safety Plans, serves in a consultation capacity to the technical staff on health and safety-related issues, and has the authority to conduct health and safety audits.

2.2.2 Project Manager

The Project Manager (PM) is accountable for health and safety compliance on his or her projects. The PM is responsible for the technical and financial execution of the project, and has the authority to commit resources, adopt program policies and procedures, and approve expenditures and subcontracts. The PM will try to ensure that adequate resources are budgeted and available to implement a sound health and safety program and that appropriate technical resources are brought in to support the health and safety needs of the project. The PM will try to ensure that health and safety is a high priority in planning fieldwork and/or lab studies, and that adequate resources are available to develop and implement an appropriate project-specific health and safety plan.

2.2.3 Project Health and Safety Officer

The Site Safety Leader (SSL) is responsible for developing and implementing the project- or Site-Specific Health and Safety Plan. In the event a SSL has not been identified for a specific project, the PM will assume those responsibilities. The PM is ultimately responsible for health and safety for the project. It is the responsibility of the PM to report any unsafe conditions reported by the project staff to the HSMHSM and to work cooperatively to mitigate unsafe conditions. The SSL will also try to ensure compliance with health and safety requirements presented in this Plan. The PM will serve as the SSL unless site-specific hazards are identified create the need for assignment of a SSL to the project. To meet these responsibilities, the PM/SSL may:

- Act as a health and safety consultant to the project field staff
- Provide site-specific training to staff assigned to work at the site
- Review and confirm any changes in personal protective clothing or respiratory protection requirements
- Indicate that specific health and safety precautions be taken before personnel enter a site
- Restrict access to the site or a portion thereof
- Perform necessary personnel review
- Stop work when the health or safety of project personnel are jeopardized and order the immediate evacuation of personnel from any area of the site
- Recommend personnel to obtain immediate medical attention if necessary
- Provide health and safety briefings to site visitors
- Enforce the requirements stated in the Corporate Health and Safety Manual and the project- or Site-Specific Health and Safety Plan

2.2.4 Field Team Members

OBG personnel must know, understand, and comply with the requirements of this Plan developed for their projects. Field personnel will:

- Read and understand applicable health and safety plans
- Perform work safely
- Be aware of and alert for signs and symptoms of work-related injuries and illnesses
- Promptly report any unsafe conditions that may occur on site to the SSL, PM, and/or HSM

2.2.5 Subcontractors

Subcontractors have primary responsibility for the health and safety of their own employees. However, OBG is stipulated by OSHA standards (e.g., 29 CFR 1910.120) to provide information to its subcontractors on known or potential workplace hazards, as well as the methods proposed to manage the identified hazards.

It is currently OSHA policy to issue citations to prime contractors in the event that their subcontractor is found to be out of compliance with regulatory requirements. OBG may incur civil penalties as a result of non-compliance with regulatory requirements by its subcontractors and/or injuries or illnesses incurred by the subcontractor's staff. Personal injury suits have been successfully brought against prime contractors in instances where a subcontractor's employee has demonstrated that the lack of health and safety oversight on the part of a prime contractor played a role in his or her sustaining an injury or illness.

OBG intends to manage its subcontractors to protect the health and well-being of OBG staff. OBG's objective is to manage subcontractors in a way that limits OBG's and our client's liabilities related to subcontractor performance, including management of health and safety issues. To achieve this objective, a reasonable level of subcontractor surveillance, with respect to health and safety issues is recommended.

When indicated by OBG, **the subcontractor must review project-specific health and safety information and hazards, and develop and implement a health and safety plan.** This plan must comply with applicable health and safety regulations and any project-specific requirements that OBG has specified. The subcontractor must provide OBG with a copy of this plan before the start of work. OBG acceptance of the subcontractor's plan does not mean that OBG concurs with the adequacy of the plan for protection of the health and safety of the subcontractor's employees. That responsibility rests solely with the subcontractor. OBG's review of subcontractor health and safety plans will be for the purposes of**: 1) assessing potential health and safety impacts to OBG personnel and 2) meeting OBG legal responsibilities as a prime contractor**. Any deficiencies in the subcontractor's plan or inconsistencies in proposed work practices between OBG and its subcontractor should be identified. If appropriate, these deficiencies or differences should be resolved before the work begins.

2.3 COMMUNICATION

Field staff and subcontractors are both permitted to call 911 in an emergency situation. As part of preparing the Site-Specific Health and Safety Plan, 911 services will be verified for each site location. Assuming the PM is not on-site, the field staff should contact the PM as soon as possible regarding the on-site situation. It is then up to the discretion of the PM if necessary to contact the Client.

3 TASK/OPERATION SAFETY AND HEALTH RISK ANALYSIS

3.1 HISTORICAL OVERVIEW OF SITE

A historical overview of the site along with details of the project description is provided in the project Work Plan. Specific protocols for sampling, sample handling and storage, chain-of-custody, and laboratory and field analyses to be performed are described in the site-specific work plan. Quality assurance/quality control (QA/QC) procedures are structured in accordance with applicable technical standards, regulations, and guidance.

3.2 RISK ANALYSIS-GENERAL

Personnel in the vicinity of the drilling, excavation, and sampling operations are not only subject to the hazards of direct exposure to contaminants, but also to dangers posed by machinery operation. In addition, stresses due to working in protective clothing may be encountered. Physical, chemical, and biological hazards are present to some degree at most job sites.

3.2.1 Heat/Cold Stress

THERMAL STRESS – HEAT

At times OBG personnel need to work in hot and humid weather conditions, when temperatures and or humidity create a heat index which may be dangerous to work in. Field personnel must dress appropriately for the weather conditions and drink fluids to stay hydrated. In addition, more frequent breaks to cool down should be taken when temperatures and the heat index are high. Site personnel should take breaks as often as necessary to prevent the conditions listed below. It is also very important that field staff work together (i.e.," buddy system") so that they can observe each other for signs of heat stress. The table below calculates the heat index and provides a guide to potentially dangerous working conditions.

NOAA's National Weather Service

Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

IMPORTANT: Since heat index values were devised for shady, light wind conditions, **exposure to full sunshine can increase heat index values by up to 15°F.** Also, **strong winds**, particularly with very hot, dry air, can be extremely hazardous.

HEAT STRESS

The site safety leader (SSL) shall identify the extent to which heat stress observation and measures are needed based on the guidance provided in this section. The stress of working in a hot environment can cause a variety of illnesses including heat exhaustion or heat stroke; the latter can be fatal. Persona protective equipment (PPE) (i.e., Environmental Protection Agency (EPA) Level C protection [respirators]) can increase heat stress significantly. To reduce or prevent heat stress, frequent rest periods and beverage consumption to replace body fluids and salts is recommended. It should be noted that heat stress can occur in people wearing regular, permeable work clothing.

Quantitative physiological observation for heat stress may be conducted. Physiological observation for heat stress includes heart rate as a primary indicator and oral temperature as a secondary indicator. The frequency of observation depends on the ambient temperature and the level of protection used on site. To identify the initial review frequency, after a work period of moderate exertion, use the table below (source, NIOSH/OSHA/USCG/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities):

*Adjusted Temperature**	*Level D*	*Level C*
90 °F or above	After 45 minutes	After 15 minutes
87.5 to 90 °F	After 60 minutes	After 30 minutes
82.5 to 87.5 °F	After 90 minutes	After 60 minutes
77.5 to 82.5 °F	After 120 minutes	After 90 minutes
72.5 to 77.5 °F	After 150 minutes	After 120 minutes

°F – Degrees Fahrenheit

*Adjusted air temperature (°F) = observed temp + (0.13 x percent sunshine)

Observed temp = air temperature measured with bulb shielded from radiant heat.

Percent sunshine = the time sun is not covered by clouds thick enough to produce a shadow (100 percent = no cloud cover and a sharp, distinct shadow; 0 percent = no shadows).

Heart rate: Count the radial pulse during a 30-second period as early as possible in the rest period. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle one-third and keep the rest period the same. If the heart rate exceeds the 110 beats per minute at the next rest period, shorten the following work cycle by another one-third and also observe oral temperature.

Oral temperature: Use a clinical thermometer (3 minutes under the tongue), temperature strip or ear thermometer to measure the temperature at the end of the work period (before drinking). If the temperature exceeds 99.6 F, shorten the next work cycle by one-third without changing the rest period. If the temperature exceeds 99.6 F at the beginning of the next rest period, shorten the following work cycle by one-third. ***DO NOT*** allow a field team member to wear EPA Level C protection when the measured temperature exceeds 100.6 F.

Personnel will pay particular attention to the information in this section in order to recognize the symptoms of heat stress and the appropriate action to take upon recognition. Even though physiological observation is not generally necessary, it is essential that personnel understand the significance of heat stress and its recognition.

Symptoms that indicate **heat exhaustion** are:

- Clammy skin
- Weakness, fatigue
- Lightheadedness
- Confusion
- Slurred speech
- Fainting

- Rapid pulse
- Nausea (vomiting)

If these conditions are noted, the following steps should be taken:

- Remove the victim to a cool and uncontaminated area.
- Remove protective clothing.
- Give water to drink, if conscious.

Symptoms that indicate **heat stroke** include:

- Staggering gait
- Mental confusion
- Hot skin, high temp (yet may feel chilled)
- Convulsions
- Unconsciousness
- Incoherent, delirious

If heat stroke conditions are noted, immediately perform the following steps:

- Remove victim to a cool, uncontaminated area.
- Cool the victim with water, compresses and/or rapid fanning.
- Give water to drink, if conscious.
- Transport the victim to the designated medical facility for further cooling and observation of body functions. ***HEAT STROKE IS A MEDICAL EMERGENCY!***

Sunburns are another hazard of performing outdoor work. If hard hats are not necessary, team members should consider a brimmed hat and possibly neck flaps. Many weather reports now include an ultraviolet index to aid in the determination to apply sunscreen. When using sunscreen it is important to get one with a sun protection factor of about 30. Apply the sunscreen at least 30 minutes prior to going outdoors and reapply during the day. The SSL is responsible for ensuring that sunscreen is brought to the site and available for use.

It is also important to stay hydrated by drinking water and sports drinks with electrolytes to replenish salts lost through perspiration. Avoid caffeinated drinks when trying to stay hydrated because caffeine is a diuretic which is counter-productive to hydration.

THERMAL STRESS - COLD

On days with low temperature, high winds, and humidity, anyone can suffer from the extreme cold. Severe cold exposure can be life threatening. Several factors increase the harmful effects of cold: being very young or very old, wet clothing, having wounds or fractures, smoking, drinking alcoholic beverages, fatigue, emotional stress, and certain diseases and medications.

Cold weather injuries may be local or systemic. Local cold weather injuries include chilblains (chronic injury of the skin and peripheral capillary circulation) and frostbite. Frostbite occurs in three progressive stages: frostnip, superficial frostbite, and deep frostbite. Systemic cold injuries, due to hypothermia, affect the entire body system. Hypothermia is caused by exposure to cold and is aggravated by moisture, cold winds, fatigue, hunger, and inadequate clothing or shelter. Precautionary measures that will be taken include the following:

- Providing field shelters or windscreens
- Observing temperature and wind speed to identify appropriate cold stress personal safety measures

- Adjusting work schedule based on weather conditions and temperature
- Providing insulated clothing for field workers
- Adhering strictly to the buddy system so that workers can assess cold stress symptoms in their co-workers
- Providing chemical hand and feet warmers
- Employees should also take common sense precautionary measures in regards to traveling in cold weather
- When driving, keep as full a tank of gas as possible, so the car can be run for warmth if needed
- Carry cold weather gear (boots, gloves, hats, blankets) when traveling to stay warm in the event of an emergency
- Keep cell phones charged

The following table provides temperature, wind, and wind chill relationships:

Temperature (°F)

Wind (mph)	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
	5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
	10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
	15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
	20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
	25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
	30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
	35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
	40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
	45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
	50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
	55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
	60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes | 10 minutes | 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Field personnel must be cognizant of wind chill factors and take necessary precautions to prevent frostbite. The following are work/warm-up guidelines for working in cold temperatures and with associated wind chill factors. Please note these are only guidelines and field personnel should take warm-up breaks as often as necessary to prevent cold stress situations.

THRESHOLD LIMIT VALUES WORK/WARM-UP SCHEDULE FOR FOUR-HOUR SHIFT*

Air Temperature Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
° C (approx)	° F (approx)	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
-26° to -28°	-15° to -19°	(Norm breaks) 1		(Norm breaks) 1		75 min.	2	55 min.	3	40 min.	4
-29° to -31°	-20° to -24°	(Norm breaks) 1		75 min.	2	55 min.	3	40 min.	4	30 min.	5
-32° to -34°	-25° to -29°	75 min.	2	55 min.	3	40 min.	4	30 min.	5		
-35° to -37°	-30° to -34°	55 min.	3	40 min.	4	30 min.	5				
-38° to -39°	-35° to -39°	40 min.	4	30 min.	5						
-40° to -42°	-40° to -44°	30 min.	5								
-43° to below	-45° & below	Non-emergency work should cease									

Non-emergency work should cease ↓ (5 mph Wind)

Non-emergency work should cease ↓ (10 mph Wind)

Non-emergency work should cease ↓ (15 mph Wind)

Non-emergency work should cease ↓ (20 mph Wind)

*Source: Adapted from Threshold Limit Values (TLV) and Biological Exposure Indices (BEI) booklet: published by ACGIH, Cincinnati, Ohio, 2008

Frostbite Monitoring: Frostbite is a potentially crippling condition that can occur when inadequately protected skin or body parts are subjected to freezing weather. Team members should continually be alert for signs of frostbite in coworkers and bring it to the attention of the site safety leader (SSL). A cold feeling, pain, and numbness precede the onset of frostbite. Frostbite usually appears as gray or white waxy spots on skin. Areas most susceptible are nose, ears, and cheeks. The following steps should be taken to avoid frostbite:

- Dress warmly (avoid cotton, wear polypropylene, wool, Gore-Tex, or other moisture wicking materials instead).
- Wear at least three layers of clothing. An inner layer of wool, silk, or synthetic to wick moisture away from the body. A middle layer of wool or synthetic to provide insulation even when wet. An outer wind and rain protection layer that allows some ventilation to prevent overheating.
- Wear a hat or hood. Up to 40% of body heat can be lost when the head is left exposed.
- Keep boots and gloves loose fitting.
- Stay dry; carry extra clothing.
- Avoid touching cold metal with bare hands.
- Avoid spilling cold fuel, alcohol, or other liquids that freeze below 32 °F on your body or clothing.

If a person suffers frostbite, get them to a hospital as soon as possible. If transport to a hospital is not immediately available, get the person to a warm shelter and immediately perform the following:

- Cover exposed areas with additional clothing while still exposed to the elements.
- Wrap the person in blankets or a sleeping bag.
- Give the person warm drinks (no liquor).
- Undress the frozen part and submerge the frozen part in a tub of warm water (102 °F to 105 °F), or put the frostbitten person in a large tub of warm water, if available, and stir the water.

- Warm with skin to skin contact, such as placing warm hands on frozen nose or ears, but do not rub.
- Get the person to a hospital as soon as possible.

Do ***not*** allow the following to occur:

- Do not rub the frozen part.
- Do not give the person liquor.
- Do not allow the person to walk on thawed feet.
- Do not let the person smoke.
- Do not break any blisters that may form.
- Do not let the thawed part freeze again.
- Do not warm the frozen part in front of a source of dry heat (e.g., open fire or oven).

Hypothermia Monitoring: Hypothermia is a lowering of the body's temperature due to exposure to cold or cool temperatures. Team members should continually be alert for signs of hypothermia in co-workers and bring it to the attention of the SSL. Most cases of hypothermia occur at temperatures between 30 °F and 50 °F. If not properly treated, hypothermia can cause death. Safety equipment for hypothermia should include a synthetic sleeping bag and a hypothermia thermometer. ***HYPOTHERMIA IS A MEDICAL EMERGENCY!*** Transport to a hospital as soon as possible, even if victim appears to be recovering.

To prevent hypothermia:

- Eat well prior to exposure.
- Dress warmly (avoid cotton, wear polypropylene, wool, Gore-Tex, or other moisture wicking materials instead).
- Avoid becoming wet due to sweating, rain or snow, or falling in water.

Early signs of hypothermia may include:

- Violent shivering
- Slurred speech
- Decrease in coordination
- Confusion, inability to answer simple questions
- Unusually irritable behavior
- Strange behavior
- Tendency to drop or lose clothing or equipment

As hypothermia progresses into more serious stages, victims typically:

- Develop trouble seeing clearly
- Become sleepy and numb
- Move with difficulty
- Eventually become unconscious if not properly cared for

The following actions should be taken to treat a hypothermia victim:

- Get the victim to a warm, dry shelter as soon as possible.
- Remove any wet or cold garments and dry the person thoroughly.

- Wrap the victim in blankets, sleeping bags, or dry clothing to prevent more heat loss.
- If a warm area is not available:
  - Build a shelter and put the victim in the warmest, driest area available.
  - Remove any wet or cold garments.
  - Have one or more persons remove their clothing and lay next to the victim, providing skin to skin contact.
- Wrap the victim and rescuers in dry warm blankets, sleeping bags, or clothing.
- When the victim becomes conscious, place warm objects along the victim's sides to warm vital areas.
- When the victim is able to swallow easily, provide warm, sweetened drinks and food (preferably candy or sweetened food).
- Do not give the victim alcohol or allow smoking.
- Do not rub the victim's skin.

Keep checking the victim and give additional assistance as needed.

3.2.2 Slips, Trips, and Falls

The most common hazards that will be encountered on a jobsite will be slips, trips, and falls. Common sense will be used to avoid these hazards. When working on slippery surfaces, tasks will be planned to decrease the risk of slipping. Slippery surfaces will be avoided, work and travel will not be hurried, and good housekeeping will be maintained. It is not advisable to walk and talk on a cell phone at a job site, if possible. It is also not advisable to text while walking on a job site. Personnel must vigilantly observe where they are working and walking to avoid slips, trips, and falls.

3.2.3 Vehicular Traffic

Another common hazard that will be encountered at many sites will be vehicle traffic, including cars, trucks, drilling rigs and heavy machinery. When it is necessary to move a vehicle, site drivers must be mindful that pedestrians are present on site. If appropriate, site personnel on foot may guide site drivers while moving vehicles to alert and protect non-site personnel. Site personnel on foot must avoid standing in blind spots or in high traffic areas, be aware of vehicle locations, and make eye contact with site drivers if crossing the path of vehicles is necessary. Site personnel on foot must vigilantly observe where they are working and walking to avoid being struck by vehicles which, for one reason or another, are moving. Finally, when working in high traffic areas (e.g., on the edge or in the middle of city streets, heavily used parking areas) site personnel are recommended to set up the "Workers Ahead" sign, amber traffic strobe light on vehicle, traffic cones and wear Class 2 high visibility traffic safety vests to alert drivers to their presence.

Work performed in rail yards or along railroad tracks poses an additional hazard. Numerous incidents have occurred when working between or alongside rail lines and have resulted in serious injury or death. Therefore, the following rules must be followed when working near rail lines:

- It is best to not walk or step on a railroad track; tracks can be slick and injury due to slipping off a track is possible.
- It is best to not run over tracks - Walk; tripping injuries can occur when running over the tracks which can result in serious head injuries.
- It is best to not stand between the tracks; when necessary, walk across the railroad tracks and stand to one side or the other of a rail line.
- Wear a hard hat, eye protection, steel-toed boots, and an orange reflective vest for personal protection.

In addition to these rules, whenever work is done near railroad tracks or in a railroad right-of-way, the railroad company must be contacted and a flagman requested to observe work activities. No work will be done without a railroad flagman being present unless the railroad company expressly permits it.

3.2.4 Hunting Season

It is possible field activities will be conducted during hunting seasons and may pose a risk to site workers. The hunting season dates will be reviewed prior to conducting field activities in non-urban areas. During hunting season, site workers will wear a at least 50% of the outer clothing above the waist in 100% blaze orange (faded blaze orange is not acceptable) to alert potential hunters to their presence. If site work is performed in densely vegetated locations, site personnel may post signs along access locations to indicate their presence.

3.2.5 Exposure to Excessive Noise

Overexposure to noise can result in hearing loss. If it is difficult to hear normal speech when the speaker is 3 to 4 feet from the listener, and that condition is present for more than four hours a day, it will be assumed that the noise level exceeds 85 decibels (dB) and appropriate hearing protection will be used. The disposable "ear plug" type hearing protectors are recommended.

3.2.6 Chemical Hazards

PPE requirements are stated in Personnel Protection Section 5 of this Plan. Safety Data Sheets (SDSs) for suspected contaminants present at a site are contained in Appendix A.

3.2.7 Biological Hazards

During warm weather months, potential biological hazards include venomous insects, snakebites, and poisonous plants. Appropriate safety measures, such as the use of insect repellent (with DEET) and probing of possible nesting areas, will be taken to prevent exposure to biological hazards.

Ticks are common in wooded and heavily vegetated areas in spring summer, and fall in the Midwest. The deer tick, also known as a bear tick or a blacklegged tick, is much smaller than the wood tick. Adults are about 1/8 inch long and reddish-brown in color. They live in the woods and are common along trails. Deer ticks crawl, rather than jump, so are most likely to come into contact with humans as they brush against low-lying vegetation.

Wood ticks are a type of hard tick. Male wood ticks have mottled gray backs. Females have gray coloration behind their heads. They are found in both grassy and wooded areas. Both wood ticks and deer ticks can occasionally cause illness in their hosts. The deer tick can sometimes carry Lyme disease, a serious illness which can cause a rash, fever, tiredness, and flu-like symptoms. Wood ticks can carry Rocky Mountain spotted fever, a rare but sometimes serious illness that causes a rash and severe flu-like symptoms. At the end of the day personnel should do a self-review for ticks to remove them. Pulling them off with tweezers works the best. Grab the tick as close to the skin as possible and pull upward with a slow steady pressure. Try not to leave the head or any mouth parts of a tick imbedded in the skin as it can transmit diseases. In addition, staff may treat their clothes with permethrin which is a tick repellent.

Poison ivy, poison oak, and poison sumac release oil (urushiol) when the leaf or other plant parts are bruised, damaged, or burned. When the oil gets on the skin an allergic reaction, referred to as contact dermatitis, occurs in most exposed people as an itchy red rash with bumps or blisters. When exposed to 50 micrograms of urushiol, an amount that is less than one grain of table salt, 80 to 90 percent of adults will develop a rash. The rash, depending upon where it occurs and how broadly it is spread, may significantly impede or prevent a person from working. Although over-the-counter topical medications may relieve symptoms for most people, immediate medical attention may be recommended for severe reactions. Long sleeves and pants will provide protection from contact with poisonous plants and insects. Field personnel should familiarize themselves with poison ivy, poison oak, and poison sumac. Care should be taken to avoid contact with poisonous plants.

3.2.8 Thunderstorms and Rain

Drilling/excavation and sampling activities during electrical storms poses a hazard of electrocution by a lightning strike, and adverse working conditions, as well as high winds tipping the drill rig. Drilling/ excavation and sampling activities will stop and the drilling rig mast will be lowered at the approach of a thunderstorm. Drilling activities during rainstorms can cause not only slippery conditions but also excess friction on cathead pulleys. This can cause dangerous conditions during drive sampling operations. Therefore, drive sampling operations will cease and, depending on the SSL's assessment, drilling may be halted.

When drilling or using excavating equipment, if lightning is seen or thunder is heard, regardless of the distance, drilling and excavation operations must be temporarily shut down. If possible, the mast on the rig should be lowered and connection with the drill pipe in the ground broken. Operations may not resume until threat from lightning is over, which is at least 30 minutes after the last observed lightning or thunder. Lightning strikes are possible up to 10-miles from an obvious storm front. It is recommended to check local radar images to identify if other storms are following the one that shut operations down before resuming drilling.

3.3 RISK ANALYSIS-TASK-BY-TASK

Table 1. Anticipated Task Hazards

	Hazards													
					Physical									
	Chemical	Biological	Explosive	General Safety	Heat	Cold	Traffic	Noise	Slip, Trips, Falls	Heavy Equipment	Underground utilities	Overhead Power	Lines	Trench/Excavation
Site reconnaissance/field mobilization	X	X	X	X	X	X	X	X	X	X	X		X	
Well and borehole drilling	X	X	X	X	X	X	X	X	X	X	X	X	X	
Monitoring well development	X	X		X	X	X	X		X					
Groundwater level measurements	X	X		X	X	X	X		X					
Groundwater and soil sampling	X	X		X	X	X	X		X					X
Test pits and excavation	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Surface water sampling	X	X		X	X	X	X	X	X	X			X	
Sampling solid material, wipe sampling, surface sampling	X	X		X	X	X	X	X	X	X	X	X	X	
Sampling through ice	X	X		X		X	X	X	X	X			X	

3.3.1 Well and Borehole Drilling

In addition to the possibility of contact with the above listed chemicals, physical hazards associated with well and borehole drilling includes:

- Snapping cables
- Brush and equipment fires
- Being hit by equipment

- Being caught in rotating tools
- Falling objects
- Exposure to excessive noise
- Contact with energized electrical lines

3.3.2 Air Rotary Drilling

This type of drilling, in addition to the above listed hazards, may also expose field personnel to blowing dust and high-pressure airlines.

3.3.3 Groundwater, Seep, Soil, and Pipe Sampling

Collection of these samples presents inhalation and, direct skin contact hazards with the substances listed in Appendix A.

3.3.4 Drilling/Excavation near Overhead Electrical Lines

Drilling or excavation activities near overhead electrical lines present a serious electrocution hazard. Safe work distance must be maintained. This distance is a function of the humidity and the voltage present. Should work in the proximity of overhead lines be indicated, a reasonable clearance will be identified based on OSHA standards as follows:

- Lines rated 50kV or below - usual clearance between the lines and any part of the crane or load shall be 10 feet. (1926.550(a)(15)(i)).
- Lines rated over 50 kV - usual clearance between the lines and any part of the crane or load shall be 10 feet plus 0.4 inch for each 1 kV over 50 kV, or twice the length of the line insulator, but should not ever be less than 10 feet (CFR 1926.550(a)(15)(ii)).

Safe working distances are as follows:

- Power line 51,000 to 138,000 volts - work at least 11 feet away
- Power line more than 230,000 volts - work at least 13 feet away
- Power line ≥500,000 volts - work at least 18 feet away

Note that humid or wet conditions (rain) are conducive to potential arcing from power lines to the piece of equipment. It is not advisable to work near power lines during humid or wet conditions.

3.3.5 Drilling/Excavation near Underground Electrical/Utility Lines

Buried electrical/utility lines present a hidden danger while drilling/excavating. The subcontractor will be responsible for contacting the local underground utility locator service (call 811 nationally for state one-call system); however, it is the responsibility of the OBG PM or SSL to try to ensure that the subcontractor has contacted the appropriate locator service to try to ensure that site activities can be completed in accordance with the schedule. The locator service will mark underground lines to try to ensure safe working conditions. Drilling/excavation will not occur until the site is properly marked. Drilling/excavation will not occur within three feet of any marked utility. In addition, a private utility locate arranged by OBG will also likely be required.

3.3.6 Test Pits and Excavation

Test pits and excavations pose a serious threat of injury resulting from falls or excavation wall collapses. During excavation or digging activities an exclusion work zone will be established around excavating machinery. Bystanders and on-lookers will be prohibited from entering this work zone while the excavating machinery is in operation. The work zone will be large enough so that the excavating machinery (e.g., trackhoe) can rotate 360-degree without extending out of the work zone. After the excavation is completed it should either be backfilled immediately or the entire excavation will be encircled with a physical barrier (e.g., barricades, orange excavation fencing), which will limit access to the excavation and decrease the likelihood of injury resulting from falls. Any excavation greater than four feet deep will NOT be entered unless the walls of the excavation have been

reinforced to prevent wall collapse. Entry into any excavation greater than four feet deep will constitute a confined space entry procedure. Therefore, no excavation entrance is allowed.

A photoionization detector (PID) may be used to observe air quality in the breathing zone of the work area for volatile organic compound (VOC) vapor levels and in an excavation (See Section 7 of this plan) if VOCs are anticipated to be present. Prior to Contractor Personnel entering any excavations to install piping or any other equipment, the PID will be lowered into the excavation to identify air quality in the excavation. Depending on the potential hazards present additional air monitoring may include, oxygen levels, lower explosives limit, sulfide, carbon monoxide, and cyanide. Confined spaces will not be entered.

3.3.7 Operations on Surface Waters

The procedures specified in this subsection are designed to protect OBG staff when conducting work activities involving water craft vessels on surface waters. Governmental laws and regulations regarding onshore waters are under the jurisdiction of the Unites States Coast Guard (USCG) and the state regulatory agency and its regulations will be adhered to. It is OBG's standard practice to work in pairs, deviations will be addressed in site-specific work plans.

3.3.7.1 Scope and Applicability

The procedures specified in this subsection apply to work activities involving surface waters (including sediment sampling). The highest ranking OBG staff member (e.g., Project Manager, Field Task Leader) at the work site is responsible for implementing this plan. The work activities will not be initiated prior to receiving approval from the PM.

- Work activities can be conducted in "open water" or "ice" conditions.
- Each OBG staff person at the site is responsible for following these procedures.

3.3.7.2 Water Craft

The following procedures will be observed when OBG staff conducts work activities in "open water" conditions in a water craft vessels (including drill rigs mounted on barges):

- Work will not be initiated prior to meeting approval from the PM.
- Work activities conducted on surface waters will be conducted in accordance with the requirements of the USCG and the appropriate state agency.
- Personal Flotation Devices (PFD) that is USCG approved must be worn at all times when on surface waters. The PFD must be properly securely fastened. There should be one adult size PFD (wearable style) for every person on the water craft.
- Two (2) PFDs must be on board on the water craft.
- One "throwable" flotation device with attached line must be on board.
- Distribute weight evenly across the beam of the watercraft.
- Only allow one person to stand at a time in a small watercraft vessel.
- Do not exceed manufacture's capacity plate load limits.
- Attach a lanyard or safety line which can be tied to the sampling personnel when water surface conditions are rough. This will enable easier retrieval of the person should he/she fall over the side of the water craft.
- Check running condition of the outboard motor prior to launching (e.g., ample supply of fuel/oil mix, fuel line condition, integrity of the propeller, **EXTRA SHEAR PINS** for the propeller).
- Equipment to have on board includes oars, anchor with line (at least100 foot line on inland waters) and mooring lines of adequate length.
- Wear work gloves when using equipment that could injure hands.

- Wear hard hat if overhead hazards exist (e.g., A-Frame, use of long coring devices).
- Secure overboard equipment to vessel.
- Use proper lifting techniques when retrieving heavy equipment.

3.3.7.3 Shallow Water

Site-Specific Work Plan and the site reconnaissance will evaluate the best approach to sampling in shallow water. If wading is necessary, work activities in shallow water along the shore line shall consider the following hazards:

- Use waders to minimize exposure to water, sediment contaminant exposure and heat loss.
- A PFD may be required when working within 10 feet of the shoreline.
- Proceed carefully – water currents and falling can cause the waders to fill creating a very serious condition. In addition to wearing a PFD, a safety line should be tethered to the person walking in water currents.
- Fatigue can occur more rapidly from walking through the water.

3.3.7.4 Sampling Through Ice

Collection of samples through frozen rivers/lakes presents the difficulties of working on ice. Precautions for slips, trips, and falls will be observed. Ice thickness will be at least 9-inches thick before work activities will commence.

The following procedures will be observed when OBG staff conducts work activities on "ice" conditions:

- Work activities will not be initiated prior to meeting approval from the SSL
- Know the ice (e.g., thickness) and proceed with extreme caution. Ice thickness at least should be 18 to 24 inches (when conducting drilling operations) and reviewed for integrity. Check ice thickness regularly when traversing across ice to see if adequate support exists. Be especially cautious when approaching pressure cracks, areas of open water or areas of rivers where water velocity may be higher.
- Wear PFDs while aboard any water craft.
- Warm weather causes ice thinning and potential for slipping (drilling holes on thinning ice can cause flooding of ice surface and can accelerate ice thinning and breakage).
- Equipment may need to be hauled between work stations (use sleds).
- Fatigue can occur from walking and drilling holes.

Based on water currents, water temperature and the amount of clothing worn by OBG staff, the threat of being swept downstream or drowning is possible. Extreme caution must be used when conducting these types of work activities. If a OBG staff employee should fall into the water, the employee will be retrieved and necessary precautions shall be taken to in effort to see to the safety and wellbeing of that individual. Work activities will be immediately suspended and the person brought to shore. Wet clothing shall be removed and the person shall be dried and dressed in a set of dry clothes. If the possibility of hypothermia exists, seek medical attention immediately.

Persons sampling contaminated or potentially contaminated materials should wear the same PPE as listed for monitoring well sampling. The recommended PPE will be carried along on the sediment sampling water craft. PPE can add to heat stress during warm conditions and can cause decreased mobility dexterity.

3.3.7.5 Subcontractors

It is the responsibility of the PM to require subcontractors assisting in the work activities, to adhere to state and federal governmental laws and regulations related to onshore and inland waters. Any refusal on behalf of the subcontractor will mandate shutdown of the project.

4 PERSONNEL TRAINING REQUIREMENTS

4.1 GENERAL

OBG and subcontractor employees performing field work on this project should have appropriate safety training as specified in the OSHA Standards, particularly the HAZWOPER Standard 29CFR1910.120. OBG personnel performing fieldwork on this project must meet the necessary general training requirements. Subcontractors are responsible for supplying OBG's PM with written statements stating that their project personnel meet the necessary general training requirements.

4.2 SITE-SPECIFIC

Site-specific hazard and hazard management information is contained in this health and safety plan. OBG personnel will be provided with a copy of this plan prior to the beginning of fieldwork. Each person will be need to "sign off" that they have read, understood, and will follow the procedures set forth in the plan.

4.3 INFORMATIONAL BRIEFINGS

It is the responsibility of each OBG staff member in charge field operations to keep their crew members appraised of site conditions relative to health and safety, and of any approved modifications to the plan. This will be accomplished through ongoing daily "tailgate" safety meetings. OBG personnel should to report injuries, illnesses, and unsafe conditions to their immediate supervisor. The supervisor will then report in writing any such accidents to the HSM, PM and SSL within 24 hours of occurrence or sooner depending on the severity of the injury.

5 PERSONAL PROTECTIVE EQUIPMENT

Listed in the health and safety plan summary at the very beginning of this plan are hazardous substances that have been found or are suspected to be present at the site. Hazardous substances may be found in air, soil, sediment, surface water and/or groundwater. Common routes of exposure include inhalation, ingestion, and absorption. Proper PPE should be worn when applicable.

5.1 DRILLING/EXCAVATION/INSTALLATION OF WELLS

Persons handling contaminated or potentially contaminated equipment, soils, sediment, or groundwater must wear the following PPE:

- Long sleeve coveralls (light or heavy weights subject to ambient temperature)
- Bib style rain pants where wet operations exist
- Nitrile gloves
- Vinyl gloves for sample handling
- Safety glasses with side-shields ***(SHOULD BE WORN AT ALL TIMES)***
- Hard hat (whenever overhead dangers are present)
- Steel-toed boots ***(SHOULD BE WORN AT ALL TIMES)***
- Reflective orange vest (as needed)
- Hearing protection (as needed – see note below)

NOTE: Guidance on the requirements of ear protection is as follows: if you must raise your voice to converse with persons three feet away from you, you are probably being overexposed to noise. This roughly equates to being exposed to over 85 dB of noise for greater than a 4 hour period. In these instances, the wearing of hearing protection is recommended. The muff or "EAR" type disposable earplugs will suffice.

5.2 GROUND/SURFACE WATER AND SOIL/SEDIMENT SAMPLING

Persons sampling contaminated or potentially contaminated materials, soil, sediment, or water must wear the following PPE:

- Long sleeve coveralls (light or heavy weights subject to ambient temperature)
- Bib style rain pants where wet operations exist
- Nitrile gloves
- Vinyl gloves for sample handling
- Safety glasses with side-shields
- Steel-toed boots
- Hearing protection (as needed)

Persons whose skin or inner clothing comes in contact with contaminated soils or liquids should remove such clothing, shower or clean as appropriate, then re-suit for continued work activities.

NOTE: Outer gloves should be changed or decontaminated between samples if contact to the sample occurs. This will preserve sample integrity.

6 MEDICAL SURVEILLANCE REQUIREMENTS

The hazardous substances known or suspected to be present at the site are not known to produce injury or illness that would not be detected by the medical examination. The medical monitoring program complies with OSHA guidelines regarding and necessitating medical monitoring in the work place.

7 FREQUENCY AND TYPES OF AIR MONITORING/SAMPLING

7.1 SITE AIR MONITORING

A PID and possibly a combustible gas indicator (CGI) may be used to measure air contaminant concentrations in the breathing and work zones if indicated in the Health and Safety Plan Summary. Readings are to be recorded on the logs and in the project logbook. The PID will be calibrated per the air monitoring action plan below. If a CGI is also used to detect combustible conditions at the work site, the monitoring will also follow the plan below.

7.2 SAMPLING AIR MONITORING

A PID may be used to measure air VOC concentrations at the well head or soil sample location during sampling or drilling operations if indicated in the Health and Safety Plan Summary. If measurements are collected, they should be recorded in the project logbook. These measurements may be used to upgrade or change PPE requirements and/or the methods of performing the work. The PID will be calibrated at the start of each day of use. Air monitoring should follow the action plan below.

7.3 AIR MONITORING ACTION PLAN

A PID will be calibrated and checked at least three times per day: 1) before work activities begin; 2) during lunch break or approximately half way through the working day; and 3) following work activities at the end of the day. These calibration checks will be used to try to ensure accuracy of VOC readings. Calibration procedures will follow those outlined in the PID manual and typically use isobutylene as the calibration gas.

The PID will be used to observe air quality in the breathing zone of the work area for the presence of VOC vapor levels if indicated in the Health and Safety Plan Summary. Prior to Contractor Personnel entering any excavations to install piping or any other equipment, the PID will be lowered into the excavation to identify air quality in the excavation. Confined spaces will not be entered. Besides using the PID to observe VOC vapors in the breathing zone, an oxygen meter and/or a CGM may also be used. The oxygen meter may be used to measure percent oxygen in any excavation and the CGM may be used to measure the explosive limit. Calibration of the combustible gas meter is necessary based on use to promote accuracy.

The VOCs "action level" for unknown contaminants is considered when a reading is sustained on the PID when the PID is held at a constant height, whether in the excavation or the breathing zone. If specific compounds are known to exist at the site (i.e benzene, vinyl chloride trichloroethene) actions levels will be set for the specific compound present or if several compounds are present the most conservative action level will be used. Use of either full-face or half-face respirators utilizing Organic Vapor cartridge filters will be needed to reach the VOC action level. Additionally, further air quality monitoring will be necessary to try to ensure that the PID readings do not exceed the upper limit. This will be done by the recommendation of the OBG SSL who will identify specific modifications to work practices and PPE requirements. Draeger tubes or a compound specific meter may be used to identify specific compounds present onsite. If it is concluded that a specific compound is not present the PID screening action level may be changed for the specific compound present. In addition, if engineering measures at the site (i.e ventilation, moving upwind, use of foam or other cover) mitigates the PID readings to below the action levels than respirators will not be necessary. Refer to Appendix C for the respirator use flow chart.

If the upper limit is achieved, activities on the site will immediately stop. The OBG PM will be contacted prior to taking any further action on the site, unless a situation exists which needs immediate action. Options such as nitrogen purging will be considered based on the most current information available.

It should be noted that action levels are identified by the contaminants present (if known). For example, the action level for known petroleum contaminants (gasoline or diesel fuel) may be as indicated in the preceding paragraph. However, if chlorinated solvents are suspected to be present with much lower threshold limit values than petroleum contaminants then the action levels would be adjusted to lower values.

8 SITE CONTROL MEASURES

8.1 BUDDY SYSTEM

Each worker will maintain visual contact with another worker. The buddy system will try to ensure against an employee becoming stressed with a co-worker being aware of his or her condition. Workers should watch out for each other while working close to potential chemical and physical hazards. For example, work in the exclusion zone should be scheduled so that no employee works alone in this zone at any time.

8.2 SAFE WORK PRACTICES

To prevent accidental ingestion of chemical contaminants, the following rules must be compiled with when working within the exclusion/contamination reduction zones, and when taking or handling samples.

- No eating, drinking, or smoking is allowed at work locations.
- No fires are allowed at work locations unless approved by the Project Health and Safety Officer on a site-specific, task-specific basis. If fires or propane torches are used, fires will be maintained away from potential ignition sources and site personnel will not leave the fire unattended and a fire extinguisher will be immediately available.
- OBG and contractor personnel must wash their hands, arms, face, and neck immediately after leaving the exclusion/contamination reduction zones. This must also be done after taking samples and prior to eating, drinking, smoking, or using the restroom.

8.3 WORK ZONE DEFINITION

Work crews, whether drilling, excavating, or performing other activities, must prevent the uncontrolled movement of contaminated or potentially contaminated soil, water, PPE, and equipment. Soil and water removed from its natural setting should be considered contaminated unless proven otherwise by chemical analysis or specifically known to be clean material in which verification sampling is occurring. This is also the case for PPE and equipment which either must be decontaminated or disposed. Work crews will prevent migration of contaminated materials by establishing work zones and decontamination procedures. Work zones will be delineated. Only persons certified as having the necessary training and medical qualifications will be allowed in the Exclusion Zone (EZ) or Contamination Reduction Zone (CRZ). The following describes the zones to be established during drilling or excavation:

- Exclusion Zone – An EZ will be established surrounding the drilling or excavation site, if necessary and is the area where contamination does exist or could occur. The EZ will comprise an area of at least as large as a circle having a diameter equivalent to one half the mast height of the drilling equipment or arm of excavating equipment. The size and shape of the EZ will be identified by the SSL. No personnel will be permitted in the EZ unless they are in full compliance with the site health and safety plan.
- Contamination Reduction Zone - This is the transition area between the exclusion zone and the support zone. It is the area where the decontamination of equipment and personnel takes place. Its purpose is to keep the support zone free of contamination.
- Support Zone: The support zone is the area free of contamination. People wear normal work clothes in this area. The personnel in this zone are responsible for organizing off-site emergency response teams in the event of an emergency.

8.4 DAILY START-UP AND SHUTDOWN PROCEDURES

The following protocols will be followed daily prior to the start of work activities:

- The SSL will review site conditions to determine if modifications of the work and safety plans are needed.
- Personnel will be briefed and updated at the daily tailgate safety meeting on any new safety procedures based on the previous day's findings and the planned work activity for that day.

- Safety equipment will be checked for proper function.
- The SSL will try to ensure that the hospital route map and first aid equipment are readily available.
- The SSL will initiate appropriate observation.

The following protocol will be followed at the end of daily operations and before breaks:

- Personnel will proceed through appropriate decontamination procedures and facilities.
- The work site will be left clean. Drums will be properly labeled and staged.
- All PPE must be removed prior to eating, drinking, smoking, or using the restroom.
- Equipment will be decontaminated and properly stored.

8.5 EQUIPMENT

Drilling rigs and heavy equipment should be reviewed at the start of each day to detect equipment problems. Particular attention should be paid to cables and hydraulic lines. Examine them for evidence of stretching, fraying and cracking. The fuel system and hydraulic system should be in good repair (free from leaks) to avoid the potential for fire or explosion. Kill switches should be tested and functioning properly. The drill rig and heavy equipment should be equipped with or have stationed in the area two 20-pound type BC fire extinguishers.

8.6 DRILLING/EXCAVATION AREA

The drilling/excavation area should be located away from overhead electrical lines. The location of buried water, storm and sanitary sewer, electrical, telephone, and gas utility lines must be identified and marked by the authorized personnel. Slope of terrain, stability of embankments, soil load bearing ability, etc. should be evaluated in selection of the drilling/excavation locations.

In addition, a “competent person” as defined by CFR 1926.650 (b) must be designated for excavation safety at the site:

- Competent person means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

The designated competent person has the abilities described above either through onsite experience, classroom training or the combination of both.

9 DECONTAMINATION PLAN

9.1 DECONTAMINATION PROCEDURES

Personal decontamination will be accomplished by using good personal hygiene. Personal contamination should not occur if the protection methods specified in this plan are used. However, the following procedures must be complied with to try to ensure that contamination does not remain on equipment, sample containers, or in contact with personnel.

- While in the EZ clean gross contamination off equipment by scraping or brushing. Collect contaminated soil with the drill cuttings and transport the cuttings in an appropriate manner to the staging area on site (e.g., placed in DOT approved 55-gallon drums).
- If steam cleaning of equipment is necessary it will occur at the designated area on site. If capture of decontamination water is necessary, it will be placed in DOT approved 55-gallon drums.

After equipment and sample container decontamination is accomplished, drilling crewmembers must remove PPE before leaving the CRZ. PPE must be removed in a step-wise fashion to prevent contamination of work clothing, as follows:

- Remove contaminated soil from work boots and remove protective clothing for decontamination or disposal. If disposable PPE is used, it should be placed in an open top drum designated for that purpose. A lid should be placed on the drum after usage. Drummed material will be labeled identifying contents and the date filled.
- Remove and wash outer gloves and hard hat. Place disposable gloves in a collection bag.
- The use of respiratory protection is not anticipated. If a respirator must be used or otherwise removed from its containers, wash it down and take it with you as you exit the CRZ.
- Final daily decontamination will be reviewed by the SSL to ensure that no contaminated articles are accessible to the public. Therefore, disposable PPE and other miscellaneous garbage will be stored in a drum with a secured lid.

After leaving the CRZ, and before eating, drinking, smoking, or using the restroom, personnel must wash their hands, arms, face, and neck. In addition, personnel should take a full-body shower at the end of the workday. A full-body shower includes the use of a wash cloth to scrub the skin.

9.2 WASTE STORAGE AND DISPOSAL

Since soil and water removed from its natural setting is considered potentially contaminated, these materials will be stored and disposed of per the guidelines established in the Work Plan for the site.

Waste container contents and identification will be made in the field log for future reference. The number of containers will be counted and assessed for the amount of content present in each (1/2 full, full). All Containers will be distinctly labeled using a paint pen or marker. The drums labels with have at least the following information:

- Company name
- Date contents added to drum
- Contents of drum (soil, water, PPE)
- Well or soil boring identification (MW-1 or SB-1)

10 EMERGENCY ACTION PLAN

10.1 MEDICAL EMERGENCIES

In the event of a medical emergency, the following procedures should be used.

1. If serious injury or life-threatening condition exists, call 911. Clearly describe the location, injury, and conditions to the dispatcher. Designate a person to show emergency responders to the injured person(s).
2. Call the project manager or HSM.
3. Implement steps to prevent the reoccurrence of the accident.

10.2 CHEMICAL EMERGENCIES

1. If serious injury or life-threatening condition exists, call 911. Clearly describe the location, injury, and conditions to the dispatcher.
2. Evacuate other on-site personnel to a safe place in an upwind direction until it is safe for work to resume.
3. Call the PM.
4. If necessary contact clean-up contractor.
5. If release requires contacting government agencies the PM makes the appropriate calls (PM also contacts Client).

10.3 GENERAL EMERGENCIES

In the case of fire (other than a managed pre-approved fire, discussed in Section 8.2), flood, explosion, spills, severe weather, tank or pipe punctures, or other hazard, work shall be halted and if applicable, 911 called. On-site personnel will immediately be evacuated to a safe place.

10.4 ACCIDENT REPORTS AND FOLLOW UP

Accidents, including those that do not result in injury or illness, are to be reported verbally to the SSL or the PM immediately, with written documentation within 24 hours of their occurrence. The Incident and Vehicle Accident Report forms are included as Appendix B.

11 CONFINED SPACE ENTRY PROCEDURES

No confined spaces (or the need to enter a confined space) are anticipated at the site; however, should such an issue arise (or become anticipated at a particular site), it will be addressed in the site specific work plan. Only properly trained individuals may enter or be an attendant for confined space entry and only after a confined space permit has been completed.

12 SPILL CONTAINMENT PROGRAM

No potential spill situations are anticipated on the site; however, if there is an accidental release of potentially hazardous materials or waste (e.g., spilled purge water or soil cuttings, ruptured hydraulic line), site personnel will:

- Contact the HSM, SSL and Project Manager
- Contain the spill, if it is possible and it can be done safely
- Initiate cleanup
- Report the spill to the proper authorities if the reportable quantity has been exceeded for a particular compound

- Alconox
- Alkaline batteries
- Benzene
- Benzo(a)pyrene
- Coal Tar
- Deep Woods Off
- Ethylbenzene
- Flocculant
- Granular Activated Carbon (GAC)
- H_2SO4
- HCL
- HCN
- Isobutylene
- Lithium batteries
- Methanol
- MSDSs 89605 First Aid Kit
- NAOH
- Naphthalene
- Nitric acid
- Organoclay
- Xylenes
- PAH Mixture
- Nickel Cadmium Batteries
- Sun X SPF 30
- Toulene

Appendix A

Chemical Information / Safety Data Sheets

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Effective date: 11/20/2014 **Revision:** 05/12/2015

ALCONOX

1 Identification of the Substance/mixture and of the Company/Undertaking

1.1 Product identifier
Trade name: ALCONOX
Application of the substance / the preparation: Cleaning material/ Detergent

1.2 Relevant identified uses of the substance or mixture and uses advised against:
No additional information available.

1.3 Details of the supplier of the Safety Data Sheet
Manufacturer/Supplier:
Alconox, Inc.
30 Glenn St., Suite 309
White Plains, NY 10603
Phone: 914-948-4040

Further information obtainable from: Product Safety Department

1.4 Emergencytelephone number:
ChemTel Inc.: (800)255-3924, +1 (813)248-0585

2 Hazards Identification

2.1 Classification of the substance or mixture Classification according to Regulation (EC) No 1272/2008:

Eye Irrit. 2B; H320: Causes eye irritation.

Information concerning particular hazards for human and environment:
The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.
Classificationsystem:
The classification is according to the latest editions of the EU-lists, and extended by company and literature data

2.2 Label elements
Labelling according to Regulation (EC) No 1272/2008:
The product is classified and labelled according to the CLP regulation.

Hazardpictograms:

Signal word: Warning

Hazard-determining components of labelling:
Sodium Alkylbenzene Sulfonate
Hazardstatements:
H320: Causes eye irritation.

Precautionary statements:
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P264: Wash thoroughly after handling.
P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses,if present and easy to do. Continue rinsing.
P337+P313: If eye irritation persists: Get medical advice/attention.

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Effective date: 11/20/2014 **Revision:** 05/12/2015

ALCONOX

Other Hazard description:
WHMIS-classification and symbols:
D2B - Toxic material causing other toxic effects

NFPA ratings (scale 0 - 4)

Health = 1
Fire = 0
Reactivity = 0

HMIS-ratings (scale 0 - 4)

HEALTH	1	
FIRE	0	
REACTIVITY	0	

Health = 1
Fire = 0
Reactivity = 0

2.3 Other hazards
Results of PBT and vPvB assessment
PBT: Not applicable.
vPvB: Not applicable.

3 Composition/Information on Ingredients

3.2 Chemical characterization: Mixture
Description: Hazardous ingredients of mixture listed below.

Identifying Nos.	Description	Wt. %
CAS: 68081-81-2	Sodium Alkylbenzene Sulfonate	10 - 25%
CAS: 497-19-8	Sodium Carbonate	5-15%
CAS: 7722-88-5	Tetrasodium pyrophosphate	5-15%
CAS: N/A	Proprietary (non-classified)	40-60%

Additional information: For the wording of the listed risk phrases refer to section 16.

4 First Aid Measures

4.1 Description of first aid measures
General information:
Contaminated individuals of chemical exposure must be taken for medical attention if any adverse effect occurs. Rescuers should be taken for medical attention, if necessary. Take copy of label and SDS to health professional with contaminated individual.
After inhalation:
Supply fresh air; consult doctor in case of complaints.
After skin contact:
Immediately wash with water and soap and rinse thoroughly. If skin irritation continues, consult a doctor.

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

After eye contact:
Remove contact lenses if worn. Rinse opened eye for several minutes under running water. If symptoms persist, consult a doctor.

After swallowing:
Rinse out mouth and then drink plenty of water. Do not induce vomiting; call for medical help immediately.

4.2 Most important symptoms and effects, both acute and delayed:
No additional information available.

4.3 Indication of any immediate medical attention and special treatment needed:
No additional information available.

5 Firefighting Measures

5.1 Extinguishing media:
Suitable extinguishing agents:
CO2, powder or water spray. Fight larger fires with water spray or alcohol resistant foam.

5.2 Special hazards arising from the substance or mixture:
No additional information available.

5.3 Advice for firefighters:
Protective equipment:
Wear self-contained respiratory protective device.
Wear fully protective suit.

6 Accidental Release Measures

6.1 Personal precautions, protective equipment and emergency procedures:
Product forms slippery surface when combined with water.

6.2 Environmental precautions:
Do not allow product to reach sewage system or any water course.

6.3 Methods and material for containment and cleaning up:
Pick up mechanically.
Clean the affected area carefully; suitable cleaners are: Warm water

6.4 Reference to other sections:
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information

7 Handling and Storage

7.1 Precautions for safe handling:
Ensure good ventilation/exhaustion at the workplace.
Keep receptacles tightly sealed.
Prevent formation of dust.
Information about fire - and explosion protection: No special measures required.

7.2 Conditions for safe storage, including any incompatibilities:
Storage:
Requirements to be met by storerooms and receptacles: No special requirements.
Information about storage in one common storage facility: None required.
Further information about storage conditions: Protect from humidity and water.

7.3 Specific end use(s): No additional information available.

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

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8 Exposure Controls/Personal Protection

8.1 Control parameters

Ingredients with limit values that require monitoring at the workplace: Not required.

Additional information: The lists valid during the making were used as basis.

8.2 Exposure controls:

Personal protective equipment:

General protective and hygienic measures:

Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing.
Wash hands before breaks and at the end of work.
Avoid contact with the skin.
Avoid contact with the eyes and skin.

Respiratory protection:

Not required under normal conditions of use.
In case of brief exposure or low pollution use respiratory filter device.
In case of intensive or longer exposure use self-contained respiratory protective device.

Protection of hands:


Protective gloves

The glove material has to be impermeable and resistant to the product. Selection of the glove material should be based on the penetration time, rates of diffusion and the degradation of the glove material.

Material of gloves:

The selection of a suitable gloves does not only depend on the material, but also on the quality, and varies from manufacturer to manufacturer.

Penetration time of glove material:

The exact break through time has to be determined by the manufacturer of the protective gloves. DO NOT exceed the breakthrough time set by the Manufacturer.

For long term contact, gloves made of the following materials are considered suitable:

Butyl rubber, BR
Nitrile rubber, NBR
Natural rubber (NR)
Neoprene gloves

Eye protection:


Safety glasses

Body protection: Protective work clothing

9 Physical and Chemical Properties

9.1 Information on basic physical and chemical properties:

General Information:

Appearance:

Form:	Powder
Color:	White
Odor:	Odorless
Odor threshold:	Not determined.
pH-value (10 g/l) at 20 °C:	9.5 (NA for Powder form)

Change in condition:

Melting point/Melting range:	Not determined.
Boiling point/Boiling range:	Not determined.

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Flash point:	Not applicable.
Flammability (solid, gaseous):	Not determined.
Ignition temperature:	Not determined.
Decomposition temperature:	Not determined.
Self-igniting:	Product is not selfigniting.
Danger of explosion:	Product does not present an explosion hazard.
Explosion limits:	
Lower:	Not determined.
Upper:	Not determined.
Vapor pressure:	Not applicable.
Density at 20°C:	1,1 g/cm³
Relative density:	Not determined.
Vapor density:	Not applicable.
Evaporation rate:	Not applicable.
Solubility in / Miscibility with water:	Soluble.
Segregation coefficient (n-octanol/water):	Not determined.
Viscosity:	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
Solvent content:	
Organic solvents:	0.0 %
Solids content:	100 %
9.2 Other information:	No additional information available.

10 Stability and Reactivity

10.1 Reactivity:
10.2 Chemical stability:
Thermal decomposition / conditions to be avoided:
No decomposition if used according to specifications.
10.3 Possibility of hazardous reactions:
Reacts with acids.
Reacts with strong alkali.
Reacts with strong oxidizing agents.
10.4 Conditions to avoid:
No additional information available.
10.5 Incompatible materials:
No additional information available.
10.6 Hazardous decomposition products:
Carbon monoxide and carbon dioxide
Phosphorus compounds
Sulphur oxides (SOx)

11 Toxicological Information

11.1 Information on toxicological effects:
Toxicity data: No additional information available.
Primary irritant effect:
On the skin: Irritating to skin and mucous membranes.
On the eye: Strong irritant with the danger of severe eye injury.
Sensitization: No sensitizing effects known.

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Additional toxicological information:
The product shows the following dangers according to the calculation method of the General EU Classification Guidelines for Preparations as issued in the latest version: Irritant.
Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation ofesophagus and stomach.

12 Ecological Information

12.1 Toxicity:
Aquatic toxicity: No additional information available.
12.2 Persistence and degradability: No additional information available.
12.3 Bioaccumulative potential: Not worth-mentioning accumulating in organisms.
12.4 Mobility in soil: No additional information available.
Ecotoxical effects:
Remark: Harmful to fish
Additional ecological information:
General notes:
Water hazard class 2 (German Regulation) (Self-assessment): hazardous for water.
Do not allow product to reach ground water, water course or sewage system.
Danger to drinking water if even small quantities leak into the ground.
12.5 Results of PBT and vPvB assessment:
PBT: Not applicable.
vPvB: Not applicable.
12.6 Other adverse effects: No additional information available.

13 Disposal Considerations

13.1 Waste treatment methods:
Recommendation:
Smaller quantities can be disposed of with household waste.
Small amounts may be diluted with plenty of water and washed away. Dispose of bigger amounts in accordance with Local Authority requirements.
The surfactant used in this product complies with the biodegradability criteria as laid down in Regulation (EC) No. 648/2004 on detergents. Data to support this assertion are held at the disposal of the competent authorities of the Member States and will be made available to them, at their direct request or at the request of a detergent manufacturer.
Uncleaned packaging:
Recommendation: Disposal must be made according to official regulations.
Recommended cleansing agents: Water, together with cleansing agents, if necessary.

14 Transport Information

14.1 UN-Number:
DOT, ADR, ADN, IMDG, IATA: Not Regulated

14.2 UN proper shipping name:
DOT, ADR, IMDG, IATA: Not Regulated

14.3 Transport hazard class(es):
DOT, ADR, IMDG, IATA:
Class: Not Regulated
Label: -

14.4 Packing group:
DOT, ADR, IMDG, IATA: Not Regulated

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14.5 Environmental hazards:
Marine pollutant: No

14.6 Special precautions for user: Not applicable.

14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code: Not applicable.

UN "Model Regulation": Not Regulated

15 Regulatory Information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture:
United States (USA):
SARA:
Section 355 (extremely hazardous substances): None of the ingredient is listed.
Section 313 (Specific toxic chemical listings): None of the ingredient is listed.
TSCA (Toxic Substances Control Act): All ingredients are listed.

Proposition 65 (California):
Chemicals known to cause cancer: None of the ingredient is listed.
Chemicals known to cause reproductive toxicity for females: None of the ingredient is listed.
Chemicals known to cause reproductive toxicity for males: None of the ingredient is listed.
Chemicals known to cause developmental toxicity: None of the ingredient is listed.

Carcinogenic Categories:
EPA (Environmental Protection Agency): None of the ingredient is listed.
TLV (Threshold Limit Value established by ACGIH): None of the ingredient is listed.
NIOSH-Ca (National Institute for Occupational Safety and Health): None of the ingredient is listed.
OSHA-Ca (Occupational Safety & Health Administration): None of the ingredient is listed.

Canadá:
Canadian Domestic Substances List (DSL): All ingredients are listed.
Canadian Ingredient Disclosure list (limit 0.1%): None of the ingredient is listed.
Canadian Ingredient Disclosure list (limit 1%):

497-19-8	Sodium Carbonate
7722-88-5	Tetrasodium pyrophosphate
151-21-3	Sodium dodecylsulphate

15.2 Chemical safety assessment: A Chemical Safety Assessment has not been carried out.

16 Other Information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

Relevant phrases:

H320: Causes eye irritation.

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according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

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ALCONOX

Abbreviations and Acronyms:

ADR: European Agreement concerning the International Carriage of Dangerous Goods by Road.
IMDG: International Maritime Code for Dangerous Goods.
DOT: US Department of Transportation.
IATA: International Air Transport Association.
GHS: Globally Harmonized System of Classification and Labelling of Chemicals.
ACGIH: American Conference of Governmental Industrial Hygienists.
NFPA: National Fire Protection Association (USA).
HMIS: Hazardous Materials Identification System (USA).
WHMIS: Workplace Hazardous Materials Information System (Canada).
VOC: Volatile Organic Compounds (USA, EU).
LC50: Lethal concentration, 50 percent.
LD50: Lethal dose, 50 percent.

SDS Created by:

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Safety Data Sheet

SECTION 1: IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Product Name: DURACELL® ALKALINE BATTERIES
Product Identification: Alkaline Manganese Dioxide Cells –
Tradenames: Plus, Ultra, Simply

Product Use: Energy Source
SDS Date of Preparation: November 2, 2009; Updated May 19, 2010

Duracell Designations:

Name/Size	Duracell Designation	Voltage	IEC Designation
Duracell Plus/Simply D	MN1300	1,5	LR20
Duracell Ultra D	MX1300	1,5	LR20
Duracell Plus/Simply C	MN1400	1,5	LR14
Duracell Ultra C	MX1400	1,5	LR14
Duracell Plus/Simply AA	MN1500	1,5	LR6
Duracell Ultra AA	MX1500	1,5	LR6
Duracell Plus/Simply AAA	MN2400	1,5	LR03
Duracell Ultra AAA	MX2400	1,5	LR03
Duracell Plus/Simply 9V	MN1604	9	6LR61
Duracell Ultra 9V	MX1604	9	6LR61
Duracell 4.5V	MN1203	4,5	3LR12
Duracell AAAA	MN2500	1,5	
Duracell MN11	MN11	6	
Duracell MN9100 N	MN9100	1,5	LR1
Duracell 7K67 J	7K67J	6,2	4LR61

Company Identification:

EU Office
Procter & Gamble UK.
The Heights, Brooklands
Weybridge, Surrey
KT13 0XP UK
Telephone: +44-1-93-289-6000

Switzerland Office
Procter& Gamble
Switzerland SARL
Route de Saint-Georges 47
1213 Petit-Lancy, 1, Geneva,
Telephone: +41-58-004-6111

US Office
Duracell, a division of P&G
Berkshire Corporate Park
Bethel, CT 06801 USA
Telephone: 203-796-4000

Emergency Phone Number: INFOTRAC 24-Hour Emergency Response Hotline: 1-352-323-3500 (United States of America)

SECTION 2: HAZARDS IDENTIFICATION

Physical Appearance: Copper top battery.

CAUTION: May explode or leak, and cause burn injury, if recharged, disposed of in fire, mixed with a different battery type, inserted backwards or disassembled. Replace all used batteries at the same time. Do not carry batteries loose in your pocket or purse. Do not remove the battery label.

EU Classification of Preparation: Not classified as a dangerous preparation.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS Number	EINECS Number	Amount	Classification
Manganese Dioxide	1313-13-9	215-202-6	35-40 %	Xn, R20/22
Zinc	7440-66-6	231-175-3	10-25 %	N, R50/53
Potassium Hydroxide (35 %)	1310-58-3	215-181-3	5-10 %	C, Xn, R22, R35
Graphite (natural or synthetic)	7782-42-5, 7440-44-0	231-955-3 231-153-3	1-5 %	None

Note: Some Duracell alkaline batteries contain a Duracell Power Check™ battery energy gauge, which is a small conductive strip located underneath the PVC battery label that indicates the amount of charge in the battery. It is composed of minute quantities of conductive materials. Due to the small quantity of materials and their solid form, a health or environmental risk is unlikely.

SECTION 4: FIRST AID MEASURES

General Advice: The chemicals and metals in this product are contained in a sealed can. Exposure to the contents will not occur unless the battery leaks, is exposed to high temperatures or is mechanically, physically, or electrically abused. Damaged battery will release concentrated potassium hydroxide, which is caustic. Anticipated potential leakage of potassium hydroxide is 2 to 20 ml, depending on battery size.

Eye Contact: If battery is leaking and material contacts the eye, flush thoroughly with copious amounts of running water for 30 minutes. Seek immediate medical advice.

Skin Contact: If battery is leaking and material contacts the skin, remove any contaminated clothing and flush exposed skin with copious amounts of running water for at least 15 minutes. If irritation, injury or pain persists, seek medical advice.

Inhaled: If battery is leaking, contents may be irritating to respiratory passages. Move to fresh air. If irritation persists, seek medical advice.

Swallowed: If battery contents are swallowed, do not induce vomiting. If the victim is alert, have them rinse their mouth are the surrounding skin with water for at least 15 minutes. Seek immediate medical attention.

Note: This SDS does not include or address the small button cell batteries which can be ingested.

SECTION 5: FIRE FIGHTING MEASURES

Fire and Explosion Hazards: Batteries may burst and release hazardous decomposition products when exposed to a fire situation.

Extinguishing Media: Use any extinguishing media that is appropriate for the surrounding fire.

Special Fire Fighting Procedures: Firefighters should wear positive pressure self-contained breathing apparatus and full protective clothing. Fight fire from a distance or protected area. Cool fire exposed

batteries to prevent rupture. Use caution when handling fire-exposed containers (containers may rocket or explode in heat of fire).

Hazardous Combustion Products: Thermal degradation may produce hazardous fumes of zinc and manganese; hydrogen gas, caustic vapors of potassium hydroxide and other toxic by-products.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Notify safety personnel of large spills. Caustic potassium hydroxide may be released from leaking or ruptured batteries. Clean-up personnel should wear appropriate protective clothing to avoid eye and skin contact and inhalation of vapors or fumes. Increase ventilation. Carefully collect batteries and place in an appropriate container for disposal.

SECTION 7: HANDLING AND STORAGE

Avoid mechanical or electrical abuse. DO NOT short circuit or install incorrectly. Batteries may explode, pyrolize or vent if disassembled, crushed, recharged or exposed to high temperatures. Install batteries in accordance with equipment instructions. Do not mix battery systems, such as alkaline and zinc carbon, in the same equipment. Replace all batteries in equipment at the same time. Do not carry batteries loose in a pocket or bag. Do not remove battery tester or battery label.

Storage: Store batteries in a dry place at normal room temperature. Do not refrigerate – this will not make them last longer.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

The following occupational exposure limits are provided for informational purposes. No exposure to the battery components should occur during normal consumer use. **Refer to specific country regulations for additional exposure limit information.**

Chemical Name	Exposure Limits
Manganese Dioxide	0,5 mg/m^3 TWA UK WEL 0,5 mg/m^3 TWA (inhalable) DFG MAK 0,2 mg/m^3 VL Belgium 0,2 mg/m^3 TWA Denmark LV
Zinc	None established for zinc metal
Potassium Hydroxide	2 mg/m^3 STEL UK WEL 2 mg/m^3 VCD Belgium 2 mg/m^3 Ceiling Denmark LV
Graphite	4 mg/m^3 TWA UK WEL (respirable dust) 10 mg/m^3 TWA UK WEL (inhalable dust) 1,5 mg/m^3 TWA DFG MAK (respirable dust) 4 mg/m^3 TWA DFG MAK (inhalable dust) 2 mg/m^3 VL Belgium (respirable dust)

Ventilation: No special ventilation is needed for normal use.

Respiratory Protection: None required for normal use.

Skin Protection: None required for normal use. Use neoprene, rubber or latex gloves when handling leaking batteries.

Eye Protection: None required for normal use. Wear safety goggles when handling leaking batteries.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Appearance and Odor: Copper top battery.
Water Solubility: Insoluble

SECTION 10: STABILITY AND REACTIVITY

Stability: This product is stable.

Incompatibility/Conditions to Avoid: Contents are incompatible with strong oxidizing agents. Do not heat, crush, disassemble, short circuit or recharge.

Hazardous Decomposition Products: Thermal decomposition may produce hazardous fumes of zinc and manganese; caustic vapors of potassium hydroxide and other toxic by-products.

Hazardous Polymerization: Will not occur

SECTION 11: TOXICOLOGICAL INFORMATION

Potential Health Effects:

The chemicals and metals in this product are contained in a sealed can. Exposure to the contents will not occur unless the battery leaks, is exposed to high temperatures or is mechanically, physically, or electrically abused. Damaged battery will release concentrated potassium hydroxide, which is caustic. Anticipated potential leakage of potassium hydroxide is 2 to 20 ml, depending on battery size.

Eye Contact: Contact with battery contents may cause severe irritation and burns. Eye damage is possible.

Skin Contact: Contact with battery contents may cause severe irritation and burns.

Inhalation: Inhalation of vapors or fumes released due to heat or a large number of leaking batteries may cause respiratory and eye irritation.

Ingestion: Swallowing is not anticipated due to battery size. Choking may occur if smaller AAA batteries are swallowed. Ingestion of battery contents (from a leaking battery) may cause mouth, throat and intestinal burns and damage.

Acute Toxicity Data:
Manganese Dioxide: LD50 oral rat >3478 mg/kg
Potassium Hydroxide: LD50 oral rat 273 mg/kg

Chronic Effects: The chemicals in this product are contained in a sealed can and exposure does not occur during normal handling and use. No chronic effects would be expected from handling a leaking battery.

Target Organs: Skin, eyes and respiratory system.

Carcinogenicity: None of the components of this product are listed as carcinogens by the EU Directive on the classification and labeling of substances.

SECTION 12: ECOLOGICAL INFORMATION

No ecotoxicity data is available. This product is not expected to present an environmental hazard.

SECTION 13: DISPOSAL INFORMATION

Disposal should be in accordance with national and local regulations. Do not incinerate except for disposal in a controlled incinerator.

Duracell alkaline manganese dioxide batteries are labeled in compliance with EU Battery Directive 2006/66.

SECTION 14: TRANSPORT INFORMATION

Transportation Information – Products covered by this SDS, in their original form, are considered "dry cell" batteries and are not regulated as "DANGEROUS GOODS" for transportation.

For finished packaged product transported by ground (ADR/RID): – not regulated
For finished packaged product transported by sea (IMDG) – not regulated
For finished packaged product transported by air (IATA): – not regulated

SECTION 15: REGULATORY INFORMATION

EU Classification of Preparation: Not classified as a dangerous preparation.

REACH: These products are manufactured articles and not subject to REACH registration requirements.

EU Labeling: None Required
Labeling is not required because batteries are classified as articles under the both REACH and the Dangerous Preparations Directive and as such are exempt from the requirement for labeling.

SECTION 16: OTHER INFORMATION

P&G Hazard Rating: Health: 0 Fire: 0 Reactivity: 0

EU Classes and Risk Phrases for Reference (See Sections 2 and 3)
C Corrosive
N Dangerous for the Environment
Xn Harmful
R20/22 : Harmful by inhalation and if swallowed.
R22 Harmful if swallowed.
R35 Causes severe burns
R50/53 : Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
==========

Data supplied is for use only in connection with occupational safety and health.

DISCLAIMER: This SDS is intended to provide a brief summary of our knowledge and guidance regarding the use of this material. The information contained here has been compiled from sources considered by Procter & Gamble to be dependable and is accurate to the best of the Company's knowledge. It is not meant to be an all-inclusive document on worldwide hazard communication regulations.

This information is offered in good faith. Each user of this material needs to evaluate the conditions of use and design the appropriate protective mechanisms to prevent employee exposures, property damage or release to the environment. Procter & Gamble assumed no responsibility for injury to the recipient or third persons, or for any damage to any property resulting from misuse of the product.

SAFETY DATA SHEET

Benzene

Section 1. Identification

GHS product identifier : Benzene

Chemical name : Benzene

Synonyms : Benzol; CITGO® Material Code: 03101

Code : 03101

MSDS # : 03101

Supplier's details : CITGO Petroleum Corporation
P.O. Box 4689
Houston, TX 77210
sdsvend@citgo.com

Emergency telephone number : Technical Contact: (832) 486-4000
Medical Emergency: (832) 486-4700
CHEMTREC Emergency: (800) 424-9300
(United States Only)

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : FLAMMABLE LIQUIDS - Category 2
SKIN CORROSION/IRRITATION - Category 2
SERIOUS EYE DAMAGE/ EYE IRRITATION - Category 2
GERM CELL MUTAGENICITY - Category 1B
CARCINOGENICITY - Category 1A
SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) - Category 1
ASPIRATION HAZARD - Category 1

GHS label elements

Hazard pictograms :

Signal word : Danger

Hazard statements : Highly flammable liquid and vapor.
Causes serious eye irritation.
Causes skin irritation.
May cause genetic defects.
May cause cancer.
May be fatal if swallowed and enters airways.
Causes damage to organs through prolonged or repeated exposure.

Precautionary statements

Prevention : Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Use personal protective equipment as required. Wear protective gloves. Wear eye or face protection. Keep away from heat, sparks, open flames and hot surfaces. - No smoking. Use explosion-proof electrical, ventilating, lighting and all material-handling equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Keep container tightly closed. Do not breathe vapor. Do not eat, drink or smoke when using this product. Wash hands thoroughly after handling.

Section 2. Hazards identification

Response : Get medical attention if you feel unwell. IF exposed or concerned: Get medical attention. IF SWALLOWED: Immediately call a POISON CENTER or physician. Do NOT induce vomiting. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower. IF ON SKIN: Wash with plenty of soap and water. Take off contaminated clothing. If skin irritation occurs: Get medical attention. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical attention.

Storage : Store locked up. Store in a well-ventilated place. Keep cool.

Disposal : Dispose of contents and container in accordance with all local, regional, national and international regulations.

Hazards not otherwise classified : None known.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Chemical name : Benzene

Other means of identification : Benzol; CITGO® Material Code: 03101

CAS number/other identifiers

CAS number : 71-43-2

Ingredient name	%	CAS number
Benzene	99 - 100	71-43-2

* = Various ** = Mixture *** = Proprietary

Any concentration shown as a range is to protect confidentiality or is due to process variation.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Wash contaminated clothing thoroughly with water before removing it, or wear gloves. Continue to rinse for at least 10 minutes. Get medical attention. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : Get medical attention immediately. Call a poison center or physician. Wash out mouth with water. Remove dentures if any. Remove victim to fresh air and keep at rest in a position comfortable for breathing. Aspiration hazard if swallowed. Can enter lungs and cause damage. Do not induce vomiting. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Most important symptoms/effects, acute

Potential acute health effects

Section 4. First aid measures

Eye contact : Causes serious eye irritation.

Inhalation : Breathing high concentrations can cause irregular heartbeats which can be fatal.

Skin contact : Causes skin irritation.

Ingestion : May be fatal if swallowed and enters airways. Irritating to mouth, throat and stomach.

Over-exposure signs/symptoms

Eye contact : Adverse symptoms may include the following:
pain or irritation
watering
redness

Inhalation : Breathing high concentrations can cause irregular heartbeats which can be fatal.

Skin contact : Adverse symptoms may include the following:
irritation
redness

Ingestion : Adverse symptoms may include the following:
nausea or vomiting

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : This material (or a component) may sensitize the heart to the effects of sympathomimetic amines. Epinephrine and other sympathomimetic drugs may initiate cardiac arrthymias in individuals exposed to this material. If ingested, this material presents a significant aspiration and chemical pneumonitis hazard. Induction of emesis is not recommended. Consider activated charcoal and/or gastric lavage. If patient is obtunded, protect the airway by cuffed endotracheal intubation or by placement of the body in a Trendelenburg and left lateral decubitus position.

Specific treatments : Treat symptomatically and supportively.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that gas or vapor is still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Specific hazards arising from the chemical : Highly flammable liquid and vapor. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. The vapor/gas is heavier than air and will spread along the ground. Vapors may accumulate in low or confined areas or travel a considerable distance to a source of ignition and flash back. Runoff to sewer may create fire or explosion hazard. Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain.

Extinguishing media

Suitable extinguishing media : Use dry chemical, CO_2, water spray (fog) or foam.

Unsuitable extinguishing media : Do not use water jet.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Section 5. Fire-fighting measures

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Water polluting material. May be harmful to the environment if released in large quantities.

Methods and materials for containment and cleaning up

Small spill : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Dilute with water and mop up if water-soluble. Alternatively, or if water-insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Large spill : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see Section 13). Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Avoid exposure - obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not get in eyes or on skin or clothing. Do not breathe vapor or mist. Do not swallow. Avoid release to the environment. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Take precautionary measures against electrostatic discharges. Empty containers retain product residue and can be hazardous. Do not reuse container.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Section 7. Handling and storage

Conditions for safe storage, including any incompatibilities : Avoid storing below the following temperature: 5.6°C (42.1°F). Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Store locked up. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

Bulk Storage Conditions: Maintain all storage tanks in accordance with applicable regulations. Use necessary controls to monitor tank inventories. Inspect all storage tanks on a periodic basis. Test tanks and associated piping for tightness. Maintain the automatic leak detection devices to assure proper working condition.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
Benzene	**ACGIH TLV (United States, 4/2014). Absorbed through skin.** TWA: 0.5 ppm 8 hours. TWA: 1.6 mg/m³ 8 hours. STEL: 2.5 ppm 15 minutes. STEL: 8 mg/m³ 15 minutes. **OSHA PEL (United States, 2/2013).** TWA: 1 ppm 8 hours. STEL: 5 ppm 15 minutes. **OSHA PEL Z2 (United States, 2/2013).** TWA: 10 ppm 8 hours. CEIL: 25 ppm AMP: 50 ppm 10 minutes.

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, vapor controls, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety glasses equipped with side shields are recommended as minimum protection in industrial settings. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: Splash goggles. Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. chemical splash goggles. If inhalation hazards exist, a full-face respirator may be required instead.

Skin protection

Section 8. Exposure controls/personal protection

Hand protection : Chemical-resistant gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Use a properly fitted, air-purifying or supplied-air respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Physical state : Liquid.

Color : Colorless.

Odor : Characteristic. Sweet.

pH : Not available.

Melting point : 6°C (42.8°F)

Boiling point/boiling range : 80°C (176°F)

Flash point : Closed cup: -11°C (12.2°F) [Tagliabue (ASTM D-56)]

Evaporation rate : 3.5 (butyl acetate = 1)

Lower and upper explosive (flammable) limits : Lower: 1.2%
Upper: 8%

Vapor pressure : 10 kPa (75 mm Hg) [room temperature]

Vapor density : 2.7 [Air = 1]

Relative density : 0.88

Density lbs/gal : 7.36 lbs/gal

Gravity, °API : 28.6

Solubility : Very slightly soluble in the following materials: cold water.

Auto-ignition temperature : 498°C (928.4°F)

Conductivity : <50 picosiemens/meter (unadditized)

Section 10. Stability and reactivity

Reactivity : Not expected to be Explosive, Self-Reactive, Self-Heating, or an Organic Peroxide under US GHS Definition(s).

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition. Do not allow vapor to accumulate in low or confined areas.

Incompatible materials : Reactive or incompatible with the following materials:
oxidizing materials

Section 10. Stability and reactivity

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Benzene	LC50 Inhalation Gas. LD50 Oral LD50 Oral LD50 Oral LDLo Oral	Rat Mammal - species unspecified Mouse Rat Dog	10000 ppm 5700 mg/kg 4700 mg/kg 6400 mg/kg 2 g/kg	7 hours - - - -

Conclusion/Summary : No additional information.

Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
Benzene	Eyes - Moderate irritant Skin - Mild irritant Skin - Mild irritant	Rabbit Rat Rabbit	- - -	88 milligrams 8 hours 60 microliters 24 hours 15 milligrams	- - -

Skin : No additional information.

Eyes : No additional information.

Respiratory : No additional information.

Sensitization

Skin : No additional information.

Respiratory : No additional information.

Mutagenicity

Conclusion/Summary : **Benzene**: Some studies of workers exposed to benzene have shown an association with increased rates of chromosome aberrations in circulating lymphocytes.

Carcinogenicity

Product/ingredient name	Result	Species	Dose	Exposure
Benzene	Positive - Inhalation - TD	Rat - Female	-	-

Conclusion/Summary : **Benzene**: Studies of workers exposed to benzene show clear evidence that over-exposure can cause cancer of the blood forming organs (acute myelogenous leukemia) and aplastic anemia. Also, studies suggest over-exposure to benzene may be associated with other types of leukemia and other blood disorders. Studies in laboratory animals indicate that prolonged, repeated exposure to high levels of benzene vapor can cause bone marrow suppression and cancer in multiple organ systems.

Classification

Product/ingredient name	OSHA	IARC	NTP
Benzene	+	1	Known to be a human carcinogen.

Reproductive toxicity

Conclusion/Summary : **Benzene**: One study of women workers exposed to benzene suggested a weak association with irregular menstruation. However, other studies of workers exposed to benzene have not demonstrated clear evidence of an effect on fertility or reproductive outcome in humans. Benzene can cross the placenta and affect the developing fetus. Cases of aplastic anemia have been reported in the offspring of persons severely over-exposed to benzene. Studies in laboratory animals show evidence of adverse effects on male reproductive organs following high levels of exposure but no significant effects on reproduction have been observed. Embryotoxicity has been reported in studies of laboratory animals but effects were limited to reduced fetal weight and skeletal

Section 11. Toxicological information

variations.

Teratogenicity

Product/ingredient name	Result	Species	Dose	Exposure
Benzene	Negative - Inhalation	Rat	-	-

Conclusion/Summary : No additional information.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
Benzene	Category 1	Not determined	Not determined

Aspiration hazard

Name	Result
Benzene	ASPIRATION HAZARD - Category 1

Information on the likely routes of exposure : Routes of entry anticipated: Oral, Dermal, Inhalation.

Potential acute health effects

Eye contact : Causes serious eye irritation.

Inhalation : Breathing high concentrations can cause irregular heartbeats which can be fatal.

Skin contact : Causes skin irritation.

Ingestion : May be fatal if swallowed and enters airways. Irritating to mouth, throat and stomach.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : Adverse symptoms may include the following:
pain or irritation
watering
redness

Inhalation : Breathing high concentrations can cause irregular heartbeats which can be fatal.

Skin contact : Adverse symptoms may include the following:
irritation
redness

Ingestion : Adverse symptoms may include the following:
nausea or vomiting

Potential chronic health effects

General : Causes damage to organs through prolonged or repeated exposure.

Carcinogenicity : May cause cancer. Risk of cancer depends on duration and level of exposure.

Mutagenicity : May cause genetic defects.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Section 12. Ecological information

Toxicity

Product/ingredient name	Result	Species	Exposure
Benzene	Acute EC50 29000 µg/l Fresh water	Algae - Pseudokirchneriella subcapitata	72 hours
	Acute EC50 1360000 µg/l Fresh water	Algae - Scenedesmus abundans	96 hours
	Acute EC50 9230 µg/l Fresh water	Daphnia - Daphnia magna - Neonate	48 hours
	Acute LC50 21000 µg/l Marine water	Crustaceans - Artemia salina - Nauplii	48 hours
	Acute LC50 5.28 ul/L Fresh water	Fish - Oncorhynchus gorbuscha - Fry	96 hours
	Chronic NOEC 1.5 to 5.4 ul/L Marine water	Fish - Morone saxatilis - Juvenile (Fledgling, Hatchling, Weanling)	4 weeks

Conclusion/Summary : Not available.

Persistence and degradability

Conclusion/Summary : Biodegradability: Rapidly biodegradable in aerobic conditions.

Partition Coefficient (log Kow): 2.3
Photodegradation: Based on similar materials, this product will have a significant tendency to partition to air. Hydrocarbons from this product which do partition to air are expected to rapidly photodegrade.Distribution: Principally to air.
Not available.

Product/ingredient name	Aquatic half-life	Photolysis	Biodegradability
Benzene	-	-	Readily

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
Benzene	2.13	4.27	low

Mobility in soil

Soil/water partition coefficient (K_{OC}) : 60 to 83

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Vapor from product residues may create a highly flammable or explosive atmosphere inside the container. Do not cut, weld or grind used containers unless they have been cleaned thoroughly internally. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

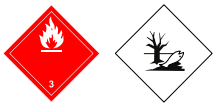
RCRA classification : D001, D018

United States - RCRA Toxic hazardous waste "U" List

Section 13. Disposal considerations

Ingredient	CAS #	Status	Reference number
Benzene	71-43-2	Listed	U019

Section 14. Transport information

	DOT Classification	IMDG	IATA
UN number	UN1114	UN1114	UN1114
UN proper shipping name	Benzene	BENZENE	Benzene
Transport hazard class(es)	3 	3 	3 
Packing group	II	II	II
Environmental hazards	No.	Yes.	No.
Additional information	**Reportable quantity** 10.05 lbs / 4.5628 kg [1.3697 gal / 5.185 L] Package sizes shipped in quantities less than the product reportable quantity are not subject to the RQ (reportable quantity) transportation requirements. **Limited quantity** Yes. **Packaging instruction** **Passenger aircraft** Quantity limitation: 5 L **Cargo aircraft** Quantity limitation: 60 L **Special provisions** IB2, T4, TP1 **Remarks** Not a DOT "Marine Pollutant" per 49 CFR 171.8.	**Emergency schedules (EmS)** F-E, S-D	**Passenger and Cargo Aircraft** Quantity limitation: 5 L Packaging instructions: 353 **Cargo Aircraft Only**Quantity limitation: 60 L Packaging instructions: 364 **Limited Quantities - Passenger Aircraft**Quantity limitation: 1 L Packaging instructions: Y341

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Section 15. Regulatory information

U.S. Federal regulations : **United States inventory (TSCA 8b)**: All components are listed or exempted.

Clean Water Act (CWA) 307: Benzene; Toluene

Clean Water Act (CWA) 311: Benzene; Toluene

This material is classified as an oil under Section 311 of the Clean Water Act (CWA) and the Oil Pollution Act of 1990 (OPA). Discharges or spills which produce a visible sheen on waters of the United States, their adjoining shorelines, or into conduits leading to surface waters must be reported to the EPA's National Response Center at (800) 424-8802.

SARA 302/304

Composition/information on ingredients

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Fire hazard
Immediate (acute) health hazard
Delayed (chronic) health hazard

Composition/information on ingredients

Name	Fire hazard	Sudden release of pressure	Reactive	Immediate (acute) health hazard	Delayed (chronic) health hazard
Benzene	Yes.	No.	No.	Yes.	Yes.

SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	Benzene	71-43-2	99 - 100
Supplier notification	Benzene	71-43-2	99 - 100

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

State regulations

Massachusetts : The following components are listed: BENZENE

New York : The following components are listed: Benzene

New Jersey : The following components are listed: BENZENE

Pennsylvania : The following components are listed: BENZENE

California Prop. 65

WARNING: This product contains a chemical known to the State of California to cause cancer and birth defects or other reproductive harm.

Ingredient name	%	Cancer	Reproductive	No significant risk level	Maximum acceptable dosage level
Benzene	99 - 100	Yes.	Yes.	6.4 µg/day (ingestion) 13 µg/day (inhalation)	24 µg/day (ingestion) 49 µg/day (inhalation)
Toluene	<0.1	No.	Yes.	No.	7000 µg/day (ingestion)

International regulations

Section 15. Regulatory information

International lists : **Australia inventory (AICS)**: All components are listed or exempted.
China inventory (IECSC): All components are listed or exempted.
Japan inventory: All components are listed or exempted.
Korea inventory: All components are listed or exempted.
Malaysia Inventory (EHS Register): All components are listed or exempted.
New Zealand Inventory of Chemicals (NZIoC): All components are listed or exempted.
Philippines inventory (PICCS): All components are listed or exempted.
Taiwan inventory (CSNN): All components are listed or exempted.

Canada inventory : All components are listed or exempted.

EU Inventory : All components are listed or exempted.

WHMIS (Canada) : Class B-2: Flammable liquid
Class D-2A: Material causing other toxic effects (Very toxic).
Class D-2B: Material causing other toxic effects (Toxic).

Section 16. Other information

National Fire Protection Association (U.S.A.)

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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

History

Date of issue/Date of revision : 2/6/2015.

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

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Section 16. Other information

PRODUCT.

CITGO is a registered trademark of CITGO Petroleum Corporation

Fisher Scientific

Part of Thermo Fisher Scientific

SAFETY DATA SHEET

Revision Date 10-Feb-2015 **Revision Number** 1

1. Identification

Product Name **Benzo[a]pyrene, 98%**

Cat No. : **AC105600010; AC105601000**

Synonyms Benzo[def]chrysene.; 3,4-Benzopyrene; 3,4-Benzpyrene

Recommended Use Laboratory chemicals.

Uses advised against No Information available

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Entity / Business Name
Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin Sensitization	Category 1
Germ Cell Mutagenicity	Category 1A
Carcinogenicity	Category 1A
Reproductive Toxicity	Category 1A

Label Elements

Signal Word
Danger

Hazard Statements
May cause an allergic skin reaction
May cause genetic defects
May cause cancer
May damage fertility or the unborn child

Precautionary Statements
Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Avoid breathing dust/fume/gas/mist/vapors/spray
Contaminated work clothing should not be allowed out of the workplace
Wear protective gloves
Response
IF exposed or concerned: Get medical attention/advice
Skin
IF ON SKIN: Wash with plenty of soap and water
If skin irritation or rash occurs: Get medical advice/attention
Wash contaminated clothing before reuse
Storage
Store locked up
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Very toxic to aquatic life with long lasting effects

3. Composition / information on ingredients

Component	CAS-No	Weight %
Benzo[a]pyrene	50-32-8	> 96

4. First-aid measures

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes.

Inhalation Move to fresh air.

Ingestion Do not induce vomiting.

Most important symptoms/effects May cause allergic skin reaction. Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Unsuitable Extinguishing Media No information available

Flash Point
Method - No information available

Autoignition Temperature No information available
Explosion Limits

Upper	No data available
Lower	No data available
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products
None known
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
2	0	0	N/A

6. Accidental release measures

Personal Precautions	Ensure adequate ventilation. Use personal protective equipment.
Environmental Precautions	See Section 12 for additional ecological information. Avoid release to the environment. Collect spillage.

Methods for Containment and Clean Up No information available.

7. Handling and storage

Handling Ensure adequate ventilation.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Benzo[a]pyrene		TWA: 0.2 mg/m^3	

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Benzo[a]pyrene	TWA: 0.005 mg/m^3		TWA:

Legend

OSHA - Occupational Safety and Health Administration

Engineering Measures Ensure adequate ventilation, especially in confined areas.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Powder Solid
Appearance	Dark yellow
Odor	aromatic
Odor Threshold	No information available
pH	
Melting Point/Range	175 179 °C
Boiling Point/Range	°C @ 760 mmHg
Flash Point	
Evaporation Rate	No information available
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	No information available
Vapor Density	No information available
Relative Density	No information available
Solubility	Insoluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	C20H12
Molecular Weight	252.31

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under normal conditions.

Conditions to Avoid Incompatible products.

Incompatible Materials Strong oxidizing agents

Hazardous Decomposition Products None under normal use conditions

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Component Information

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation No information available

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Benzo[a]pyrene	50-32-8	Group 1	Reasonably Anticipated	A2	X	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known
STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing
Endocrine Disruptor Information No information available

Component	EU - Endocrine Disrupters Candidate List	EU - Endocrine Disruptors - Evaluated Substances	Japan - Endocrine Disruptor Information
Benzo[a]pyrene	Group III Chemical	Not applicable	Not applicable

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity
Do not empty into drains.

Persistence and Degradability No information available
Bioaccumulation/ Accumulation No information available.

Mobility No information available.

Component	log Pow
Benzo[a]pyrene	6.06

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Benzo[a]pyrene - 50-32-8	U022	-

14. Transport information

DOT
UN-No UN3077
Proper Shipping Name ENVIRONMENTALLY HAZARDOUS SUBSTANCE,SOLID, N.O.S.
Hazard Class 9
Packing Group III

TDG
UN-No UN3077
Proper Shipping Name ENVIRONMENTALLY HAZARDOUS SUBSTANCE,SOLID, N.O.S.
Hazard Class 9
Packing Group III

IATA
UN-No UN3077
Proper Shipping Name ENVIRONMENTALLY HAZARDOUS SUBSTANCE,SOLID, N.O.S.
Hazard Class 9
Packing Group III

IMDG/IMO
UN-No UN3077

Proper Shipping Name	ENVIRONMENTALLY HAZARDOUS SUBSTANCE,SOLID, N.O.S.
Hazard Class	9
Packing Group	III

15. Regulatory information

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Benzo[a]pyrene	X	X	-	200-028-5	-		X	-	-	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Benzo[a]pyrene	50-32-8	> 96	0.1

SARA 311/312 Hazardous Categorization

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Benzo[a]pyrene	-	-	X	X

Clean Air Act Not applicable

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA
Not applicable

Component	Hazardous Substances RQs	CERCLA EHS RQs
Benzo[a]pyrene	1 lb	-

California Proposition 65 This product does not contain any Proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Benzo[a]pyrene	50-32-8	Carcinogen	0.06 µg/day	Carcinogen

State Right-to-Know

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Benzo[a]pyrene	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ): N
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

Canada
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

WHMIS Hazard Class D2A Very toxic materials

16. Other information

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Revision Date 10-Feb-2015
Print Date 10-Feb-2015
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

Disclaimer
The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of SDS

SAFETY DATA SHEET
COAL TAR SOLUTION

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND THE COMPANY:

PRODUCT NAME: COAL TAR SOLUTION

PART No.: RM080

SUPPLIER:

J M Loveridge plc
Southbrook Road, Southampton
Hampshire
SO15 1BH
Tel: 023 8022 2008
Fax: 023 8022 2117

2. COMPOSITION/INFORMATION ON INGREDIENTS:

NAME CAS No.:	EINECS Nr.:	CLASSIFICATION	CONTENT
ETHANOL 64-17-5	200-578-6	F R-11	60-100 %
METHANOL 67-56-1	200-659-6	T ,F R-11, 23/24/25, 39/23/24/25	1-5 %
COAL TAR 65996-84-1	266-018-8	T R-45 Carc2	10-30 %

The Full Text for all R-Phrases are Displayed in Section 16

COMPOSITION COMMENTS: Coal tar component is a complex mixture of aromatic hydrocarbons, phenolic compounds and coal tar pitch. The mixture may also contain benzo[a]-pyrene and benzo[b+j+k]-fluoranthene.

3. HAZARDS IDENTIFICATION:

Highly flammable. Harmful by inhalation, in contact with skin and if swallowed. May cause cancer. Harmful: possible risk of irreversible effects through inhalation, in contact with skin and if swallowed. Carcinogen Category 2. Mutagen Category 3.

Coal tar component of the preparation is classified as Carcinogen Category 2.

4. FIRST AID MEASURES:

GENERAL: IN ALL CASES OF DOUBT OR WHEN SYMPTOMS PERSIST, ALWAYS SEEK MEDICAL ATTENTION

INHALATION:	Remove affected person from exposure, rest and keep warm. If recovery not rapid or complete seek medical attention.
INGESTION:	DO NOT INDUCE VOMITING. In case of spontaneous vomiting, be sure that vomit can freely drain because of danger of suffocation. Only when conscious, rinse mouth with plenty of water and give plenty of water to drink - (approx 500ml). Keep patient at rest and obtain medical attention.
SKIN:	Remove contaminated clothing. Wash affected area with plenty of soap and water. Do not use solvents. Obtain medical attention. Launder clothing before re-use.
EYES:	Rinse immediately with plenty of water for at least 5 minutes while lifting the eye lids. Seek medical attention. Continue to rinse.

5. FIRE FIGHTING MEASURES:

EXTINGUISHING MEDIA:	Water spray, fog or mist, carbon dioxide (CO2), alcohol resistant foam, dry chemicals, sand, dolomite etc.
SPECIAL FIRE FIGHTING PROCEDURES:	Take measures to retain water used for extinguishing. Do not release contaminated water into drains, soil and surface water. Dispose of contaminated water and soil according to local regulations.
HAZARDOUS COMBUSTION PRODUCTS:	Burning may release oxides of carbon and other hazardous gases or vapours.
PROTECTIVE MEASURES IN FIRE:	Fire fighters should wear self-contained breathing apparatus.

6. ACCIDENTAL RELEASE MEASURES:

PERSONAL PRECAUTION IN SPILL:	Wear appropriate protective clothing. Eliminate all sources of ignition. Avoid direct contact with skin, eyes and clothing. Ventilate area to dispel residual vapour or fumes.
PRECAUTIONS TO PROTECT ENVIRONMENT:	Prevent material from entering drains or water courses. Advise the Environment Agency or relevant local authority if contamination of soil or water systems occurs.
SPILL CLEANUP METHODS:	Take-up spillage with absorbent, inert material and place in a suitable and closable labelled container for recovery or disposal.

7. HANDLING AND STORAGE:

USAGE PRECAUTIONS:	HANDLING - Product should be used in accordance with good industrial principles for handling and storing of hazardous chemicals. Avoid vapour formation and ignition sources. Avoid contact with skin or eyes. Avoid vapour inhalation.
STORAGE PRECAUTIONS:	Store in a cool, dry, well ventilated place, in securely closed original container. Store away from sources of heat or ignition.
STORAGE CRITERIA:	Flammable liquid storage.

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION:

INGREDIENT NAME:	**CAS No.:**	**STD**	**LT EXP 8 Hrs**	**ST EXP 15 Min**
ETHANOL	64-17-5	OES	1000 ppm	No std.
METHANOL	67-56-1	OES	200 ppm(Sk)	250 ppm(Sk)

RESPIRATORS:	Respiratory protection required in insufficiently ventilated working areas. For short periods of work, a suitable RPE fitted with a combination charcoal or organic vapour cartridge is recommended.
PROTECTIVE GLOVES:	Use impervious gloves.
EYE PROTECTION:	Approved chemical safety goggles or face protection.
OTHER PROTECTION:	Wear personal protective equipment appropriate to the quantity of material handled.
HYGIENIC WORK PRACTICES:	SKIN PROTECTION - apply barrier cream to hands and exposed skin. Apply good personnal hygiene principles, such as washing of hands, arms and face.

9. PHYSICAL AND CHEMICAL PROPERTIES:

APPEARANCE:	Dark brown to black mobile liquid.		
ODOUR/TASTE:	Characteristic pitch/tar odour.		
DENSITY/SPECIFIC GRAVITY (g/ml):	~ 0.83 - 0.85	**Temperature (°C):**	20
FLASH POINT (°C):	18°C	**Method:**	

10. STABILITY AND REACTIVITY:

STABILITY:	Stable under normal conditions of use.
MATERIALS TO AVOID:	Oxidising agents.
HAZARDOUS DECOMP. PRODUCTS:	Thermal decomposition or burning may release oxides of carbon or other hazardous gases, acrid smoke and irritating fumes.

11. TOXICOLOGICAL INFORMATION:

TOXICOLOGICAL INFORMATION:	Prolonged or repeated contact with skin may result in the occurrence of tar warts, which may develop into skin cancer.
INHALATION:	Irritating to mucous membranes.
INGESTION:	May cause nausea, vomiting, abdominal pain, drowsiness. High ethanol content may cause intoxication.
SKIN:	Prolonged or repeated exposure may cause severe irritation.
EYES:	Irritating to eyes.
HEALTH WARNINGS:	Acute effects include headache and nausea.
OTHER HEALTH EFFECTS:	Chronic effects - exposure to high concentrations may result in damage to internal organs.

12. ECOLOGICAL INFORMATION:

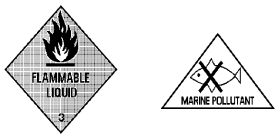
ECOLOGICAL INFORMATION:	Avoid release to the environment. No specific information available, but material is expected to have adverse effect on the environment. Coal tar component is classified as marine pollutant.

13. DISPOSAL CONSIDERATIONS:

DISPOSAL METHODS:	This material and/or its container must be disposed of as hazardous waste according to Special Waste Regulations 1996 or according to local regulations, in compliance with Duty of Care Regulations and Special Waste Regulations.
WASTE CLASS:	WASTE CODE: 0705** HAZARDOUS PROPETY: H7, H14

14. TRANSPORT INFORMATION:

LABEL FOR CONVEYANCE:



UK ROAD PACK GR.:	III
ADR CLASS No.:	3
ADR CLASS:	Class 3: Flammable liquids.
ADR ITEM No.:	5°(c)
HAZARD No. (ADR):	33 Highly flammable liquid (flash-point below 23°C).
ADR MARGINAL:	2301
HAZCHEM CODE:	3YE
PROPER SHIPPING NAME I:	FLAMMABLE LIQUID, NOS
PROPER SHIPPING NAME II:	TECHNICAL NAME - (contains ethanol)
UN No. SEA:	UN 1993
IMDG CLASS:	3
IMDG PAGE No.:	3345
IMDG PACK GR.:	III
MARINE POLLUTANT:	Yes.
SEA TRANSPORT NOTES:	Contains marine pollutant (P).
UN No., AIR:	UN-ID 1993
ICAO CLASS:	3
AIR PACK GR.:	III

15. REGULATORY INFORMATION:

LABEL FOR SUPPLY:

RISK PHRASES:	R-11 Highly flammable. R-20/21/22 Harmful by inhalation, in contact with skin and if swallowed. R-45 May cause cancer. R-68/20/21/22 Harmful: possible risk of irreversible effects through inhalation, in contact with skin and if swallowed.
SAFETY PHRASES:	P-11 Restricted to professional users. S-36/37 Wear suitable protective clothing and gloves. S-38 In case of insufficient ventilation, wear suitable respiratory equipment. S-45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). S-53 Avoid exposure - obtain special instructions before use. S-60 This material and its container must be disposed of as hazardous waste.
UK REGULATORY REFERENCES:	Chemicals (Hazard Information & Packaging) Regulations 1993. Classification, Packaging and Labelling Regulations 1984.

16. OTHER INFORMATION:

INFORMATION SOURCES:	This product has been classified in accordance with CHIP3 regulations.
REVISION COMMENTS:	Edition 01; Revised item(s):
ISSUED BY:	MK
SDS No.:	129
DATE:	12/07/02
DISCLAIMER:	The foregoing data has been compiled for safety information only and does not form part of any selling specification. Information contained in this Data Sheet is to the best of JMLs knowledge correct at the time of publication. Customers should always satisfy themselves, that the product which they have selected is entirely suitable for their purpose under their conditions of use and in compliance with current regulations. For any further information, please contact the supplier.
R-PHRASES (Full Text):	R-45 May cause cancer. R-11 Highly flammable. R-23/24/25 Toxic by inhalation, in contact with skin and if swallowed. R-39/23/24/25 Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed.

OFF!® DEEP WOODS® INSECT REPELLENT V

Version *1*.1 Print Date 03/04/2015

Revision Date 02/23/2015 SDS Number 350000004807

1. PRODUCT AND COMPANY IDENTIFICATION

Product information

Product name : **OFF!® DEEP WOODS® INSECT REPELLENT V**

Recommended use : Insect Repellent

Manufacturer, importer, supplier : S.C. Johnson & Son, Inc.
1525 Howe Street
Racine WI 53403-2236

Telephone : +18005585252
Emergency telephone number : 24 Hour Medical Emergency Phone: (866)231-5406
24 Hour International Emergency Phone: (703)527-3887
24 Hour Transport Emergency Phone: (800)424-9300

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

Globally Harmonized System (GHS) Classification

Hazard classification	Hazard category	Hazards identification
Aerosol	Category 1	Extremely flammable aerosol.
Gases under pressure	Liquefied gas	Contains gas under pressure; may explode if heated.

Labelling
Hazard symbols
Flame
Gas cylinder

Signal word
Danger

Hazard statements
Extremely flammable aerosol.
Contains gas under pressure; may explode if heated.

Precautionary statements
Protect from sunlight. Do not expose to temperatures exceeding 50 °C/ 122 °F.
Protect from sunlight. Store in a well-ventilated place.
Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
Do not spray on an open flame or other ignition source.
Do not pierce or burn, even after use.

Other hazards : None identified

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS-No.	Weight percent
Ethyl alcohol	64-17-5	30.00 - 60.00
N,N-Diethyl-m-toluamide	134-62-3	10.00 - 30.00
Butane	106-97-8	1.00 - 5.00
Propane	74-98-6	1.00 - 5.00
Isobutane	75-28-5	1.00 - 5.00

The specific chemical identity and/or exact percentage (concentration) of this composition has been withheld as a trade secret.

For additional information on product ingredients, see www.whatsinsidescjohnson.com.

4. FIRST AID MEASURES

Eye contact : No special requirements

Skin contact : If you suspect a reaction to this product, discontinue use and remove contaminated clothing.

Inhalation : No special requirements.

Ingestion : No special requirements

5. FIREFIGHTING MEASURES

Suitable extinguishing media : Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Specific hazards during firefighting : Aerosol Product - Containers may rocket or explode in heat of fire. Do not allow run-off from fire fighting to enter drains or water courses.

Further information : Fight fire from maximum distance or protected area. Cool and use caution when approaching or handling fire-exposed containers. Wear full protective clothing and positive pressure

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self-contained breathing apparatus. In case of fire and/or explosion do not breathe fumes.

NFPA Classification : NFPA Level 2 Aerosol

6. ACCIDENTAL RELEASE MEASURES

Personal precautions : Remove all sources of ignition.
Wear personal protective equipment.
Wash thoroughly after handling.

Environmental precautions : Do not flush into surface water or sanitary sewer system.
Use appropriate containment to avoid environmental contamination.
Outside of normal use, avoid release to the environment.

Methods and materials for containment and cleaning up : If damage occurs to aerosol can:
Contain spillage, soak up with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and transfer to a container for disposal according to local / national regulations (see section 13).
Use only non-sparking equipment.
Dike large spills.
Clean residue from spill site.

7. HANDLING AND STORAGE

Handling

Precautions for safe handling : Avoid contact with eyes and lips.
For personal protection see section 8.
Use only as directed.
KEEP OUT OF REACH OF CHILDREN AND PETS.
Pressurized container.
Do not pierce or burn, even after use.

Advice on protection against fire and explosion : Keep away from sources of ignition - No smoking.
Do not spray on an open flame or other ignition source.

Storage

Requirements for storage areas and containers : Protect from sunlight. Do not expose to temperatures exceeding 50 °C/ 122 °F.

OFF!® DEEP WOODS® INSECT REPELLENT V

Keep away from food, drink and animal feedingstuffs.
Keep in a dry, cool and well-ventilated place.

Other data : Stable under recommended storage conditions.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational Exposure Limits

Components	CAS-No.	mg/m3	ppm	Non-standard units	Basis
Ethyl alcohol	64-17-5	1,900 mg/m3	1,000 ppm	-	OSHA TWA
Ethyl alcohol	64-17-5	-	1,000 ppm	-	ACGIH STEL
Butane	106-97-8	-	1,000 ppm	-	ACGIH STEL
Propane	74-98-6	-	1,000 ppm	-	ACGIH TWA
Propane	74-98-6	1,800 mg/m3	1,000 ppm	-	OSHA TWA
Isobutane	75-28-5	-	1,000 ppm	-	ACGIH STEL

Personal protective equipment

Respiratory protection : Do not spray in enclosed areas.

Hand protection : No special requirements.

Eye protection : No special requirements.

Skin and body protection : No special requirements.

Hygiene measures : Handle in accordance with good industrial hygiene and safety practice. Wash thoroughly after handling.

9. PHYSICAL AND CHEMICAL PROPERTIES

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Form	:	aerosol
Form	:	Compressed gas
Color	:	clear
Odor	:	Alcohol Odor
Odour Threshold	:	No data available
pH	:	No data available
Melting point/freezing point	:	No data available
Initial boiling point and boiling range	:	No data available
Flash point	:	-7 °C 19.4 °F
Evaporation rate	:	No data available
Flammability (solid, gas)	:	No data available
Upper/lower flammability or explosive limits	:	No data available
Vapour pressure	:	No data available
Vapour density	:	No data available
Relative density	:	0.84 g/ml at 21 °C
Solubility(ies)	:	slightly soluble

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Partition coefficient: n-octanol/water	:	No data available
Auto-ignition temperature	:	No data available
Decomposition temperature	:	No data available
Viscosity, dynamic	:	No data available
Viscosity, kinematic	:	No data available
Oxidizing properties	:	No data available
Volatile Organic Compounds Total VOC (wt. %)*	:	64.2 % - additional exemptions may apply *as defined by US Federal and State Consumer Product Regulations
Other information	:	None identified :

10. STABILITY AND REACTIVITY

Possibility of hazardous reactions	:	Stable under recommended storage conditions.
Conditions to avoid	:	Heat, flames and sparks.
Incompatible materials	:	Strong oxidizing agents
Hazardous decomposition products	:	Thermal decomposition can lead to release of irritating gases and vapours.

11. TOXICOLOGICAL INFORMATION

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Emergency Overview : Danger

Acute oral toxicity : No data available
Acute inhalation toxicity : No data available

Acute dermal toxicity : No data available

GHS Properties	Classification	Routes of entry
Acute toxicity	No classification proposed	-
Skin corrosion/irritation	No classification proposed	-
Serious eye damage/eye irritation	No classification proposed	-
Skin sensitisation	No classification proposed	-
Respiratory sensitisation	No classification proposed	-
Germ cell mutagenicity	No classification proposed	-
Carcinogenicity	No classification proposed	-
Reproductive toxicity	No classification proposed	-
Specific target organ toxicity - single exposure	No classification proposed	-
Specific target organ toxicity - repeated exposure	No classification proposed	-
Aspiration hazard	No classification proposed	-

Aggravated Medical Condition : Do not apply to cuts or irritated skin.

12. ECOLOGICAL INFORMATION

Product : The product itself has not been tested.

Toxicity
The ingredients in this formula have been reviewed and no adverse impact to the environment is expected when used according to label directions.

Toxicity to fish

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Components	End point	Species	Value	Exposure time
Ethyl alcohol	flow-through test LC50	Pimephales promelas (fathead minnow)	14,200 mg/l	96 h
N,N-Diethyl-m-toluamide	static test LC50	Oncorhynchus mykiss (rainbow trout)	71.25 mg/l	96 h
Butane	No data available			
Propane	LC50	Fish	27.98 mg/l	96 h
Isobutane	LC50	Fish	27.98 mg/l	96 h

Toxicity to aquatic invertebrates

Components	End point	Species	Value	Exposure time
Ethyl alcohol	static test EC50	Daphnia magna (Water flea)	2 mg/l	48 h
	NOEC	Daphnia magna	9.6 mg/l	9 d
N,N-Diethyl-m-toluamide	No data available			
Butane	No data			

	available			
Propane	LC50	Daphnid	14.22 mg/l	48 h
Isobutane	LC50	Daphnid	16.33 mg/l	48 h

Toxicity to aquatic plants

Components	End point	Species	Value	Exposure time
Ethyl alcohol	Static EC50	Chlorella vulgaris (Fresh water algae)	275 mg/l	72 h
N,N-Diethyl-m-toluamide	No data available			
Butane	No data available			
Propane	No data available			
Isobutane	EC50	Green algea	8.57 mg/l	96 h

Persistence and degradability

Component	Biodegradation	Exposure time	Summary
Ethyl alcohol	97 %	28 d	Readily biodegradable
N,N-Diethyl-m-toluamide	No data available		
Butane	100 %	385.5 h	Readily biodegradable
Propane	70 %	< 10 d	Readily biodegradable
Isobutane	70 %	< 10 d	Readily biodegradable

Bioaccumulative potential

Component	Bioconcentration	Partition Coefficient n-

	factor (BCF)	Octanol/water (log)
Ethyl alcohol	3.2 estimated	-0.35 Measured
N,N-Diethyl-m-toluamide	No data available	No data available
Butane	No data available	2.89
Propane	No data available	2.36
Isobutane	1.57 - 1.97	2.8

Mobility

Component	End point	Value
Ethyl alcohol	No data available	
N,N-Diethyl-m-toluamide	No data available	
Butane	No data available	
Propane	No data available	
Isobutane	No data available	

PBT and vPvB assessment

Component	Results
Ethyl alcohol	Not fulfilling PBT and vPvB criteria
N,N-Diethyl-m-toluamide	Not fulfilling PBT and vPvB criteria
Butane	Not fulfilling PBT and vPvB criteria
Propane	Not fulfilling PBT and vPvB criteria
Isobutane	Not fulfilling PBT and vPvB criteria

Other adverse effects : None known.

13. DISPOSAL CONSIDERATIONS

PESTICIDAL WASTE:
For disposal information, please read and follow Disposal instructions on the pesticide label.
Consumer may discard empty container in trash, or recycle where facilities exist.

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14. TRANSPORT INFORMATION

Please refer to the Bill of Lading/receiving documents for up-to-date shipping information.

	Land transport	Sea transport	Air transport
UN number	1950	1950	1950
UN proper shipping name	AEROSOLS, Flammable, 2.1	AEROSOLS, Flammable, 2.1	AEROSOLS, Flammable, 2.1
Transport hazard class(es)	2.1	2	2.1
Packing group	-	-	-
Environmental hazards	-	-	-
Special precautions for user	Limited quantities derogation may be applicable to this product, please check transport documents.	Limited quantities derogation may be applicable to this product, please check transport documents.	Limited quantities derogation may be applicable to this product, please check transport documents.

15. REGULATORY INFORMATION

FIFRA Labeling

This chemical is a pesticide product registered by the Environmental Protection Agency and is subject to certain labeling requirements under federal pesticide law. These requirements differ from the classification criteria and hazard information required for safety data sheets, and for workplace labels of non-pesticide chemicals.
Following is the hazard information as required on the pesticide label:

CAUTION:
Causes moderate eye irritation.
Harmful if swallowed.
Use of this product may cause skin reactions in rare cases.
Flammable.
Contents under pressure.
Exposure to temperatures above 120° F may cause bursting.

Notification status : All ingredients of this product are listed or are excluded from listing on the U.S. Toxic Substances Control Act (TSCA)

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Chemical Substance Inventory.

Notification status : All ingredients of this product comply with the New Substances Notification requirements under the Canadian Environmental Protection Act (CEPA).

California Prop. 65 : This product is not subject to the reporting requirements under California's Proposition 65.

Registration # / Agency
4822-167/US/EPA

16. OTHER INFORMATION

HMIS Ratings

Health	2
Flammability	4
Reactivity	0

NFPA Ratings

Health	2
Fire	4
Reactivity	0
Special	-

This information is being provided in accordance with the Occupational Safety and Health Administration (OSHA) regulation (29 CFR 1910.1200). The information supplied is designed for workplaces where product use and frequency of exposure exceeds that established for the labeled consumer use.

Further information

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This document has been prepared using data from sources considered to be technically reliable. It does not constitute a warranty, expressed or implied, as to the accuracy of the information contained herein. Actual conditions of use are beyond the seller's control. User is responsible to evaluate all available information when using product for any particular use and to comply with all Federal, State, Provincial and Local laws and regulations.

Prepared by	SC Johnson Global Safety Assessment & Regulatory Affairs (GSARA)

Ethylbenzene

Version 1.4 Revision Date 2011-08-24

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product information

Trade name : Ethylbenzene
Material : 1037350, 1036462, 1015418

Company : Chevron Phillips Chemical Company LP
10001 Six Pines Drive
The Woodlands, TX 77380

Emergency telephone:

Health:
866.442.9628 (North America)
1.832.813.4984 (International)
Transport:
North America: CHEMTREC 800.424.9300 or 703.527.3887
Asia: +800 CHEMCALL (+800 2436 2255) China: 0532.8388.9090
EUROPE: BIG +32.14.584545 (phone) or +32.14583516 (telefax)
Chemcare Asia: Tel: +65 6848 9048 - Mob: +65 8382 9188 - Fax: +65 6848
South America SOS-Cotec Inside Brazil: 0800.111.767 Outside Brazil: +55.19.3467.1600

Responsible Department : Product Safety and Toxicology Group
E-mail address : MSDS@CPChem.com
Website : www.CPChem.com

2. HAZARDS IDENTIFICATION

Emergency Overview

Physical state: Liquid **Color**: Colorless **Odor**: Aromatic

OSHA Hazards : Flammable Liquid, Moderate skin irritant, Moderate eye irritant

GHS Classification

: Flammable liquids, Category 2
Skin irritation, Category 2
Acute toxicity, Category 5, Oral
Acute toxicity, Category 4, Inhalation
Eye irritation, Category 2A
Specific target organ systemic toxicity - single exposure, Category 3, Inhalation
Aspiration hazard, Category 1
Acute aquatic toxicity, Category 2
Specific target organ systemic toxicity - repeated exposure, Category 2, OralInhalation, Auditory organs

GHS-Labeling

Symbol(s) :

Signal Word : Danger

Hazard Statements :
H225: Highly flammable liquid and vapor.
H303: May be harmful if swallowed.
H304: May be fatal if swallowed and enters airways.
H315: Causes skin irritation.
H319: Causes serious eye irritation.
H332: Harmful if inhaled.
H335: May cause respiratory irritation.
H401: Toxic to aquatic life.
H373: May cause damage to organs through prolonged or repeated exposure if inhaled.
H373: May cause damage to organs through prolonged or repeated exposure if swallowed.

Precautionary Statements :
Prevention:
P210: Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P233: Keep container tightly closed.
P240: Ground/bond container and receiving equipment.
P241: Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P242: Use only non-sparking tools.
P243: Take precautionary measures against static discharge.
P261: Avoid breathing dust/fume/gas/mist/vapors/spray.
P264: Wash skin thoroughly after handling.
P271: Use only outdoors or in a well-ventilated area.
P273: Avoid release to the environment.
P280: Wear protective gloves/ protective clothing/ eye protection/ face protection.
Response:
P301 + P310: IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician.
P303 + P361 + P353: IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P304 + P340: IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P305 + P351 + P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P312: Call a POISON CENTER or doctor/ physician if you feel unwell.
P321: Specific treatment (see supplemental first aid instructions on this label).
P331: Do NOT induce vomiting.
P332 + P313: If skin irritation occurs: Get medical advice/ attention.
P337 + P313: If eye irritation persists: Get medical advice/ attention.
P362: Take off contaminated clothing and wash before reuse.
P370 + P378: In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.
Storage:
P403 + P233: Store in a well-ventilated place. Keep container tightly closed.

P403 + P235: Store in a well-ventilated place. Keep cool.
P405: Store locked up.
Disposal:
P501: Dispose of contents/ container to an approved waste disposal plant.

Carcinogenicity:

IARC
Group 2B: Possibly carcinogenic to humans
Ethylbenzene 100-41-4

NTP
No ingredient of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

ACGIH
Confirmed animal carcinogen with unknown relevance to humans: The agent is carcinogenic in experimental animals at a relatively high dose, by route(s) of administration, at site(s), of histologic type(s), or by mechanism(s) that may not be relevant to worker exposure. Available epidemiologic studies do not confirm an increased risk of cancer in exposed humans. Available evidence does not suggest that the agent is likely to cause cancer in humans except under uncommon or unlikely routes or levels of exposure.
Ethylbenzene 100-41-4

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms : Ethylbenzol
EB
Phenylethane

Molecular formula : C8H10
Index-No. : 601-023-00-4
EINECS-No. : 202-849-4

Component	CAS-No.	Weight %
Ethylbenzene	100-41-4	99.00

4. FIRST AID MEASURES

General advice : Move out of dangerous area. Show this material safety data sheet to the doctor in attendance. Symptoms of poisoning may only appear several hours later. Do not leave the victim unattended.

If inhaled : Consult a physician after significant exposure. If unconscious place in recovery position and seek medical advice.

In case of skin contact : If skin irritation persists, call a physician. If on skin, rinse well with water. If on clothes, remove clothes.

In case of eye contact : Immediately flush eye(s) with plenty of water. Remove contact lenses. Protect unharmed eye. Keep eye wide open while rinsing. If eye irritation persists, consult a specialist.

If swallowed	:	Keep respiratory tract clear. Do NOT induce vomiting. Do not give milk or alcoholic beverages. Never give anything by mouth to an unconscious person. If symptoms persist, call a physician. Take victim immediately to hospital.

5. FIRE-FIGHTING MEASURES

Flash point	:	15 °C (59 °F) Method: closed cup
Autoignition temperature	:	432.22 °C (810.00 °F) Typical
Suitable extinguishing media	:	Alcohol-resistant foam. Carbon dioxide (CO2). Dry chemical.
Unsuitable extinguishing media	:	High volume water jet.
Specific hazards during fire fighting	:	Do not allow run-off from fire fighting to enter drains or water courses.
Special protective equipment for fire-fighters	:	Wear self contained breathing apparatus for fire fighting if necessary.
Further information	:	Collect contaminated fire extinguishing water separately. This must not be discharged into drains. Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations. For safety reasons in case of fire, cans should be stored separately in closed containments. Use a water spray to cool fully closed containers.
Fire and explosion protection	:	Do not spray on an open flame or any other incandescent material. Take necessary action to avoid static electricity discharge (which might cause ignition of organic vapors). Use only explosion-proof equipment. Keep away from open flames, hot surfaces and sources of ignition.
Hazardous decomposition products	:	Carbon Dioxide. Carbon oxides.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions	:	Use personal protective equipment. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapors accumulating to form explosive concentrations. Vapors can accumulate in low areas.
Environmental precautions	:	Prevent product from entering drains. Prevent further leakage or spillage if safe to do so. If the product contaminates rivers and lakes or drains inform respective authorities.
Methods for cleaning up	:	Contain spillage, and then collect with non-combustible

absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see section 13).

7. HANDLING AND STORAGE

Handling

Advice on safe handling : Avoid formation of aerosol. Do not breathe vapors/dust. Avoid exposure - obtain special instructions before use. Avoid contact with skin and eyes. For personal protection see section 8. Smoking, eating and drinking should be prohibited in the application area. Take precautionary measures against static discharges. Provide sufficient air exchange and/or exhaust in work rooms. Open drum carefully as content may be under pressure. Dispose of rinse water in accordance with local and national regulations.
Electrostatic charge may accumulate and create a hazardous condition when handling this material. To minimize this hazard, bonding and grounding may be necessary, but may not by themselves be sufficient. Review all operations, which have the potential to generating and accumulation of electrostatic charge and/or a flammable atmosphere (including tank and container filling, splash filling, tank cleaning, sampling, gauging, switch loading, filtering, mixing, agitation, and vacuum truck operations) and use appropriate mitigating procedures. For more information, refer to OSHA Standard 29 CFR 1910.106 "Flammable and Combustible Liquids"; National Fire Protection Association (NFPA 77), "Recommended Practice on Static Electricity"; and/or the American Petroleum Institute (API) Recommended Practice 2003, "Protection Against Ignitions Arising Out of Static, Lightning, and stray Currents".

Advice on protection against fire and explosion : Do not spray on an open flame or any other incandescent material. Take necessary action to avoid static electricity discharge (which might cause ignition of organic vapors). Use only explosion-proof equipment. Keep away from open flames, hot surfaces and sources of ignition.

Storage

Requirements for storage areas and containers : No smoking. Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Observe label precautions. Electrical installations / working materials must comply with the technological safety standards.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Ingredients with workplace control parameters

US

Ingredients	Basis	Value	Control parameters	Note
Ethylbenzene	ACGIH	TWA	100 ppm,	(), BEI, A3,
	ACGIH	STEL	125 ppm,	(), BEI, A3,
	OSHA Z-1	TWA	100 ppm, 435 mg/m3	(b),
	OSHA Z-1-A	TWA	100 ppm, 435 mg/m3	
	OSHA Z-1-A	STEL	125 ppm, 545 mg/m3	
	NIOSH REL	TWA	100 ppm, 435 mg/m3	

	NIOSH REL	ST	125 ppm, 545 mg/m3	

() Adopted values or notations enclosed are those for which changes are proposed in the NIC
(b) The value in mg/m3 is approximate.
A3 Confirmed animal carcinogen with unknown relevance to humans: The agent is carcinogenic in experimental animals at a relatively high dose, by route(s) of administration, at site(s), of histologic type(s), or by mechanism(s) that may not be relevant to worker exposure. Available epidemiologic studies do not confirm an increased risk of cancer in exposed humans. Available evidence does not suggest that the agent is likely to cause cancer in humans except under uncommon or unlikely routes or levels of exposure.
BEI Substances for which there is a Biological Exposure Index or Indices (see BEI® section)

Personal protective equipment

Respiratory protection : In the case of vapor formation use a respirator with an approved filter.

Hand protection : The suitability for a specific workplace should be discussed with the producers of the protective gloves.

Eye protection : Eye wash bottle with pure water. Tightly fitting safety goggles. Wear face-shield and protective suit for abnormal processing problems.

Skin and body protection : Impervious clothing. Choose body protection according to the amount and concentration of the dangerous substance at the work place.

Hygiene measures : When using do not eat or drink. When using do not smoke. Wash hands before breaks and at the end of workday.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Appearance

Physical state : Liquid
Color : Colorless
Odor : Aromatic

Safety data

Flash point : 15 °C (59 °F)
Method: closed cup
Lower explosion limit : 1 %(V)

Upper explosion limit : 6.7 %(V)

Oxidizing properties : No

Autoignition temperature : 432.22 °C (810.00 °F)
Typical

Molecular formula : C8H10

Molecular Weight : No data available

pH : Not applicable

Pour point : No data available

Boiling point/boiling range : 136 °C (277 °F)

Vapor pressure	:	9.00 MMHG at 25 °C (77 °F)
Relative density	:	0.87, 15.6 °C(60.1 °F)
Water solubility	:	Slightly soluble in water (14mg/100ml). Miscible with alcohol and ether.
Partition coefficient: n-octanol/water	:	No data available
Viscosity, kinematic	:	< 1.138 cSt at 37.8 °C (100.0 °F)
Relative vapor density	:	3.7 (Air = 1.0)
Evaporation rate	:	No data available

Other information

Conductivity	:	123 pSm

10. STABILITY AND REACTIVITY

Possibility of hazardous reactions

Conditions to avoid	:	Heat, flames and sparks.
Materials to avoid	:	May react with oxygen and strong oxidizing agents, such as chlorates, nitrates, peroxides, etc.
Other data	:	This material is considered stable under normal ambient and anticipated storage and handling conditions of temperature and pressure. No decomposition if stored and applied as directed.

11. TOXICOLOGICAL INFORMATION

Ethylbenzene
Acute oral toxicity : Acute toxicity estimate: 2,525.25 mg/kg
Method: Calculation method

Ethylbenzene
Acute inhalation toxicity : Acute toxicity estimate: 17.58 mg/l
Method: Calculation method

Acute dermal toxicity

Ethylbenzene : LD50: 15,415 mg/kg
Species: rabbit

Ethylbenzene

Skin irritation : May cause skin irritation in susceptible persons.

Ethylbenzene
Eye irritation : Eye irritation.

Sensitization

Ethylbenzene : Did not cause sensitization on laboratory animals.

Ethylbenzene
Aspiration toxicity : May be fatal if swallowed and enters airways.
Substances known to cause human aspiration toxicity hazards or to be regarded as if they cause human aspiration toxicity hazard.

CMR effects

Ethylbenzene : Carcinogenicity: Carcinogenicity classification not possible from current data.
Mutagenicity: In vivo tests did not show mutagenic effects
Teratogenicity: Did not show teratogenic effects in animal experiments.
Reproductive toxicity: No toxicity to reproduction

Ethylbenzene
Further information : Solvents may degrease the skin.

12. ECOLOGICAL INFORMATION

Toxicity to fish

Ethylbenzene : LC50: 4.3 mg/l
Exposure time: 96 HR
Species: Marone saxatilis (striped bass)

Toxicity to daphnia and other aquatic invertebrates.

Ethylbenzene : LC50: 2.6 mg/l
Exposure time: 96 HR
Species: Mysidopsis bahia (mysid shrimp)

EC50: 2.2 mg/l
Exposure time: 48 HR
Species: Daphnia magna (Water flea)
Method: OECD Test Guideline 202

Toxicity to algae

Ethylbenzene : ErC50: 5.0 mg/l
Exposure time: 96 HR
Species: Selenastrum capricornutum (algae)

ErC50: 7.7 mg/l
Exposure time: 72 HR
Species: Skeletonema costatum (Marine Algae)

Elimination information (persistence and degradability)

Biodegradability : This material is expected to be readily biodegradable.

Further information on ecology

Results of PBT assessment

Ethylbenzene : This substance is not considered to be persistent, bioaccumulating nor toxic (PBT)., This substance is not considered to be very persistent nor very bioaccumulating (vPvB).

Additional ecological information : An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.
Toxic to aquatic life.

13. DISPOSAL CONSIDERATIONS

The information in this MSDS pertains only to the product as shipped.

Use material for its intended purpose or recycle if possible. This material, if it must be discarded, may meet the criteria of a hazardous waste as defined by US EPA under RCRA (40 CFR 261) or other State and local regulations. Measurement of certain physical properties and analysis for regulated components may be necessary to make a correct determination. If this material is classified as a hazardous waste, federal law requires disposal at a licensed hazardous waste disposal facility.

Product : The product should not be allowed to enter drains, water courses or the soil. Do not contaminate ponds, waterways or ditches with chemical or used container. Send to a licensed waste management company.

Contaminated packaging : Empty remaining contents. Dispose of as unused product. Do not re-use empty containers. Do not burn, or use a cutting torch on, the empty drum.

14. TRANSPORT INFORMATION

The shipping descriptions shown here are for bulk shipments only, and may not apply to shipments in non-bulk packages (see regulatory definition).

Consult the appropriate domestic or international mode-specific and quantity-specific Dangerous Goods Regulations for additional shipping description requirements (e.g., technical name or names, etc.) Therefore, the information shown here, may not always agree with the bill of lading shipping description for the material. Flashpoints for the material may vary slightly between the MSDS and the bill of lading.

US DOT (United States Department of Transportation)
UN1175, ETHYLBENZENE, 3, II, RQ (ETHYLBENZENE)

IMO / IMDG (International Maritime Dangerous Goods)
UN1175, ETHYLBENZENE, 3, II, (15 °C)

IATA (International Air Transport Association)
UN1175, ETHYLBENZENE, 3, II

ADR (Agreement on Dangerous Goods by Road (Europe))
UN1175, ETHYLBENZENE, 3, II, (D/E)

RID (Regulations concerning the International Transport of Dangerous Goods (Europe))
UN1175, ETHYLBENZENE, 3, II

ADN (European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways)
UN1175, ETHYLBENZENE, 3, II

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

15. REGULATORY INFORMATION

National legislation

SARA 311/312 Hazards	:	Fire Hazard Acute Health Hazard Chronic Health Hazard
CERCLA Reportable Quantity	:	1010 lbs Ethylbenzene
SARA 302 Threshold Planning Quantity	:	1000 lbs CERCLA hazardous substances. 40 cfr part 302. May be subject to emergency release notification under sara title III.
SARA 313 Ingredients	:	The following components are subject to reporting levels established by SARA Title III, Section 313:
	:	Ethylbenzene 100-41-4

Clean Air Act

Ozone-Depletion Potential	:	This product neither contains, nor was manufactured with a Class I or Class II ODS as defined by the U.S. Clean Air Act Section 602 (40 CFR 82, Subpt. A, App.A + B).

US State Regulations

Pennsylvania Right To Know

: Ethylbenzene 100-41-4

New Jersey Right To Know : Ethylbenzene 100-41-4

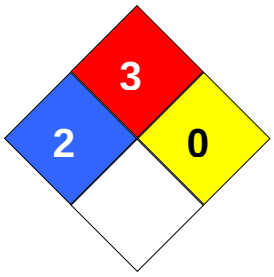
California Prop. 65 Ingredients : WARNING! This product contains a chemical known in the State of California to cause cancer.

Notification status

Europe REACH	:	Not in compliance with the inventory
United States of America US.TSCA	:	On the inventory, or in compliance with the inventory
Canada DSL	:	On the inventory, or in compliance with the inventory
Australia AICS	:	On the inventory, or in compliance with the inventory
New Zealand NZIoC	:	On the inventory, or in compliance with the inventory
Japan ENCS	:	On the inventory, or in compliance with the inventory
Korea KECI	:	On the inventory, or in compliance with the inventory
Philippines PICCS	:	On the inventory, or in compliance with the inventory
China IECSC	:	On the inventory, or in compliance with the inventory

16. OTHER INFORMATION

NFPA Classification : Health Hazard: 2
Fire Hazard: 3
Reactivity Hazard: 0



Further information

Legacy MSDS Number : 790

Significant changes since the last version are highlighted in the margin. This version replaces all previous versions.

The information in this MSDS pertains only to the product as shipped.

The information provided in this Material Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Key or legend to abbreviations and acronyms used in the safety data sheet			
ACGIH	American Conference of Government Industrial Hygienists	LD50	Lethal Dose 50%
AICS	Australia, Inventory of Chemical Substances	LOAEL	Lowest Observed Adverse Effect Level
DSL	Canada, Domestic Substances List	NFPA	National Fire Protection Agency
NDSL	Canada, Non-Domestic Substances List	NIOSH	National Institute for Occupational Safety & Health
CNS	Central Nervous System	NTP	National Toxicology Program

CAS	Chemical Abstract Service	NZIoC	New Zealand Inventory of Chemicals
EC50	Effective Concentration	NOAEL	No Observable Adverse Effect Level
EC50	Effective Concentration 50%	NOEC	No Observed Effect Concentration
EGEST	EOSCA Generic Exposure Scenario Tool	OSHA	Occupational Safety & Health Administration
EOSCA	European Oilfield Specialty Chemicals Association	PEL	Permissible Exposure Limit
EINECS	European Inventory of Existing Chemical Substances	PICCS	Philipines Inventory of Commercial Chemical Substances
MAK	Germany Maximum Concentration Values	PRNT	Presumed Not Toxic
GHS	Globally Harmonized System	RCRA	Resource Conservation Recovery Act
>=	Greater Than or Equal To	STEL	Short-term Exposure Limit
IC50	Inhibition Concentration 50%	SARA	Superfund Amendments and Reauthorization Act.
IARC	International Agency for Research on Cancer	TLV	Threshold Limit Value
IECSC	Inventory of Existing Chemical Substances in China	TWA	Time Weighted Average
ENCS	Japan, Inventory of Existing and New Chemical Substances	TSCA	Toxic Substance Control Act
KECI	Korea, Existing Chemical Inventory	UVCB	Unknown or Variable Compositon, Complex Reaction Products, and Biological Materials
<=	Less Than or Equal To	WHMIS	Workplace Hazardous Materials Information System
LC50	Lethal Concentration 50%		

Safety Data Sheet

NON-Hazardous Chemical, Dangerous Goods

1. MATERIAL AND SUPPLY COMPANY IDENTIFICATION

Product name: Flocculant

Recommended use: Water treatment

Supplier:	Cyndan Chemicals
ABN:	31 001 670 097
Street Address:	Unit 1, 1 Prosperity Parade Warriewood NSW 2102 Australia
Telephone:	1800 812 309

Emergency Telephone number:

2. HAZARDS IDENTIFICATION

Based on available information, this material is not classified as hazardous according to criteria of Safe Work Australia.

Prevention Precautionary Statements

P262	Do not get in eyes, on skin, or on clothing.
P280	Wear gloves, and suitable eye/face protection.

Response Precautionary Statement
Not allocated

Storage Precautionary Statement
Not allocated

Disposal Precautionary Statement
Not allocated

Poison Schedule: Not Applicable

DANGEROUS GOOD CLASSIFICATION

Classified as Dangerous Goods by the criteria of the "Australian Code for the Transport of Dangerous Goods by Road & Rail" and the "New Zealand NZS5433: Transport of Dangerous Goods on Land".

Dangerous Goods Class: 9

3. COMPOSITION INFORMATION

CHEMICAL ENTITY	CAS NO	PROPORTION
Cationic flocculant		20-50 % (w/w)
Ingredients determined to be Non-Hazardous		Balance

4. FIRST AID MEASURES

If poisoning occurs, contact a doctor or Poisons Information Centre (Phone Australia 131 126, New Zealand 0800

764 766).

Inhalation: Not expected to occur. If irritation occurs and persists, seek medical advice from a doctor or the Poison Information Centre.

Skin Contact: Immediately wash the area with excess water until the material is gone. Irritation is unlikely, but seem medical advice is there are signs of skin irritation such as incessant itching, redness or rash.

Eye contact: Flush the eye with water for at least 5min, pulling back the eyelids to remove all of the material from the eye. No effects are anticipated, however seek medical advice if persistent signs of irritation are observed.

Ingestion: DO NOT induce vomiting. Rinse the mouth with water, removing any prostheses or objects to ensure complete removal of the product. Give the patient water to drink, as much and as quickly as they can; do not give liquids to someone with reduced awareness. Not expected to cause irritation or other acute effects, however if irritation or similar symptoms are observed contact a Poisons Information Centre or seek other medical advice.

Notes to physician: Treat symptomatically. Treat symptomatically; no acute or long term hazards anticipated.

5. FIRE FIGHTING MEASURES

Hazchem Code: •3Z

Suitable extinguishing media: If material is involved in a fire use alcohol resistant foam or dry agent (carbon dioxide, dry chemical powder).

Specific hazards: Non-combustible material.

Fire fighting further advice: Not applicable.

6. ACCIDENTAL RELEASE MEASURES

SMALL SPILLS
Wear protective equipment to prevent skin and eye contamination. Avoid inhalation of vapours or dust. Wipe up with absorbent (clean rag or paper towels). Collect and seal in properly labelled containers or drums for disposal.

LARGE SPILLS
Clear area of all unprotected personnel. Slippery when spilt. Avoid accidents, clean up immediately. Wear protective equipment to prevent skin and eye contamination and the inhalation of vapours. Work up wind or increase ventilation. Contain - prevent run off into drains and waterways. Use absorbent (soil, sand or other inert material). Collect and seal in properly labelled containers or drums for disposal. If contamination of crops, sewers or waterways has occurred advise local emergency services.

Dangerous Goods – Initial Emergency Response Guide No: 47

7. HANDLING AND STORAGE

Handling: Avoid eye contact and repeated or prolonged skin contact. Avoid inhalation of vapour, mist or aerosols.

Storage: Store in a cool, dry, well-ventilated place and out of direct sunlight. Store away from foodstuffs. Store away from incompatible materials described in Section 10. Store away from sources of heat and/or ignition. Keep container standing upright. Keep containers closed when not in use - check regularly for leaks.

This material is classified as a Class 9 Miscellaneous Dangerous Good as per the criteria of the "Australian Code for the Transport of Dangerous Goods by Road & Rail" and/or the "New Zealand NZS5433: Transport of Dangerous Goods on Land" and must be stored in accordance with the relevant regulations.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

National occupational exposure limits: No value assigned for this specific material by Safe Work Australia.

Biological Limit Values: As per the "National Model Regulations for the Control of Workplace Hazardous Substances (Safe Work Australia)" the ingredients in this material do not have a Biological Limit Allocated.

National occupational exposure limits: Natural ventilation should be adequate under normal use conditions..

Personal Protection Equipment: SAFETY SHOES, OVERALLS
Wear safety shoes and overalls.

Hygiene measures: Keep away from food, drink and animal feeding stuffs. When using do not eat, drink or smoke. Wash hands prior to eating, drinking or smoking. Avoid contact with clothing. Avoid eye contact and repeated or prolonged skin contact. Avoid inhalation of vapour, mist or aerosols. Ensure that eyewash stations and safety showers are close to the workstation location.

9. PHYSICAL AND CHEMICAL PROPERTIES

Form:	Clear Liquid
Colour:	Colourless
Odour:	Odourless

Solubility:	Miscible
Specific Gravity (20 °C):	approx 1.5 (calculated)
Vapour Pressure (20 °C):	2.37kPa @20C (water)
pH:	5.0-6.0

(Typical values only - consult specification sheet)
N Av = Not available, N App = Not applicable

10. STABILITY AND REACTIVITY

Chemical stability: Stable under normal ambient conditions, transportation, storage, handling, and usage.

Conditions to avoid: Avoid high temperatures; keep below 30C.

Incompatible materials: Anionic polymers

Hazardous decomposition products: May produce oxides of carbon and or nitrogen in fire conditions. In rare cases may produce hydrogen cyanide gas when in contact with reducing agents.

Hazardous reactions: None known.

11. TOXICOLOGICAL INFORMATION

No adverse health effects expected if the product is handled in accordance with this Safety Data Sheet and the product label. Symptoms or effects that may arise if the product is mishandled and overexposure occurs are:

Acute Effects

Inhalation: No known effects.

Skin contact: No known effects.

Ingestion: No known effects.

Eye contact: No known effects.

Acute toxicity

Inhalation: This material has been classified as non-hazardous. Acute toxicity estimate (based on ingredients): >20 mg/L

Skin contact: This material has been classified as non-hazardous. Acute toxicity estimate (based on ingredients): >2,000 mg/Kg

Ingestion: This material has been classified as non-hazardous. Acute toxicity estimate (based on ingredients): >2,000 mg/Kg

Corrosion/Irritancy: Eye: this material has been classified as not corrosive or irritating to eyes. Skin: this material has been classified as not corrosive or irritating to skin.

Sensitisation: Inhalation: this material has been classified as not a respiratory sensitiser. Skin: this material has been classified as not a skin sensitiser.

Aspiration hazard: This material has been classified as non-hazardous.

Specific target organ toxicity (single exposure): This material has been classified as non-hazardous.

Chronic Toxicity

Mutagenicity: This material has been classified as non-hazardous.

Carcinogenicity: This material has been classified as non-hazardous.

Reproductive toxicity (including via lactation): This material has been classified as non-hazardous.

Specific target organ toxicity (repeat exposure): This material has been classified as non-hazardous.

12. ECOLOGICAL INFORMATION

Avoid contaminating waterways.

Acute aquatic hazard: Toxic to aquatic life.LC50 flathead minnow: 1.5mg/L

Long-term aquatic hazard: No known long term hazards.

Ecotoxicity: No information available.

Persistence and degradability: The product is readily biodegradable.

Bioaccumulative potential: No known bioaccumulation; produce is biodegradable.

Mobility: Does not accumulate in soil or water.

13. DISPOSAL CONSIDERATIONS

Persons conducting disposal, recycling or reclamation activities should ensure that appropriate personal protection equipment is used, see "Section 8. Exposure Controls and Personal Protection" of this SDS.

If possible material and its container should be recycled. If material or container cannot be recycled, dispose in

accordance with local, regional, national and international Regulations.

14. TRANSPORT INFORMATION

ROAD AND RAIL TRANSPORT
Classified as Dangerous Goods by the criteria of the “Australian Code for the Transport of Dangerous Goods by Road & Rail" and the "New Zealand NZS5433: Transport of Dangerous Goods on Land".

Australian Special Provisions; AU01: Environmentally Hazardous Substances meeting the description of UN 3077 or UN 3082 are not subject to this Code (ADG 07) when transported by road or rail in;
(a) packagings that do not incorporate a receptacle exceeding 500 Kg (L); or
(b) IBCs.

UN No:	3082
Dangerous Goods Class:	9
Packing Group:	III
Hazchem Code:	•3Z
Emergency Response Guide No:	47
Proper Shipping Name:	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (CATIONIC FLOCCULANT)

Segregation Dangerous Goods: Not to be loaded with explosives (Class 1). Note 1: Materials that are fire risks are incompatible with oxidising agents (Class 5.1) or organic peroxides (Class 5.2). Exemptions may apply.

MARINE TRANSPORT
Classified as Dangerous Goods by the criteria of the International Maritime Dangerous Goods Code (IMDG Code) for transport by sea. This material is classified as a Marine Pollutant (P) according to the International Maritime Dangerous Goods Code.

UN No:	3082
Dangerous Goods Class:	9
Packing Group:	III
Proper Shipping Name:	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (CATIONIC FLOCCULANT)

AIR TRANSPORT
Classified as Dangerous Goods by the criteria of the International Air Transport Association (IATA) Dangerous Goods Regulations for transport by air.

UN No:	3082

Dangerous Goods Class:	9
Packing Group:	III
Proper Shipping Name:	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (CATIONIC FLOCCULANT)

15. REGULATORY INFORMATION

This material is not subject to the following international agreements:
Montreal Protocol (Ozone depleting substances)
The Stockholm Convention (Persistent Organic Pollutants)
The Rotterdam Convention (Prior Informed Consent)
Basel Convention (Hazardous Waste)
International Convention for the Prevention of Pollution from Ships (MARPOL)

This material/constituent(s) is covered by the following requirements:
• All components of this product are listed on or exempt from the Australian Inventory of Chemical Substances (AICS).

16. OTHER INFORMATION

Reason for issue: Change in physical properties

This information was prepared in good faith from the best information available at the time of issue. It is based on the present level of research and to this extent we believe it is accurate. However, no guarantee of accuracy is made or implied and since conditions of use are beyond our control, all information relevant to usage is offered without warranty. The manufacturer will not be held responsible for any unauthorised use of this information or for any modified or altered versions.

If you are an employer it is your duty to tell your employees, and any others that may be affected, of any hazards described in this sheet and of any precautions that should be taken.

Safety Data Sheets are updated frequently. Please ensure you have a current copy.

Fisher Scientific

Part of Thermo Fisher Scientific

SAFETY DATA SHEET

Creation Date 12-Nov-2010 **Revision Date** 10-Jan-2017 **Revision Number** 4

1. Identification

Product Name **Sulfuric Acid (Certified ACS Plus)**

Cat No. : **A300-212; A300-225LB; A300-500; A300-612GAL; A300-700LB; A300C212; A300P500; A300S212; A300S212EA; A300S500; A300SI212**

Synonyms Hydrogen sulfate; Vitriol brown oil; Oil of vitriol

Recommended Use Laboratory chemicals.

Uses advised against No Information available

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin Corrosion/irritation	Category 1 A
Serious Eye Damage/Eye Irritation	Category 1
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system.	

Label Elements

Signal Word
Danger

Hazard Statements
Causes severe skin burns and eye damage
May cause respiratory irritation

Precautionary Statements
Prevention
Do not breathe dust/fume/gas/mist/vapors/spray
Wear protective gloves/protective clothing/eye protection/face protection
Wash face, hands and any exposed skin thoroughly after handling
Use only outdoors or in a well-ventilated area
Response
Immediately call a POISON CENTER or doctor/physician
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Skin
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Ingestion
IF SWALLOWED: Rinse mouth. DO NOT induce vomiting
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)

WARNING! This product contains a chemical known in the State of California to cause cancer.
Unknown Acute Toxicity

3. Composition / information on ingredients

Component	CAS-No	Weight %
Sulfuric acid	7664-93-9	90 - 98
Water	7732-18-5	2 - 10

4. First-aid measures

General Advice Show this safety data sheet to the doctor in attendance. Immediate medical attention is required.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Remove and wash contaminated clothing before re-use. Call a physician immediately.

Inhalation If not breathing, give artificial respiration. Remove from exposure, lie down. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Call a physician immediately.

Ingestion Do not induce vomiting. Clean mouth with water. Never give anything by mouth to an unconscious person. Call a physician immediately.

Most important symptoms/effects Causes burns by all exposure routes. Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated: Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media CO_2, dry chemical, dry sand, alcohol-resistant foam.

Unsuitable Extinguishing Media DO NOT USE WATER

Flash Point Not applicable
Method - No information available

Autoignition Temperature No information available
Explosion Limits
Upper No data available
Lower No data available
Sensitivity to Mechanical Impact No information available
Sensitivity to Static Discharge No information available

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors. The product causes burns of eyes, skin and mucous membranes.

Hazardous Combustion Products
Sulfur oxides Hydrogen
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

NFPA

Health	Flammability	Instability	Physical hazards
3	0	2	W

6. Accidental release measures

Personal Precautions Ensure adequate ventilation. Use personal protective equipment. Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak.
Environmental Precautions Should not be released into the environment.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Use only under a chemical fume hood. Do not breathe vapors or spray mist. Do not ingest.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from water. Corrosives area.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Sulfuric acid	TWA: 0.2 mg/m³	(Vacated) TWA: 1 mg/m³ TWA: 1 mg/m³	IDLH: 15 mg/m³ TWA: 1 mg/m³

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Sulfuric acid	TWA: 1 mg/m³ STEL: 3 mg/m³	TWA: 1 mg/m³	TWA: 0.2 mg/m³

Legend

ACGIH - American Conference of Governmental Industrial Hygienists

OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures Use only under a chemical fume hood. Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Long sleeved clothing.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Clear, Colorless to brown
Odor	Odorless
Odor Threshold	No information available
pH	0.3 (1N)
Melting Point/Range	10 °C / 50 °F
Boiling Point/Range	290 - 338 °C / 554 - 640.4 °F
Flash Point	Not applicable
Evaporation Rate	Slower than ether
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	< 0.001 mmHg @ 20 °C
Vapor Density	3.38 (Air = 1.0)
Specific Gravity	1.84
Solubility	Soluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	340°C
Viscosity	No information available
Molecular Formula	H2SO4
Molecular Weight	98.08

10. Stability and reactivity

Reactive Hazard Yes

Stability Reacts violently with water. Hygroscopic.

Conditions to Avoid Incompatible products. Excess heat. Exposure to moist air or water.

Incompatible Materials Water, Organic materials, Strong acids, Strong bases, Metals, Alcohols, Cyanides, Sulfides

Hazardous Decomposition Products Sulfur oxides, Hydrogen

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Oral LD50 Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.

Dermal LD50 Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.

Vapor LC50 Based on ATE data, the classification criteria are not met. ATE > 20 mg/l.

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Sulfuric acid	2140 mg/kg (Rat)	Not listed	LC50 = 510 mg/m³ (Rat) 2 h
Water	-	Not listed	Not listed

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Causes severe burns by all exposure routes

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen. Exposure to strong inorganic mists containing sulfuric acid may cause cancer by inhalation.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Sulfuric acid	7664-93-9	Group 1	Known	A2	X	A2
Water	7732-18-5	Not listed	Not listed	Not listed	Not listed	Not listed

IARC: (International Agency for Research on Cancer)

IARC: (International Agency for Research on Cancer)
Group 1 - Carcinogenic to Humans
Group 2A - Probably Carcinogenic to Humans
Group 2B - Possibly Carcinogenic to Humans

NTP: (National Toxicity Program)

NTP: (National Toxicity Program)
Known - Known Carcinogen
Reasonably Anticipated - Reasonably Anticipated to be a Human Carcinogen

ACGIH: (American Conference of Governmental Industrial Hygienists)

A1 - Known Human Carcinogen
A2 - Suspected Human Carcinogen
A3 - Animal Carcinogen
ACGIH: (American Conference of Governmental Industrial Hygienists)

Mexico - Occupational Exposure Limits - Carcinogens

Mexico - Occupational Exposure Limits - Carcinogens
A1 - Confirmed Human Carcinogen
A2 - Suspected Human Carcinogen
A3 - Confirmed Animal Carcinogen
A4 - Not Classifiable as a Human Carcinogen
A5 - Not Suspected as a Human Carcinogen

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Respiratory system

STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated: Ingestion causes

severe swelling, severe damage to the delicate tissue and danger of perforation

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

This product contains the following substance(s) which are hazardous for the environment. .

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Sulfuric acid	-	LC50: > 500 mg/L, 96h static (Brachydanio rerio)	-	EC50: 29 mg/L/24h

Persistence and Degradability No information available

Bioaccumulation/ Accumulation No information available.

Mobility No information available.

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT

- **UN-No** UN1830
- **Proper Shipping Name** Sulfuric acid
- **Hazard Class** 8
- **Packing Group** II

TDG

- **UN-No** UN1830
- **Proper Shipping Name** SULFURIC ACID
- **Hazard Class** 8
- **Packing Group** II

IATA

- **UN-No** UN1830
- **Proper Shipping Name** SULFURIC ACID
- **Hazard Class** 8
- **Packing Group** II

IMDG/IMO

- **UN-No** UN1830
- **Proper Shipping Name** SULFURIC ACID
- **Hazard Class** 8
- **Packing Group** II

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Sulfuric acid	X	X	-	231-639-5	-		X	X	X	X	X
Water	X	X	-	231-791-2	-		X	-	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated

polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Sulfuric acid	7664-93-9	90 - 98	1.0

SARA 311/312 Hazard Categories

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	Yes

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Sulfuric acid	X	1000 lb	-	-

Clean Air Act Not applicable

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Sulfuric acid	1000 lb	1000 lb

California Proposition 65 This product contains the following proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Sulfuric acid	7664-93-9	Carcinogen	-	Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Sulfuric acid	X	X	X	X	X
Water	-	-	X	-	-

U.S. Department of Transportation

Reportable Quantity (RQ):	Y
DOT Marine Pollutant	N
DOT Severe Marine Pollutant	N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

Canada
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

WHMIS Hazard Class D1A Very toxic materials
E Corrosive material
D2A Very toxic materials

16. Other information

Prepared By Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 12-Nov-2010
Revision Date 10-Jan-2017
Print Date 10-Jan-2017
Revision Summary SDS sections updated; 2
Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

FLINN SCIENTIFIC, INC.
Safety Data Sheet (SDS)

SDS #: 395.00
Revision Date: August 12, 2015

SECTION 1 — CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Hydrochloric Acid, 6M - 12M (Concentrated)

Flinn Scientific, Inc. P.O. Box 219, Batavia, IL 60510 (800) 452-1261
CHEMTREC Emergency Phone Number: (800) 424-9300

Signal Word **DANGER**

Pictograms

SECTION 2 — HAZARDS IDENTIFICATION

Hazard class: Skin and eye damage, corrosion or irritation (Category 1). Causes severe skin and eye burns and damage (H314+H318). Do not breathe mist, vapors or spray (P260).

Hazard class: Acute toxicity, oral and inhalation (Category 4). Harmful if swallowed or inhaled (H332+H302). Avoid breathing mist, vapors or spray (P261). Do not eat, drink or smoke when using this product (P270).

Hazard class: Corrosive to metals (Category 1). May be corrosive to metals (H290).

Industrial exposure to hydrochloric acid vapors and mists is listed as a known human carcinogen by IARC (IARC-1).

SECTION 3 — COMPOSITION, INFORMATION ON INGREDIENTS

Component Name	CAS Number	Formula	Formula Weight	Concentration
Hydrochloric acid	7647-01-0	HCl	36.46	20-38%
Water	7732-18-5	H_2O	18.00	62-80%

SECTION 4 — FIRST AID MEASURES

Immediately call a POISON CENTER or physician (P310).
If inhaled: Remove victim to fresh air and keep at rest in a position comfortable for breathing (P304+P340). **If in eyes:** Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do so. Continue rinsing (P305+P351 +P338).
If on skin (or hair): Immediately remove all contaminated clothing. Rinse skin with water (P303+P361+P353). Wash contaminated clothing before reuse (P363). **If swallowed:** Rinse mouth. Do NOT induce vomiting (P301+P330+P331).

SECTION 5 — FIRE FIGHTING MEASURES

Nonflammable, noncombustible solution.
When heated to decomposition, emits toxic fumes of hydrogen chloride.
In case of fire: Use a tri-class dry chemical fire extinguisher.

NFPA CODE
H-3
F-0
R-1

SECTION 6 — ACCIDENTAL RELEASE MEASURES

Ventilate area and contain the spill with sand or other inert absorbent material, neutralize with sodium bicarbonate or calcium hydroxide, and deposit in a sealed bag or container. Absorb spills to prevent material damage (P390). See Sections 8 and 13 for further information.

SECTION 7 — HANDLING AND STORAGE

Flinn Suggested Chemical Storage Pattern: Inorganic #9. Store with acids, except nitric acid.
Store in a dedicated acid cabinet and away from any source of water; if an acid cabinet is not available, store in Flinn Saf-Cube™.
Keep only in original container (P234). Keep container tightly closed (P233). Use only in a hood or well-ventilated area (P271).

SECTION 8 — EXPOSURE CONTROLS, PERSONAL PROTECTION

Wear protective gloves, protective clothing, and eye protection (P280). Wash hands thoroughly after handling (P264). Use only in a hood or well-ventilated area (P271).
Exposure guidelines: (as concentrated HCl) Ceiling 5 ppm (OSHA); Ceiling 2 ppm (ACGIH); IDLH 50 ppm. Irritation threshold is ~ 5 ppm so any irritation is sign of exposure (per OSHA)

SECTION 9 — PHYSICAL AND CHEMICAL PROPERTIES

Colorless to pale yellow, fuming liquid. Pungent odor. pH: < 1
Soluble: Water and alcohol

SECTION 10 — STABILITY AND REACTIVITY

Avoid contact with strong oxidizers, bases, metals, metal oxides, hydroxides, amines, and other alkaline materials. Incompatible with cyanides, sulfides, and formaldehyde. Corrodes metal, including steel. Produces heat when diluted with water.
Shelf life: Good, if stored properly. See Section 7 for further information.

SECTION 11 — TOXICOLOGICAL INFORMATION

Acute effects: Eye and skin corrosion. Respiratory irritation, coughing, ulceration of nose and throat.
Chronic effects: Corrosive to teeth.
Target organs: Respiratory tract, teeth, skin, eyes.

ORL-RBT LD_{50}: 900 mg/kg
IHL-RAT LC_{50}: 3124 ppm/1 hour
SKN-RBT LD_{50}: N.A.

N.A. = Not available, not all health aspects of this substance have been fully investigated.

SECTION 12 — ECOLOGICAL INFORMATION

Does not biodegrade in soil, may be toxic to aquatic life.

SECTION 13 — DISPOSAL CONSIDERATIONS

Please review all federal, state and local regulations that may apply before proceeding.
Flinn Suggested Disposal Method #24b is one option.

SECTION 14 — TRANSPORT INFORMATION

Shipping name: Hydrochloric acid. Hazard class: 8, Corrosive. UN number: UN1789.

N/A = Not applicable

SECTION 15 — REGULATORY INFORMATION

TSCA-listed, EINECS-listed (231-595-7), RCRA code D002.

SECTION 16 — OTHER INFORMATION

Consult your copy of the *Flinn Science Catalog/Reference Manual* for additional information about laboratory chemicals.

Revision Date: August 12, 2015

Safety Data Sheet

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Product Name: **HYDROGEN CYANIDE GAS**

Other name(s): Hydrogen cyanide gas (decomposition product of sodium cyanide); Hydrocyanic acid gas.

Recommended Use of the Chemical and Restrictions on Use Decomposition product of sodium cyanide.

Supplier: Ixom Operations Pty Ltd
ABN: 51 600 546 512
Street Address: Level 8, 1 Nicholson Street
Melbourne 3000
Australia

Telephone Number: +61 3 9665 7111
Facsimile: +61 3 9665 7937
Emergency Telephone: **1 800 033 111 (ALL HOURS)**

Please ensure you refer to the limitations of this Safety Data Sheet as set out in the "Other Information" section at the end of this Data Sheet.

2. HAZARDS IDENTIFICATION

Classified as Dangerous Goods by the criteria of the Australian Dangerous Goods Code (ADG Code) for Transport by Road and Rail; DANGEROUS GOODS.

This material is hazardous according to Safe Work Australia; HAZARDOUS SUBSTANCE.

Classification of the substance or mixture:
Flammable liquids - Category 1
Acute Oral Toxicity - Category 1
Acute Dermal Toxicity - Category 1
Acute Inhalation Toxicity - Category 1
Specific target organ toxicity (single exposure) - Category 1

The following health/environmental hazard categories fall outside the scope of the Workplace Health and Safety Regulations:
Acute Aquatic Toxicity - Category 1
Chronic Aquatic Toxicity - Category 1

SIGNAL WORD: DANGER

Hazard Statement(s):
H224 Extremely flammable liquid and vapour.
H300+H310+H330 Fatal if swallowed, in contact with skin or if inhaled.
H370 Causes damage to organs.

Precautionary Statement(s):

Prevention:
P210 Keep away from heat / sparks / open flames / hot surfaces. No smoking.
P233 Keep container tightly closed.
P240 Ground / bond container and receiving equipment.
P241 Use explosion-proof electrical / ventilating / lighting equipment.
P242 Use only non-sparking tools.
P243 Take precautionary measures against static discharge.
P260 Do not breathe mist / vapours / spray.
P264 Wash hands thoroughly after handling.
P270 Do not eat, drink or smoke when using this product.
P271 Use only outdoors or in a well-ventilated area.
P280 Wear protective gloves / protective clothing / eye protection / face protection.
P284 Wear respiratory protection.

Response:
P301+P310 IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician.
P330 Rinse mouth.
P302+P350 IF ON SKIN: Gently wash with plenty of soap and water.
P303+P361+P353 IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P310 Immediately call a POISON CENTER or doctor/physician.
P320 Specific treatment is urgent (see First Aid Measures on this Safety Data Sheet).
P322 Specific measures (see First Aid Measures on Safety Data Sheet).
P361 Take off immediately all contaminated clothing.
P363 Wash contaminated clothing before re-use.
P304+P340 IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P307+P311 IF exposed: Call a POISON CENTER or doctor/physician.
P314 Get medical advice/attention if you feel unwell.
P370+P378 In case of fire: Use extinguishing media as outlined in Section 5 of this Safety Data Sheet to extinguish.

Storage:
P403+P233 Store in a well-ventilated place. Keep container tightly closed.
P403+P235 Store in a well-ventilated place. Keep cool.
P405 Store locked up.

Disposal:
P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

Poisons Schedule (SUSMP): S7 Dangerous Poison.

3. COMPOSITION AND INFORMATION ON INGREDIENTS

Components	CAS Number	Proportion	Hazard Codes
Hydrogen cyanide	74-90-8	>99.9%	H224 H300 H310 H330 H370 H372 H410
Stabiliser	-	<0.1%	-

4. FIRST AID MEASURES

For advice, contact a Poisons Information Centre (e.g. phone Australia 131 126; New Zealand 0800 764 766) or a doctor at once. Urgent hospital treatment is likely to be needed.

May be fatal if inhaled, swallowed or absorbed through skin. At all places where there is a risk of cyanide poisoning, items to facilitate the prompt and effective treatment of cyanide poisoning (as determined by the treatment protocol to be employed) should be kept in an accessible and convenient location.

Recommended items include:

- An oxygen resuscitator and a source of oxygen and a clearly marked CYANIDE ANTIDOTE box containing:
- An approved airway, elasticised tourniquet, 5 mL sterile disposable syringe and needles for blood samples, fluoride heparinised blood sample tubes, skin prep swabs, dressing and adhesive tape
-Either:
- 2 Cyanokits containing hydroxocobalamin 5g x 2 amps and the prescribing information outlining side effects and precautions OR
- 2 Ampoules of Kelocyanor (Dicobalt edetate), including the prescribing information outlining side effects and precautions
- Intravenous injection equipment
- A copy of the appropriate Safety Data Sheet and
- A written copy of the relevant treatment protocol

Protect the rescuer

Prior to any attempt at rescue, an assessment of the dangers must be undertaken and measures including the use of appropriate personal protective equipment must be applied to protect the rescuer. Personal protective equipment may include:

- Protective gloves to avoid contact with contaminated skin, clothing and equipment
- Chemical goggles to protect the eyes
- Suitable respiratory protective equipment to prevent inhalation of sodium cyanide dust.

Inhalation:
Shout and send for help.
Remove the person from the source of exposure and ideally to a source of fresh air.
Look for verbal and physical responses from the person suffering from poisoning. Check that they are breathing.
If Patient is Breathing: Oxygen, preferably 100% oxygen if available, should be administered by a qualified person. If the person has collapsed or is unconscious, lie on their side, ensuring airway is clear and open.
If Patient is not Breathing: Ensure airway is clear and open and commence resuscitation using a resuscitation bag or mask connected to an oxygen source (or 100% oxygen via a non rebreathing facemask). Do not use mouth-to-mouth resuscitation. Oxygen, preferably 100% oxygen if available, should be administered by a qualified person. Check for pulse. If pulse is absent start external cardiac massage.

Transport promptly to hospital or medical centre.

Skin Contact:
If skin or hair contact occurs, immediately remove any contaminated clothing and place in a sealed bag for decontamination or disposal. Wash skin and hair thoroughly with running water. Transport promptly to hospital or medical centre. Treat as for 'Inhaled'.

Eye Contact:
Immediately wash in and around the eye area with large amounts of water for at least 15 minutes. Eyelids to be held apart. Remove clothing if contaminated and wash skin. Urgently seek medical assistance. Transport promptly to hospital or medical centre. Treat as for 'Inhaled'.

Ingestion:
Do not give anything by mouth. Treat as for 'Inhaled'.

Indication of immediate medical attention and special treatment needed:
Be certain that victims have been decontaminated properly. Victims who have undergone decontamination pose no serious risks of secondary contamination to rescuers or medical staff treating the victim. In such cases, Support Zone personnel require no specialized protective gear.

Upon presentation, immediately assess the need or otherwise for assisted ventilation, administer 100% oxygen, insert intravenous lines and institute cardiac and blood pressure monitoring if available.

Assess and monitor level of consciousness.

Obtain arterial/venous blood gas as metabolic acidosis, often severe, combined with a small difference between the arterial and venous oxygen saturation levels (<10 mmHg) suggests cyanide poisoning: Correct any severe metabolic acidosis (pH below 7.20) and concurrent electrolyte imbalances (for example, hyperkalaemia, hypercalcaemia).

Take a blood sample in a fluoride heparinised tube for analysis of blood cyanide levels to confirm poisoning, but do not delay treatment while awaiting results. Treatment decisions must be made on clinical grounds.

Symptoms of fear and anxiety about possible cyanide poisoning may mimic those of mild, or the early stages, of cyanide poisoning. It is therefore important to establish cyanide poisoning has actually occurred before administering an antidote as some cyanide antidotes have severe side effects if administered in the absence of cyanide poisoning or if the dose is too great.

If a history of exposure to cyanide has been confirmed and the patient presents with, or develops, severe symptoms of cyanide poisoning (particularly if the patient has lost consciousness, is lapsing into unconsciousness or enters cardiac arrest) then antidote administration may be required.

Antidotes

There are two main antidotes for severe cyanide poisoning

- Hydroxocobalamin (preferred) OR
- Dicobalt edetate (Kelocyanor)

Hydroxocobalamin

Reconstitute the hydroxocobalamin by diluting one flask (5g) of the freeze-dried with 200mL of 0.9% saline and shake rigorously. Administer 5 grams of reconstituted solution via a fast intravenous drip over 15 minutes (approximately 15mL/ min). A further (5g) dose may be given if necessary at a slower rate of infusion - 30 min - 2 hours (or alternatively I.V. sodium thiosulphate 12.5g (50mL) may be given by slow intravenous injection) through a separate IV line . Hydroxocobalamin should not be administered if person has known hypersensitivity to Vitamin B12.

Dicobalt edetate (Kelocyanor)

Note: Overzealous administration of the antidote is contraindicated and may result in serious adverse reactions of an anaphylactic (allergic) nature. Adverse reactions reported include gross oedema of the face and neck, urticaria, palpitations, hypotension, convulsions, vomiting, chest pains, difficulty in breathing, and collapse.

Administer one ampoule containing 300mg Dicobalt edetate in 20mL glucose solution (Kelocyanor) intravenously by slow injection. The initial effect is a fall in blood pressure, rise in pulse rate, and sometimes retching. Immediately after this phase, lasting about one minute, the patient should recover. The injection should be discontinued if allergic adverse effects are noted. A second dose may be given if the response is inadequate and allergic adverse effects have not been observed (or alternatively I.V. sodium thiosulphate 12.5g (50mL) may be given by slow intravenous injection through a separate IV line.

If cyanide has been swallowed, gastric lavage, charcoal and cathartics may be used after antidote treatment if less

than two hours have elapsed since ingestion if recommended by an appropriately qualified specialist physician in a specific case although the effectiveness of this measure is not strongly supported by evidence.

Cases of proven and symptomatic cyanide poisoning should be monitored for at least 24 hours and longer if antidote administration had been required for severe poisoning. Eye splashes should be assessed by an ophthalmologist within 24 hours (as cyanide is a severe eye irritant). Persons without symptoms but with significant areas of skin contact should be observed for at least 6 hours to ensure there are no delayed effects.

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media:
Dry agent (dry chemical powder).

Unsuitable Extinguishing Media:
Carbon dioxide.

Hazchem or Emergency Action Code: 2WE

Specific hazards arising from the substance or mixture:
Extremely flammable. Toxic substance.

Special protective equipment and precautions for fire-fighters:
Fire fighters to wear self-contained breathing apparatus and suitable protective clothing if risk of exposure to vapour or products of combustion.

6. ACCIDENTAL RELEASE MEASURES

Emergency procedures/Environmental precautions:
Clear area of all unprotected personnel. Shut off all possible sources of ignition. If contamination of sewers or waterways has occurred advise local emergency services. For large spills notify the Emergency Services.

Personal precautions/Protective equipment/Methods and materials for containment and cleaning up:
Clear area of all unprotected personnel. Wear protective equipment to prevent skin and eye contact and breathing in vapours/dust.

7. HANDLING AND STORAGE

This material is a Scheduled Poison S7 and must be stored, maintained and used in accordance with the relevant regulations.

Precautions for safe handling:
Extremely flammable - eliminate all potential ignition sources. Keep out of reach of children.

Conditions for safe storage, including any incompatibilities:
Not applicable.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Hydrogen cyanide: Peak Limitation = 11 mg/m^3 (10 ppm), Sk
Cyanides (as CN): 8hr TWA = 5 mg/m^3, Sk

As published by Safe Work Australia Workplace Exposure Standards for Airborne Contaminants.

TWA - The time-weighted average airborne concentration of a particular substance when calculated over an eight-hour working day, for a five-day working week.

`Sk' (skin) Notice - absorption through the skin may be a significant source of exposure. The exposure standard is invalidated if such contact should occur.

Peak Limitation - a maximum or peak airborne concentration of a particular substance determined over the shortest analytically practicable period of time which does not exceed 15 minutes.

These Workplace Exposure Standards are guides to be used in the control of occupational health hazards. All atmospheric contamination should be kept to as low a level as is workable. These workplace exposure standards should not be used as fine dividing lines between safe and dangerous concentrations of chemicals. They are not a measure of relative toxicity.

Appropriate engineering controls:
Ensure ventilation is adequate to maintain air concentrations below Workplace Exposure Standards.

If in the handling and application of this material, safe exposure levels could be exceeded, the use of engineering controls such as local exhaust ventilation must be considered and the results documented. If achieving safe exposure levels does not require engineering controls, then a detailed and documented risk assessment using the relevant Orica Personal Protection Guide information (refer to PPE section below) as a basis must be carried out to determine the minimum PPE requirements.

Individual protection measures, such as Personal Protective Equipment (PPE):
The selection of PPE is dependent on a detailed risk assessment. The risk assessment should consider the work situation, the physical form of the chemical, the handling methods, and environmental factors.

OVERALLS, CHEMICAL GOGGLES, RUBBER BOOTS, AIR MASK , GLOVES (Long), APRON.
* Not required if wearing air supplied mask.

Wear overalls, chemical goggles, full face shield, elbow-length impervious gloves, splash apron or equivalent chemical impervious outer garment, and rubber boots. Use with adequate ventilation. If determined by a risk assessment an inhalation risk exists, wear an air-supplied mask meeting the requirements of AS/NZS 1715 and AS/NZS 1716. Always wash hands before smoking, eating, drinking or using the toilet. Wash contaminated clothing and other protective equipment before storage or re-use.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state:	Gas
Colour:	Colourless
Odour:	Distinctive 'Bitter almonds'
Molecular Formula:	HCN
Solubility:	Soluble in water.
Specific Gravity:	0.938 g/L
Relative Vapour Density (air=1):	0.93 @26°C

Vapour Pressure (20 °C):	62 kPa
Flash Point (°C):	-17.8 (CC)
Flammability Limits (%):	6-41
Autoignition Temperature (°C):	538
% Volatile by Volume:	100
Boiling Point/Range (°C):	Not applicable
pH:	Not applicable

10. STABILITY AND REACTIVITY

Reactivity: Reacts with oxidising agents.

Chemical stability: No information available.

Possibility of hazardous reactions: If not stabilised, can polymerise violently.

Conditions to avoid: Avoid exposure to heat, sources of ignition, and open flame.

Incompatible materials: Incompatible with oxidising agents .

Hazardous decomposition products: Cyanides.

11. TOXICOLOGICAL INFORMATION

No adverse health effects expected if the product is handled in accordance with this Safety Data Sheet and the product label. Symptoms or effects that may arise if the product is mishandled and overexposure occurs are:

Ingestion: Swallowing can result in nausea, vomiting, diarrhoea, abdominal pain, convulsions and loss of consciousness. Collapse and possible death may occur.

Eye contact: May be an eye irritant.

Skin contact: Contact with skin may result in irritation. Can be absorbed through the skin. Effects can include those described for 'INGESTION'.

Inhalation: Breathing in high concentrations may result in the same symptoms described for 'INGESTION'. High inhaled concentrations may lead to a feeling of suffocation and cause difficulty in breathing, headaches, dizziness and loss of consciousness. Can cause suffocation.

Acute toxicity:
Oral LD50 (mice): 3700 ug/kg

Chronic effects: Repeated or prolonged skin contact may lead to irritant contact dermatitis - 'cyanide rash' - characterised by itching and skin eruptions. Chronic and subchronic exposure to cyanide is known to induce thyroid effects due to the cyanide metabolite, thiocyanate. Thiocyanate adversely affects the thyroid gland via competitive inhibition of iodide uptake and perturbation of the homeostatic feedback mechanisms that regulate the synthesis and secretion of essential thyroid hormones.

12. ECOLOGICAL INFORMATION

Ecotoxicity Avoid contaminating waterways.

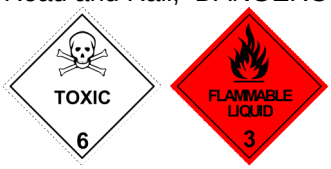
Aquatic toxicity: Very toxic to aquatic organisms. May cause long term adverse effects in the aquatic environment.

13. DISPOSAL CONSIDERATIONS

Disposal methods:
Refer to Waste Management Authority. Waste treatment is essential.

14. TRANSPORT INFORMATION

Road and Rail Transport
Classified as Dangerous Goods by the criteria of the Australian Dangerous Goods Code (ADG Code) for Transport by Road and Rail; DANGEROUS GOODS.



UN No:	1051
Transport Hazard Class:	6.1 Toxic
Subrisk 1:	3 Flammable Liquid
Packing Group:	I
Proper Shipping Name or Technical Name:	HYDROGEN CYANIDE, STABILIZED
Hazchem or Emergency Action Code:	2WE

Marine Transport
Classified as Dangerous Goods by the criteria of the International Maritime Dangerous Goods Code (IMDG Code) for transport by sea; DANGEROUS GOODS.

UN No:	1051
Transport Hazard Class:	6.1 Toxic
Subrisk 1:	3 Flammable liquid
Packing Group:	I
Proper Shipping Name or Technical Name:	HYDROGEN CYANIDE, STABILIZED
IMDG EMS Fire:	F-E
IMDG EMS Spill:	S-D
Marine Pollutant	Yes

Air Transport
Classified as Dangerous Goods by the criteria of the International Air Transport Association (IATA) Dangerous Goods Regulations for transport by air; DANGEROUS GOODS.
TRANSPORT PROHIBITED under the International Air Transport Association (IATA) Dangerous Goods Regulations for transport by air in Passenger and Cargo Aircraft, and Cargo Aircraft Only.

UN No:	1051
Transport Hazard Class:	6.1 Toxic
Subrisk 1:	3 Flammable Liquid
Packing Group:	I
Proper Shipping Name or Technical Name:	HYDROGEN CYANIDE, STABILIZED

Special precautions for user: Hydrogen cyanide (HCN) gas is a decomposition product of sodium cyanide. The above dangerous goods classification indicates that HCN is a compressed gas and could be present as a liquid. HCN liquid nor HCN compressed gas are sold or used by Ixom Operations Pty Ltd.

15. REGULATORY INFORMATION

Classification:
This material is hazardous according to Safe Work Australia; HAZARDOUS SUBSTANCE.

Classification of the substance or mixture:
Flammable liquids - Category 1
Acute Oral Toxicity - Category 1
Acute Dermal Toxicity - Category 1
Acute Inhalation Toxicity - Category 1
Specific target organ toxicity (single exposure) - Category 1

The following health/environmental hazard categories fall outside the scope of the Workplace Health and Safety Regulations:
Acute Aquatic Toxicity - Category 1
Chronic Aquatic Toxicity - Category 1

Hazard Statement(s):
H224 Extremely flammable liquid and vapour.
H300+H310+H330 Fatal if swallowed, in contact with skin or if inhaled.
H370 Causes damage to organs.

Poisons Schedule (SUSMP): S7 Dangerous Poison.

This material is listed on the Australian Inventory of Chemical Substances (AICS).

16. OTHER INFORMATION

Worksafe Australia Cyanide Poisoning; National Occupational Health and Safety Commission; Australian Government Publishing Service, 1989.
`Registry of Toxic Effects of Chemical Substances'. Ed. D. Sweet, US Dept. of Health & Human Services: Cincinatti, 2014.
US EPA Tox review of HCN and CN-salts 2010-09.

This safety data sheet has been prepared by Ixom Operations Pty Ltd Toxicology & SDS Services.

Reason(s) for Issue:
Change in company details

This SDS summarises to our best knowledge at the date of issue, the chemical health and safety hazards of the material and general guidance on how to safely handle the material in the workplace. Since Ixom Operations Pty Ltd cannot anticipate or control the conditions under which the product may be used, each user must, prior to usage, assess and control the risks arising from its use of the material.

If clarification or further information is needed, the user should contact their Ixom representative or Ixom Operations Pty Ltd at the contact details on page 1.

Ixom Operations Pty Ltd's responsibility for the material as sold is subject to the terms and conditions of sale, a copy of which is available upon request.

Isobutylene

Safety Data Sheet P-4614

according to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Date of issue: 01/01/1979 Revision date: 02/27/2015 Supersedes: 12/01/2009

SECTION: 1. Product and company identification

1.1. Product identifier

Product form	:	Substance
Name	:	Isobutylene
CAS No	:	115-11-7
Formula	:	C4H8 / CH2=C(CH3)2
Other means of identification	:	Isobutene

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture	:	Industrial use. Use as directed.

1.3. Details of the supplier of the safety data sheet

Praxair, Inc.
39 Old Ridgebury Road
Danbury, CT 06810-5113 - USA
T 1-800-772-9247 (1-800-PRAXAIR) - F 1-716-879-2146
www.praxair.com

1.4. Emergency telephone number

Emergency number	:	Onsite Emergency: 1-800-645-4633 CHEMTREC, 24hr/day 7days/week — Within USA: 1-800-424-9300, Outside USA: 001-703-527-3887 (collect calls accepted, Contract 17729)

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification (GHS-US)

Flam. Gas 1 H220
Liquefied gas H280

2.2. Label elements

GHS-US labeling

Hazard pictograms (GHS-US) :

GHS02 GHS04

Signal word (GHS-US) : DANGER

Hazard statements (GHS-US) :
H220 - EXTREMELY FLAMMABLE GAS
H280 - CONTAINS GAS UNDER PRESSURE; MAY EXPLODE IF HEATED
OSHA-H01 - MAY DISPLACE OXYGEN AND CAUSE RAPID SUFFOCATION.
CGA-HG04 - MAY FORM EXPLOSIVE MIXTURES WITH AIR
CGA-HG01 - MAY CAUSE FROSTBITE.

Precautionary statements (GHS-US) :
P202 - Do not handle until all safety precautions have been read and understood
P210 - Keep away from Heat, Open flames, Sparks, Hot surfaces. - No smoking
P271+P403 - Use and store only outdoors or in a well-ventilated place.
P377 - Leaking gas fire: Do not extinguish, unless leak can be stopped safely
P381 - Eliminate all ignition sources if safe to do so
CGA-PG05 - Use a back flow preventive device in the piping.
CGA-PG12 - Do not open valve until connected to equipment prepared for use.
CGA-PG06 - Close valve after each use and when empty.
CGA-PG11 - Never put cylinders into unventilated areas of passenger vehicles.
CGA-PG02 - Protect from sunlight when ambient temperature exceeds 52°C (125°F).

2.3. Other hazards

Other hazards not contributing to the classification : None.

2.4. Unknown acute toxicity (GHS-US)

No data available

SECTION 3: Composition/information on ingredients

3.1. Substance

Name	Product identifier	%
Isobutylene (Main constituent)	(CAS No) 115-11-7	100

3.2. Mixture

Not applicable

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures after inhalation : Immediately remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, qualified personnel may give oxygen. Call a physician.

First-aid measures after skin contact : For exposure to liquid, immediately warm frostbite area with warm water not to exceed 105°F (41°C). Water temperature should be tolerable to normal skin. Maintain skin warming for at least 15 minutes or until normal coloring and sensation have returned to the affected area. In case of massive exposure, remove clothing while showering with warm water. Seek medical evaluation and treatment as soon as possible.

First-aid measures after eye contact : Immediately flush eyes thoroughly with water for at least 15 minutes. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly. Contact an ophthalmologist immediately.

First-aid measures after ingestion : Ingestion is not considered a potential route of exposure.

4.2. Most important symptoms and effects, both acute and delayed

No additional information available

4.3. Indication of any immediate medical attention and special treatment needed

None.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : Carbon dioxide, Dry chemical, Water spray or fog.

5.2. Special hazards arising from the substance or mixture

Fire hazard : EXTREMELY FLAMMABLE GAS. If venting or leaking gas catches fire, do not extinguish flames. Flammable vapors may spread from leak, creating an explosive reignition hazard. Vapors can be ignited by pilot lights, other flames, smoking, sparks, heaters, electrical equipment, static discharge, or other ignition sources at locations distant from product handling point. Explosive atmospheres may linger. Before entering an area, especially a confined area, check the atmosphere with an appropriate device.

Explosion hazard : EXTREMELY FLAMMABLE GAS. Forms explosive mixtures with air and oxidizing agents.

Reactivity : No reactivity hazard other than the effects described in sub-sections below.

5.3. Advice for firefighters

Firefighting instructions : **DANGER: FLAMMABLE LIQUID AND VAPOR.** Evacuate all personnel from danger area. Use self-contained breathing apparatus. Immediately cool surrounding containers with water spray from maximum distance, taking care not to extinguish flames. Avoid spreading burning liquid with water. Remove ignition sources if safe to do so. If flames are accidentally extinguished, explosive reignition may occur. Reduce vapors with water spray or fog. Stop flow of liquid if safe to do so, while continuing cooling water spray. Remove all containers from area of fire if safe to do so. Allow fire to burn out. On-site fire brigades must comply with OSHA 29 CFR 1910.156 and applicable standards under 29 CFR 1919 Subpart L - Fire Protection.

Special protective equipment for fire fighters : Standard protective clothing and equipment (Self Contained Breathing Apparatus) for fire fighters.

Other information : Containers are equipped with a pressure relief device. (Exceptions may exist where authorized by DOT.).

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures : **DANGER: Flammable liquid and gas under pressure.** Forms explosive mixtures with air. Immediately evacuate all personnel from danger area. Use self-contained breathing apparatus where needed. Remove all sources of ignition if safe to do so. Reduce vapors with fog or fine water spray, taking care not to spread liquid with water. Shut off flow if safe to do so. Ventilate area or move container to a well-ventilated area. Flammable vapors may spread from leak and could explode if reignited by sparks or flames. Explosive atmospheres may linger. Before entering area, especially confined areas, check atmosphere with an appropriate device.

6.1.1. For non-emergency personnel

No additional information available

6.1.2. For emergency responders

No additional information available

6.2. Environmental precautions

Try to stop release. Prevent waste from contaminating the surrounding environment. Prevent soil and water pollution. Dispose of contents/container in accordance with local/regional/national/international regulations. Contact supplier for any special requirements.

6.3. Methods and material for containment and cleaning up

No additional information available

6.4. Reference to other sections

See also sections 8 and 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling : Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Use only non-sparking tools. Use only explosion-proof equipment.

Wear leather safety gloves and safety shoes when handling cylinders. Protect cylinders from physical damage; do not drag, roll, slide or drop. While moving cylinder, always keep in place removable valve cover. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders. Never insert an object (e.g., wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. Slowly open the valve. If the valve is hard to open, discontinue use and contact your supplier. Close the container valve after each use; keep closed even when empty. Never apply flame or localized heat directly to any part of the container. High temperatures may damage the container and could cause the pressure relief device to fail prematurely, venting the container contents. For other precautions in using this product, see section 16.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions : Store only where temperature will not exceed 125°F (52°C). Post "No Smoking or Open Flames" signs in storage and use areas. There must be no sources of ignition. Separate packages and protect against potential fire and/or explosion damage following appropriate codes and requirements (e.g., NFPA 30, NFPA 55, NFPA 70, and/or NFPA 221 in the U.S.) or according to requirements determined by the Authority Having Jurisdiction (AHJ). Always secure containers upright to keep them from falling or being knocked over. Install valve protection cap, if provided, firmly in place by hand when the container is not in use. Store full and empty containers separately. Use a first-in, first-out inventory system to prevent storing full containers for long periods. For other precautions in using this product, see section 16.

OTHER PRECAUTIONS FOR HANDLING, STORAGE, AND USE: When handling product under pressure, use piping and equipment adequately designed to withstand the pressures to be encountered. Never work on a pressurized system. Use a back flow preventive device in the piping. Gases can cause rapid suffocation because of oxygen deficiency; store and use with adequate ventilation. If a leak occurs, close the container valve and blow down the system in a safe and environmentally correct manner in compliance with all international, federal/national, state/provincial, and local laws; then repair the leak. Never place a container where it may become part of an electrical circuit.

7.3. Specific end use(s)

None.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Isobutylene (115-11-7)		
ACGIH	ACGIH TLV-TWA (ppm)	250 ppm

8.2. Exposure controls

Appropriate engineering controls : Use an explosion-proof local exhaust system. Local exhaust and general ventilation must be adequate to meet exposure standards. MECHANICAL (GENERAL): Inadequate - Use only in a closed system. Use explosion proof equipment and lighting.

Eye protection : Wear safety glasses when handling cylinders; vapor-proof goggles and a face shield during cylinder changeout or whenever contact with product is possible. Select eye protection in accordance with OSHA 29 CFR 1910.133.

Skin and body protection : Wear metatarsal shoes and work gloves for cylinder handling, and protective clothing where needed. Wear neoprene gloves during cylinder changeout or wherever contact with product is possible. Select per OSHA 29 CFR 1910.132, 1910.136, and 1910.138.

Respiratory protection : When workplace conditions warrant respirator use, follow a respiratory protection program that meets OSHA 29 CFR 1910.134, ANSI Z88.2, or MSHA 30 CFR 72.710 (where applicable). Use an air-supplied or air-purifying cartridge if the action level is exceeded. Ensure that the respirator has the appropriate protection factor for the exposure level. If cartridge type respirators are used, the cartridge must be appropriate for the chemical exposure (e.g., an organic vapor cartridge). For emergencies or instances with unknown exposure levels, use a self-contained breathing apparatus (SCBA).

Thermal hazard protection : Wear cold insulating gloves when transfilling or breaking transfer connections.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state : Gas

Molecular mass : 56 g/mol

Color : Colorless.

Odor : Sweetish.

Odor threshold : Odor threshold is subjective and inadequate to warn for overexposure.

pH : Not applicable.

Relative evaporation rate (butyl acetate=1) : No data available

Relative evaporation rate (ether=1) : Not applicable.

Melting point : -140.3 °C

Freezing point : No data available

Boiling point	:	-6.9 °C
Flash point	:	-80 °C (closed cup)
Critical temperature	:	144 °C
Auto-ignition temperature	:	465 °C
Decomposition temperature	:	No data available
Flammability (solid, gas)	:	1.8 - 8.8 vol %
Vapor pressure	:	260 kPa
Critical pressure	:	4000 kPa
Relative vapor density at 20 °C	:	No data available
Relative density	:	0.63
Specific gravity / density	:	0.599 g/cm³ (at 20 °C)
Relative gas density	:	2
Solubility	:	Water: 388 mg/l
Log Pow	:	2.35
Log Kow	:	Not applicable.
Viscosity, kinematic	:	Not applicable.
Viscosity, dynamic	:	Not applicable.
Explosive properties	:	Not applicable.
Oxidizing properties	:	None.
Explosive limits	:	No data available

9.2. Other information

Gas group	:	Liquefied gas
Additional information	:	Gas/vapor heavier than air. May accumulate in confined spaces, particularly at or below ground level.

SECTION 10: Stability and reactivity

10.1. Reactivity

No reactivity hazard other than the effects described in sub-sections below.

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

May occur.

10.4. Conditions to avoid

High temperature. Catalyst.

10.5. Incompatible materials

Halogens. Oxidizing agents. Acids.

10.6. Hazardous decomposition products

Thermal decomposition may produce : Carbon monoxide. Carbon dioxide.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity : Not classified

Isobutylene (\f)115-11-7	
LC50 inhalation rat (mg/l)	620 mg/l/4h
LC50 inhalation rat (ppm)	≥ 10000
ATE US (gases)	10000.000 ppmV/4h
ATE US (vapors)	620.000 mg/l/4h
ATE US (dust, mist)	620.000 mg/l/4h

Skin corrosion/irritation : Not classified

pH: Not applicable.

Serious eye damage/irritation : Not classified

pH: Not applicable.

Respiratory or skin sensitization : Not classified

Germ cell mutagenicity : Not classified

Carcinogenicity : Not classified

Isobutylene (115-11-7)	
National Toxicology Program (NTP) Status	1 - Evidence of Carcinogenicity

Reproductive toxicity : Not classified

Specific target organ toxicity (single exposure) : Not classified

Specific target organ toxicity (repeated exposure) : Not classified

Aspiration hazard : Not classified

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general : No known ecological damage caused by this product.

12.2. Persistence and degradability

Isobutylene (115-11-7)	
Persistence and degradability	The substance is biodegradable. Unlikely to persist.

12.3. Bioaccumulative potential

Isobutylene (115-11-7)	
Log Pow	2.35
Log Kow	Not applicable.
Bioaccumulative potential	Not expected to bioaccumulate due to the low log Kow (log Kow < 4). Refer to section 9.

12.4. Mobility in soil

Isobutylene (115-11-7)	
Mobility in soil	No data available.
Ecology - soil	Because of its high volatility, the product is unlikely to cause ground or water pollution.

12.5. Other adverse effects

Effect on ozone layer : None.

Effect on the global warming : No known effects from this product.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste disposal recommendations : Do not attempt to dispose of residual or unused quantities. Return container to supplier.

SECTION 14: Transport information

In accordance with DOT

Transport document description : UN1055 Isobutylene, 2.1

UN-No.(DOT) : UN1055

Proper Shipping Name (DOT) : Isobutylene

Department of Transportation (DOT) Hazard Classes : 2.1 - Class 2.1 - Flammable gas 49 CFR 173.115

Hazard labels (DOT) : 2.1 - Flammable gas

DOT Special Provisions (49 CFR 172.102) : 19 - For domestic transportation only, the identification number UN1075 may be used in place of the identification number specified in column (4) of the 172.101 table. The identification number used must be consistent on package markings, shipping papers and emergency response information.
T50 - When portable tank instruction T50 is referenced in Column (7) of the 172.101 Table, the applicable liquefied compressed gases are authorized to be transported in portable tanks in accordance with the requirements of 173.313 of this subchapter.

Additional information

Emergency Response Guide (ERG) Number : 115 (UN1055)

Other information : No supplementary information available.

Special transport precautions : Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. Before transporting product containers: - Ensure there is adequate ventilation. - Ensure that containers are firmly secured. - Ensure cylinder valve is closed and not leaking. - Ensure valve outlet cap nut or plug (where provided) is correctly fitted. - Ensure valve protection device (where provided) is correctly fitted.

Transport by sea

UN-No. (IMDG) : 1055

Proper Shipping Name (IMDG) : ISOBUTYLENE

Class (IMDG) : 2 - Gases

MFAG-No : 115

Air transport

UN-No.(IATA) : 1055

Proper Shipping Name (IATA) : Isobutylene

Class (IATA) : 2

Civil Aeronautics Law : Gases under pressure/Gases flammable under pressure

SECTION 15: Regulatory information

15.1. US Federal regulations

Isobutylene (115-11-7)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	
SARA Section 311/312 Hazard Classes	Immediate (acute) health hazard Delayed (chronic) health hazard Sudden release of pressure hazard Fire hazard

15.2. International regulations

CANADA

Isobutylene (115-11-7)
Listed on the Canadian DSL (Domestic Substances List)

EU-Regulations

Isobutylene (115-11-7)
Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

15.2.2. National regulations

Isobutylene (115-11-7)
Listed on the AICS (Australian Inventory of Chemical Substances) Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China) Listed on the Japanese ENCS (Existing & New Chemical Substances) inventory Listed on the Korean ECL (Existing Chemicals List) Listed on NZIoC (New Zealand Inventory of Chemicals) Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances)

15.3. US State regulations

Isobutylene(115-11-7)	
U.S. - California - Proposition 65 - Carcinogens List	No
U.S. - California - Proposition 65 - Developmental Toxicity	No
U.S. - California - Proposition 65 - Reproductive Toxicity - Female	No
U.S. - California - Proposition 65 - Reproductive Toxicity - Male	No
State or local regulations	U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List

SECTION 16: Other information

Revision date : 2/27/2015 12:00:00 AM

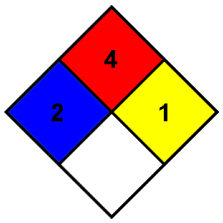
Other information : When you mix two or more chemicals, you can create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an industrial hygienist or other trained person when you evaluate the end product. Before using any plastics, confirm their compatibility with this product.

Praxair asks users of this product to study this SDS and become aware of the product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this SDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.

The opinions expressed herein are those of qualified experts within Praxair, Inc. We believe that the information contained herein is current as of the date of this Safety Data Sheet. Since the use of this information and the conditions of use are not within the control of Praxair, Inc., it is the user's obligation to determine the conditions of safe use of the product.

Praxair SDSs are furnished on sale or delivery by Praxair or the independent distributors and suppliers who package and sell our products. To obtain current SDSs for these products, contact your Praxair sales representative, local distributor, or supplier, or download from www.praxair.com. If you have questions regarding Praxair SDSs, would like the document number and date of the latest SDS, or would like the names of the Praxair suppliers in your area, phone or write the Praxair Call Center (Phone: 1-800-PRAXAIR/1-800-772-9247; Address: Praxair Call Center, Praxair, Inc., P.O. Box 44, Tonawanda, NY 14151-0044).

NFPA health hazard	: 2 - Intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt medical attention is given.
NFPA fire hazard	: 4 - Will rapidly or completely vaporize at normal pressure and temperature, or is readily dispersed in air and will burn readily.
NFPA reactivity	: 1 - Normally stable, but can become unstable at elevated temperatures and pressures or may react with water with some release of energy, but not violently.



HMIS III Rating

Health	: 1 Slight Hazard - Irritation or minor reversible injury possible
Flammability	: 4 Severe Hazard
Physical	: 2 Moderate Hazard

SDS US (GHS HazCom 2012) - Praxair

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

Ascent Battery Supply, LLC
925 Walnut Ridge Drive
Hartland, Wisconsin 53029

Safety Data Sheet (SDS) — Lithium-Ion (Li-Ion) Batteries

The information and recommendations below are believed to be accurate at the date of document preparation. Ascent Battery Supply makes no warranty or merchantability or any other warranty, express or implied, with respect to this information and assumes no liability resulting from its use. This SDS provides guidelines for safe use and handling of product. It does not, and cannot, advise all possible situations. All specific uses of this product must be evaluated by the end user to determine if additional safety precautions should be taken.

SECTION 1 - IDENTIFICATION

Product Name	Lithium-Ion Battery
Common Name(s)	Li-Ion Battery
Synonyms	Lithiated Cobalt Oxide; Li-Ion Secondary Battery; Li-Ion Rechargeable Battery
DOT Description	Dry Battery
Chemical Name	Lithium-Ion
Distributed By	Ascent Battery Supply, LLC 925 Walnut Ridge Drive
Address	Hartland, Wisconsin 53029
Emergency Number	INFOTRAC (800) 535-5053
Overseas Emergency Number	INFOTRAC (352) 323-3500 (Collect)

SECTION 2 – HAZARD(S)

Unusual Fire and Explosion Hazards

Cells or batteries may flame or leak potentially hazardous organic vapors if exposed to excessive heat, fire or short circuit condition. Damaged or opened cells or batteries can result in rapid heating and the release of flammable vapors. Vapors may be heavier than air and may travel along the ground or be moved by ventilation to an ignition source and flash back.

SECTION 3 – COMPOSITION

Chemical Name	CAS No.	Percentage %
Lithium Cobalt Oxide	12190-79-3	25-40
Iron	7439-89-6	15-25
Aluminum	7429-90-5	2-6
Graphite: Natural Graphite: Artificial	7782-42-5 7740-44-0	10-20
Copper	7440-50-8	5-15
Organic Electrolyte		10-20

SECTION 4 – FIRST AID MEASURES

For Li-Ion Chemicals:

Inhalation — Get fresh air. If symptoms persist seek medical attention

Eyes and Skin — **Skin:** Flush with copious quantities of flowing lukewarm water for a minimum of 15 minutes; wash with soap and water.

Eyes: Flush with copious quantities of flowing lukewarm water for a minimum of 15 minutes; get immediate medical attention.

Ingestion — Ingestion of battery chemicals can be harmful. Call The National Battery Ingestion Hotline (202-625-3333) 24 hours a day, for procedures treating ingestion of chemicals. Dilute with plenty of water, do not induce vomiting, and seek immediate medical attention.

SECTION 5 – FIRE-FIGHTING MEASURES

Extinguisher Media — Use water, foam or dry powder

Special Fire Fighting Procedures — Use a positive pressure self-contained breathing apparatus if batteries are involved in a fire. Full protective clothing is necessary. During water application, caution is advised as burning pieces of flammable particles may be ejected from the fire.

SECTION 6 – ACCIDENTAL RELEASE MEASURES

Damaged batteries that are *NOT* hot or burning should be placed in a sealed plastic bag or plastic-lined metal container. Chemical resistance gloves must be used to handle all battery components.
If cells rupture and a thermal event follows: using shovel or broom, cover battery or spilled substances with dry sand or vermiculite, place in approved container (after cooling if necessary) and dispose in accordance with local regulations.

SECTION 7 – HANDLING AND STORAGE

1. Use only approved chargers and charging procedures.
2. Do not disassemble a battery or bypass any safety device.
3. Batteries should be separated from other materials and stored in a non-combustible, well-ventilated, sprinkler-protected structure with sufficient clearance between walls and battery stacks.
4. Do not place batteries near heating equipment; do not expose to direct sunlight for extended periods.
5. Do not store batteries above 60 °C or below -32°C. Store batteries in a cool (below 21°C (70°F)), dry area that is subject to little temperature change. Elevated temperatures can result in reduced battery service life. Battery exposure to temperatures in excess of 130°C will result in the battery venting flammable liquid and gases.
6. Do not store batteries in a manner that allows terminals to short circuit.

SECTION 8 – EXPOSURE/PERSONAL PROTECTION

Respiratory Protection	None required under normal handling conditions; see also *Section 5 – Fire Fighting Measures*.
Gloves	Wear chemical resistant gloves if cell is ruptured, corroded, or leaking materials.
Safety Glasses	Always wear safety glasses with working with battery cells.

SECTION 9 – PHYSICAL/CHEMICAL PROPERTIES

Boiling Point	N/A	**Melting Point**	N/A
Vapor Pressure	N/A	**Vapor Density**	N/A
Specific Gravity	N/A	**Evaporation Rate**	N/A
Solubility in Water	N/A	**Appearance and Odor**	Geometric, solid object

SECTION 10 – STABILITY & REACTIVITY

Reactivity in Water	N/A	**Auto-Ignition Temperature**	N/A
Flash Point	N/A	**Flammable Limits in Air, by vol.**	N/A
Percent Volatile By Volume	N/A		
Stable	Avoid electrically shorting the cell and prolonged exposure to humid conditions. See also *Section 7 – Handling and Storage*.		
Incompatibility (materials to avoid)	N/A		

SECTION 11 – TOXICOLOGICAL INFORMATION

Threshold Limit Value	Exposure limit of $LiCoO_2$ = 0.1mg/m^3 (OSHA)
Signs and Symptoms of Exposure	None. (In fire or rupture situations, refer to sections 4, 5, & 8.)
Medical Conditions Generally Caused by Exposure	Chemicals may cause burns to skin, eyes, gastrointestinal tract and mucous membranes.
Routes of Entry	Skin, Eyes, Ingestion (swallowing), Inhalation (fumes)

SECTION 12 – ECOLOGICAL INFORMATION

Hazardous Decomposition Products	None under normal conditions. During Fire: combustible vapors (including CO), formation of Hydrogen fluoride (HF) and phosphorous oxides. Reaction with Water: may produce irritant Hydrogen fluoride (HF)
Hazardous Polymerization	Will not occur

When properly used and disposed, these batteries are not hazardous to the environment. Do not carelessly discard. Never discard Li-Ion batteries into a fire. Dispose of properly or recycle.

SECTION 13 - DISPOSAL

1. When completely discharged, Li-Ion batteries have no hazardous waste characteristics and can be landfilled.
2. This product does not contain any materials listed by the EPA as requiring specific waste disposal procedures.
3. When disposing of large quantities of Li-Ion batteries or cells, consult local/state/federal guidelines.
4. Fully discharge the battery and tape/cap terminals prior to disposal.

SECTION 14 – TRANSPORT

Product is shipped as:

Ground (DOT)	Air (IATA/ICAO)	Sea (IMDG)
Non-Hazardous by ground UN3480	Lithium ion Batteries – Not restricted UN3480	Lithium ion Batteries – Not restricted

Special Shipping Information: These batteries have been tested to Section 38.3 of the "UN Manual of Test and Criteria"

SECTION 15 – REGULATORY INFORMATION

IATA-DRG Air transportation – Packing instruction 965 Section II, IATA Dangerous Goods 51st Edition
IMO-IMDG Sea transportation
DOT 49 Code of Federal Regulations (USA)

SECTION 16 - OTHER

Document Control No:	SDS20004 – Ascent SDS for Lithium-Ion Batteries	Revision:	1	Effective Date:	07/23/13

SAFETY DATA SHEET

This Safety Data Sheet (SDS) complies with the United Nations Globally Harmonized System (GHS) of Classification and Labeling, Second revised Edition.

1. Product and Supplier Identification

Product Name: Methanol
GHS Product Identifier: Methanol
CAS Number: 67-56-1
REACH Registration Number: 01-2119433307-44-0031: 01-2119433307-44-0030, for access to the REACH SDS please access it via www.methanex.com

Recommended Use: Solvent, fuel, feedstock

Restrictions on Use: Do not use in a confined area without proper ventilation. Contact lenses may cause further damage in case of splash into eye. Avoid use near heat, flames, sparks, and other sources of ignition.

Product: **Synonyms:**	**Methanol (CH_3OH)** Methyl alcohol, methyl hydrate, wood spirit, methyl hydroxide	**EMERGENCY NUMBERS**
Company Identification:	**Methanex NZ Ltd** **409 Main North Road, SH3** **Motunui** **Private Bag 2011** **New Plymouth – 4342** **New Zealand** **Tel. #: (646)7549700**	**Methanex NZ Tel.#** **0800 361 230** **National Poisons Centre Tel.#** **0800-POISON** **(0800-764-766)** www.poisons.co.nz

2. Hazards Identification

Dangerous Goods: Class3, Subsidiary Risk 6.1, Packing Group II

Classification

Acute Toxicity (Inhalation)	Category 2
Acute Toxicity (Oral, Dermal)	Category 3
Eye Damage/Irritation	Category 1
Skin Corrosion/Irritation	Category 1
Skin Sensitization	Category 1
Germ Cell Mutagenicity	Category 2
Carcinogenicity	Category 1B
Toxic to Reproduction	Category 2
Specific Target Organ Toxicity (Repeated Exposure)	Category 2
Flammable Liquid	Category 2
Toxic to the Aquatic Environment-Acute Hazard	Category 2

*GHS Classification as determined by OSHA, 2011

Hazardous Substance (HSNO) classification

Flammable Liquid	Category 3.1B
Oral, Inhalation, Dermal	Category 6.1C
Eye Irritant	Category 6.4A
Reproductive/ Developmental Toxicant	Category 6.8B
Target Organ Toxicant	Category 6.9A
Terrestrial Vertebrate Ecotoxicity	Category 9.3C

Label:

GHS02 GHS06 GHS08

Hazard Communication:

DANGER! Highly flammable liquid and vapour. Fatal if inhaled. Toxic if swallowed. Toxic in contact with skin. Causes serious eye damage. May be fatal if swallowed.

WARNING! May cause damage to central nervous system through prolonged or repeated exposure.

Hazards and Precautions:

Colourless liquid, with a mild, characteristic alcohol odour when pure. Crude methanol may have a repulsive, pungent odour. Hygroscopic (moisture absorbing).

Keep away from heat/sparks/open flames/hot surfaces. — No smoking. Keep container tightly closed. Ground/bond container and receiving equipment. Use explosion-proof electrical/ventilating/lighting equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Wear protective gloves/protective clothing/eye protection/face protection. Do not breathe dust/fume/gas/mist/vapours/spray. Use only outdoors or in a well-ventilated area. Wear respiratory protection. Wear protective gloves/protective clothing/eye protection/face protection. Wash hands thoroughly after handling. Do not eat, drink or smoke when using this product. Avoid breathing dust/fume/gas/mist/vapours/spray. Contaminated work clothing should not be allowed out of the workplace. Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Use personal protective equipment as required.

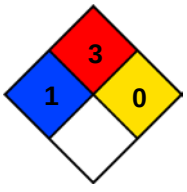
FLAMMABLE LIQUID AND VAPOUR: Burns with a clean, clear flame, which is almost invisible in daylight, or a light blue flame. Can decompose at high temperatures forming carbon monoxide and formaldehyde. Confined space toxicity hazard. Mild central nervous system depressant following inhalation, skin absorption or ingestion. May cause headache, nausea, dizziness, drowsiness, and un-coordination. Severe vision effects, including increased sensitivity to light, blurred vision, and blindness may develop following an 8-24 hour symptom-free period. Coma and death may result.

IRRITANT: Causes eye irritation. Aspiration hazard. Swallowing or vomiting of the liquid may result in aspiration (breathing) into the lungs.

POSSIBLE REPRODUCTIVE HAZARD*:* May cause fetotoxic (toxic to the fetus during the latter stages of pregnancy, often through the placenta) and teratogenic effects (causing malformations of the fetus), based on animal information.

IF SWALLOWED: Call the National Posions Centre or doctor/physician immediately. Rinse mouth. Do not induce vomiting.Get medical advice/attention if you have been exposed or feel unwell after handling this product.

NFPA Ratings (Health, Fire, Reactivity): 1, 3, 0



3. Composition

Component	% (w/w)	Exposure Limits (ACGIH)*	LD_{50}	LC_{50}
Methanol (CAS 67-56-1)	99-100	ACGIH* TLV-TWA: 200 ppm, skin TLV-STEL: 250 ppm, skin PEL-TWA: 200 ppm, skin PEL-STEL: 250 ppm, skin IDLH: 6000 ppm, acute inhalation toxicity to animals TLV Basis, critical effects: neuropathy, vision, central nervous system(CNS)	5628 mg/kg (oral/rat) 15800 mg/kg (dermal/ rabbit)	64000 ppm (inhalation/rat)

*ACGIH, American Conference of Governmental Industrial Hygienists.

Exposure limits may vary from time to time and from one jurisdiction to another. Check with local regulatory agency for the exposure limits in your area.

4. First Aid Measures

Suitable First Aid Actions	
Eye Contact	Remove contact lenses if worn. In case of contact, immediately flush eyes with plenty of clean running water for at least 15 minutes, lifting the upper and lower eyelids occasionally. Obtain medical attention.
Skin Contact	In case of contact, remove contaminated clothing. In a shower, wash affected areas with soap and water for at least 15 minutes. Seek medical attention if irritation occurs or persists. Wash clothing before reuse.
Inhalation	Remove to fresh air, restore or assist breathing if necessary. Obtain medical attention. Call the National Poisons Centre.
Ingestion	Swallowing methanol is potentially life threatening. Onset of symptoms may be delayed for 18 to 24 hours after digestion. If conscious and medical aid is not immediately available, do not induce vomiting. In actual or suspected cases of ingestion, transport to medical facility immediately. Call the National Poisons Centre.

NOTE TO PHYSICIAN: Acute exposure to methanol, either through ingestion or breathing high airborne concentrations can result in symptoms appearing between 40 minutes and 72 hours after exposure. Symptoms and signs are usually limited to the Central Nervous System (CNS), eyes and gastrointestinal tract. Because of the initial CNS's effects of headache, vertigo, lethargy and confusion, there may be an impression of ethanol intoxication. Blurred vision, decreased acuity and photophobia are common complaints. Treatment with ipecac or lavage is indicated in any patient presenting within two hours of ingestion. A profound metabolic acidosis occurs in severe poisoning and serum bicarbonate levels are a more accurate measure of severity than serum methanol levels. Treatment protocols are available from most major hospitals and early collaboration with appropriate hospitals is recommended.

Ethanol significantly decreases the toxicity of methanol because it competes for the same metabolic enzymes, and has been used to treat methanol poisoning.

5. Fire Fighting Measures

Suitable Extinguishing Media:	
	Extinguishment Media Use
Small Fire	Dry chemical, CO_2, water spray
Large Fire	AFFF(R) (Aqueous Film Forming Foam (alcohol resistant)) type with either a 3% or 6% foam proportioning system, Water spray (see note in Unsuitable Extinguishing Media).

Unsuitable Extinguishing Media	
Foam	General purpose synthetic foams or protein foams.
Water	Water may be effective for cooling, but may not be effective for extinguishing a fire because it may not cool methanol below its flash point.

Specific Hazards	
Heat	Methanol vapours may burn with an invisible flame or clean clear flame that is almost invisible in daylight.
Products of Combustion	During a fire, toxic gases and vapours, carbon monoxide, carbon dioxide, formaldehyde may be generated.
Vapours	Vapours can accumulate in confined spaces resulting in a toxicity and flammability hazard. Vapours can flow along surfaces to distant ignition sources and flash back
Solutions	Concentrations of greater that 25% methanol in water can be ignited.
Closed Containers	Closed containers may rupture violently and suddenly release large quantities of methanol when exposed to fire or excessive heat for a sufficient period of time.
Fire/Explosion	Vapours are slightly heavier than air and may travel long distances toward sources of ignition.

Fire Fighting Instructions: Stay upwind and uphill. Isolate and restrict area access. Use fine water spray or fog to control fire spread and cool adjacent structures or containers. Contain fire control water for later disposal. Fire fighters must wear full face, positive pressure, self-contained breathing apparatus or airline and appropriate protective fire fighting clothing as per NFPA. Note that methanol fires may require proximity suits. Take care not to walk through any spilled chemical.

HAZCHEM: 2WE

6. Accidental Release Measures

Overview: Flammable liquid! Can burn without a visible flame. Release can cause an immediate risk of fire and explosion. Eliminate all ignition sources, stop leak and use absorbent materials. If necessary, contain spill by diking. Fluorocarbon alcohol resistant foams may be applied to spill to diminish vapour and fire hazard. Maximize methanol recovery for recycling or re-use. Restrict access to area until completion of cleanup. Ensure cleanup is conducted by trained personnel only. Wear adequate personal protection and remove all sources of ignition. Notify all governmental agencies as required by law.

Precautions	
Personal Protection	Full face, positive pressure self-contained breathing apparatus or airline, and protective clothing must be worn. Protective fire fighting structural clothing is not effective protection from methanol.
Environmental Precautions	Biodegrades easily in water. Methanol in fresh or salt water may have serious effects on aquatic life. A study on methanol's toxic efffects on sewage sludge bacteria reported little effect on digestion at 0.1% while 0.5% methanol retarded digestion. Methanol will be broken down to carbon dioxide and water.
Remedial Measures	Flammable liquid – release/loss of primary containment can cause an immediate fire/explosion hazard. Eliminate all sources of ignition, stop leak and use absorbent materials. Collect liquid with explosion proof pumps. Do not walk through spill product as it may be on fire and not visible.
Small Spills	Soak up spill with non-combustible absorbent material. Recover methanol and dilute with water to reduce fire hazard. Prevent spilled methanol from entering sewers, confined spaces, drains, or waterways. Restrict access to unprotected personnel. Put material in suitable, covered, labeled containers. Flush area with water.
Large Spills	If necessary, contain spill by diking. Alcohol resistant foams may be applied to spill to diminish vapour and fire hazard. Maximize methanol recovery for recycling or reuse. Collect liquid with explosion proof pumps.

Methods and materials for containment and cleaning up

Remove all sources of ignition. Use non-sparking tools. Prevent further leakage or spillage if safe to do so. Dam up. Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust). Sweep up and shovel into suitable containers for disposal. Dispose of in accordance with local regulations.

7. Handling and Storage

Precautions for Handling: No smoking or open flame in storage, use or handling areas. Use explosion proof electrical equipment. Ensure proper electrical grounding procedures are in place.

Storage: Store in totally enclosed equipment, designed to avoid ignition and human contact	
Tanks	Tanks must be grounded, vented, and should have vapour emission controls. Tanks must be diked. A flammable mixture of methanol vapour and air is possible inside a storage tank or transportation tank, and handlers should take appropriate precautions to reduce the risk of ignition. Handlers must eliminate ignition sources or purge the tank with an inert gas such as nitrogen. All equipment must be grounded - bonded when transferring product in order to avoid static discharge from the equipment, and subsequent possible fire.
Incompatible Materials	Avoid storage with incompatible materials. Anhydrous methanol is non-corrosive to most metals at ambient temperatures except for lead, nickel, monel, cast iron and high silicon iron. Coatings of copper (or copper alloys), zinc (including galvanized steel), or aluminum are unsuitable for storage. These materials may be attacked slowly by the methanol. Storage tanks of welded construction are normally satisfactory.
Design	Containers should be designed and built in conformance with good engineering practice for the material being stored. While plastics can be used for short term storage, they are generally not recommended for long-term storage due to deterioration effects and the subsequent risk of contamination.

Corrosion rates for several construction materials:

Material	Corrosion Rate
Cast iron, monel, lead, nickel	<0.508 mm/year
High silicon iron	<0.051 mm/year
Polyethylene	Some attack
Neoprene, phenolic resins, polyesters, natural rubber, butyl rubber	Satisfactory
Polyvinyl chloride, unplasticized	Resistant

8. Exposure Controls, Personal Protection

New Zealand Workplace Exposure Standards

ACGIH* TLV-TWA:	200 ppm, skin (262 mg/m^3)
TLV-STEL	250 ppm, skin (328 mg/m^3)
PEL-TWA	200 ppm, skin
PEL-STEL	250 ppm, skin
IDLH	6000 ppm, acute inhalation toxicity to animals
TLV Basis	critical effects: neuropathy, vision, central nervous system (CNS)

Exposure Controls

Engineering Controls	In confined areas, local and general ventilation should be provided to maintain airborne concentrations below permissable exposure limits. Ventilation systems must be designed according to approved engineering standards.
Respiratory Protection	NIOSH approved supplied air respirator when airborne concentrations exceed exposure limits. **Cartridge type respirators are NOT recommended.** *Emergency or Planned entry into unkown concentrations:* Respirator selection must be done by a qualified person and be based upon a risk assessment of the work activities and exposure levels. Respirator users must be fit tested and clean shaven where the respirator seals to the face. Exposure must be kept at or below the applicable exposure limits and the maximum use concentration of the respirator must not be exceeded. Positive pressure, full-facepiece self-contained breathing apparatus; or Positive pressure, full-facepiece supplied air respirator with an auxiliary positive pressure self-contained breathing apparatus should be considered.
Skin Protection	Butyl and nitrile rubbers are recommended for gloves. Check with manufacturer. Wear chemical resistant pants and jackets, preferably of butyl or nitrile rubber. Check with manufacturer.
Eye and Face Protection	Face shield and chemical splash goggles when transferring is taking place.
Footwear	Chemical resistant and as specified by the workplace.

Environmental Exposure Controls: Do not flush into surface water or sanitary sewer system.

Other: Eyewash and showers should be located near work areas. NOTE: PPE must not be considered a long-term solution to exposure control. PPE usage must be accompanied by employer programs to properly select, maintain, clean, fit and use. Consult a competent industrial hygiene resource to determine hazard potential and/or the PPE manufacturers to ensure adequate protection.

Careful consideration must be made of the added danger of the concentration being in the LEL/UEL range and so there may be a fire/explosion hazard.

9. Physical and Chemical Properties

Appearance: Liquid, clear, colourless
Odour: Mild characteristic alcohol odour
Odour Threshold: detection: 4.2 - 5960 ppm
(geometric mean) 160 ppm
recognition: 53 – 8940 ppm
(geometric mean) 690 ppm
pH: Not applicable
Freezing Point: -97.8°C
Boiling Point: 64.7°C
Boiling Range: Not determined
Flash Point: 11.0°C
Solubility: Completely soluble
Partial Coefficient: Log P (oct) = -0.82
Vapour Pressure: 12.8 kPa @ 20°C
Viscosity: 0.3 cP@ 25°C

Upper Explosive Limit (UEL): 36.5 %
Lower Explosive Limit (LEL): 6%
Auto Ignition Temperature: 464°C
Solubility in other Liquids: Soluble in all proportions in other alcohols, esters, ketones, and most other organic solvents
Critical Temperature: 239.4°C
Specific Gravity: 0.82 @ 20°C
Evaporation Rate: 4.1 (n-butyl acetate =1)
Vapour Density: 1.105 @ 15°C (air = 1)
Decomposition Temperature: Not determined
Sensitivity to Impact: No
Sensitivity to Static Charge: Low
Percent Volatility: 100

10. Stability and Reactivity

Chemical Stability: Stable as supplied.

Hazardous Reactions	Avoid contact with strong oxidizers, strong mineral or organic acids, and strong bases. Contact with these materials may cause a violent or explosive reaction.
Conditions to Avoid	Avoid contact with sparks, heat, open flame, or ignition sources.
Incompatibility	Avoid contact with strong oxidizers, strong mineral or organic acids, and strong bases. Contact with these materials may cause a violent or explosive reaction. May be corrosive to lead, aluminum, magnesium, and platinum. May react with metallic aluminum or magnesium and generate hydrogen gas. May attack some forms of plastic, rubber, and coatings.
Hazardous Decomposition Products	Formaldehyde, carbon oxides

Hazardous Polymerization: Will not occur.

11. Toxicological Information

Acute toxicity Toxic if inhaled. Toxic in contact with skin. Toxic if swallowed.

Methanol (67-56-1)	
ATE (oral)	100000 mg/kg
ATE (dermal)	300000 mg/kg

LD50/oral/rat	1187- 2769 mg/kg
LD50/dermal/rabbit	17000 mg/kg
LC50/inhalation/4h/rat	1282 mg/l/4h

Primary Routes of Entry:

Skin Contact:	Yes
Skin Absorption:	Yes
Eye Contact:	Yes
Ingestion:	Yes
Inhalation:	Yes

Emergency Overview: Colourless liquid, with a mild, characteristic alcohol odour when pure. Crude methanol may have a repulsive, pungent odour. Hygroscopic. Can decompose at high temperatures forming carbon monoxide and formaldehyde. Confined space toxicity hazard. Mild central nervous system depressant following inhalation, skin absorption or ingestion. May cause headache, nausea, dizziness, drowsiness, and incoordination. Severe vision effects, including increased sensitivity to light, blurred vision, and blindness may develop following an 8-24 hour symptom-free period. Coma and death may result. Causes eye irritation. Aspiration hazard. Swallowing or vomiting of the liquid may result in aspiration (breathing) into the lungs. May cause fetotoxic (toxic to the fetus during the latter stages of pregnancy, often through the placenta) and teratogenic effects (causing malformations of the fetus), based on animal information.

Acute Exposure:

Inhalation	Inhalation of high airborne concentrations can also irriate mucous membranes, cause headaches, sleepiness, nausea, confusion, loss of consciousness, digestive and visual disturbances and even death. NOTE: Odour threshhold of methanol is several times higher than the TLV-TWA. Depending upon severity of poisoning and the promptness of treatment, survivors may recover completely or may have permanent blindness, vision disturbances and/or nervous system effects. Concentrations in air exceeding 1000 ppm may cause irritation of the mucous membranes.
Skin Contact	Methanol is moderately irritating to the skin. Methanol can be absorbed through the skin and harmful effects have been reported by this route of entry. Effects are similar to those described in “Inhalation”.
Eye Contact	Methanol is a mild to moderate eye irritant. High vapour concentration or liquid contact with eyes causes irritation, tearing and burning.
Ingestion	Swallowing even small amounts of methanol could potentially cause blindness or death. Effects of sub lethal doses may be nausea, headache, abdominal pain, vomiting and visual disturbances ranging from blurred vision to light sensitivity.

Chronic Exposure:

Irritancy	Prolonged contact with skin may defat tissue causing dermititis or aggravate existing skin problems.
Sensitization	None reported
Carcinogenicity	Not listed by IARC, NTP, ACGIH, or OSHA as a carcinogen.
Teratogenicity	Methanol has produced fetotoxicity in rats and teratogenicity in mice exposed by inhalation to high concentrations of methanol vapours.
Reproductive Toxicity	Information available does not suggest that methanol is a reproductive toxin.
Mutagenicity	There is insufficient information available to conclude that methanol is mutagenic.
Synergistic Products	In animals, high concentrations of methanol can increase the toxicity of other chemicals, particularly liver toxins like carbon tetrachloride. Ethanol significantly reduces the toxicity of methanol because it competes for the same metabolic enzymes, and has been usd to treat methanol poisoning.
Potential for Accumulation	Methanol is readily absorbed into the body following inhalation and ingestion. Skin absorption may occur if the skin is broken or exposure is prolonged. Once absorbed, methanol is rapidly distributed to body tissues. A small amount is excreted unchanged in exhaled air and the urine. The rest is first metabolized to formaldehyde, which is then metabolized to formic acid and/or formate. The formic acid and formate are eventually converted to carbon dioxide and water. In humans, methanol clears from the body, after inhalation or oral exposure, with a half-life of 1 day or more for high doses (greater than 1000 mg/kg) or about 1.5-3 hours for low doses (less than 100 mg/kg or 76.5-230 ppm (100-300 mg/m^3).
Medical Conditions Aggravated By Exposure	Persons with pre-existing skin disorders, eye problems, respiratory conditions, or impaired liver or kidney functions may be more susceptible to the effects of this substance.

12. Ecological Information

Environmental toxicity: DO NOT discharge into sewer or waterways.

Component	**Methanol (CAS 67-56-1)**
HSNO Classification	9.3C-Harmful to terrestrial vertebrates
Log Kow	-0.82 - -0.66
Half-life (hr) air	427
Half-life (hr) H2O surface water	5.3-64
Henry's Law constant (atm m3/mol)	1.35E-04
BOD 5 if unstated	0.67-1.12
COD	1.05 -1.50,99%

ThOD	1.05
BCP	0.2 -10

LC50/96h/fish	15400 -29400 mg/l
EC50/48h/daphnia	> 10000 mg/
IC50/72h/algae	ca. 22000 mg/l Selenastrum carpricornutum (Pseudokichnerela subcapitata)

Persistence and degradability	Readily biodegradable
Bioaccumulation	Does not bioaccumulate. Partition coefficient: n-octanol/water 0.77
Mobility in Soil	Mobile in soils
PBT/vPvB	This substance is not considered to be persistent, bioaccumulating nor toxic (PBT). This substance is not considered to be very persistent nor very bioaccumulating (vPvB).
Terrestial Fate	The mobility of methanol in the subsurface will not be significantly limited by adsorption. Sorption of methanol to organic carbon in soil will be minor, and methanol will tend to remain in soil pore water.
Aquatic Fate	Methanol is completely miscible with water. Accordingly, its mobility in the subsurface will not be limited by solubility. Methanol has been shown to undergo rapid biodegradation in a variety of screening studies using sewage seed and activated sludge inoculum, which suggests that biodegradation will occur in aquatic environments where the concentration does not inhibit bacterial activity.
Atmoshere Fate	Methanol has a vapor pressure of 127 mm Hg at 25°C and is expected to exist solely as a vapor in the ambient atmosphere. Vapor-phase methanol is degraded in the atmosphere by reaction with photo chemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 17 days.
Other Adverse Affects	Do not flush into surface water or sanitary sewer system.

13. Disposal Considerations

Review federal, provincial or state, and local government requirements prior to disposal. Store material for disposal as indicated in Section #7, ***Handling and Storage***. Disposal by controlled incineration or by secure land fill may be acceptable.

Recycle wherever possible. Large volumes may be suitable for re-distillation or, if contaminated, incinerated. Can be disposed of in a sewage treatment facility. Methanol levels of up to 0.1% act as a food source for bacteria; above this level may be toxic to bacteria. When pumping through sewage collection systems, the level of methanol should be kept below the flammable range (a 25% methanol/water mixture is non-flammable at temperatures below 39°C). 1 ppm of methanol is equivalent to 1.5 ppm BOD loading in the sewage plant.

Container disposal:

Empty containers may contain hazardous residue. Return to supplier for reuse if possible. Never weld, cut or grind empty containers. If disposing of containers, ensure they are well rinsed with water, then disposed of at an authorised landfill. After cleaning, all existing labels should be removed.

14. Transport Information

Dangerous Good Segregation

This product is classification as Dangerous Good Class 3.
Please consult NZS 5433:2077 Transport of Dangerous Goods on Land for information

Land Transport:	Hazard Class: 3(6.1) UN1230, P.g.II
Air Transport:	Hazard Class: 3(6.1) Packing Group: II Packing instruction 305 1 litre maximum per package
Maritime Transport :	Hazard Class: 3(6.1) UN1230 Packing Group: II Flash Point = 12°C EmS No. F-E, S-D Stowage Category “B”, Clear of living quarters
Marine Pollutant:	No

Labels

3 - Flammable liquid
6.1 - Toxic substance

Orange plate

15. Regulatory Information

Inventory: NZCIL
Status: Listed
EPA New Zealand Approval Number: HSR001186 METHANOL
Refer to www.ermanz.govt.nz for information on Controls

HSNO CLASSIFICATIONS: 3.1B (Flammable Liquid) 6.1C (Acute Toxicity)
6.4A (Eye Irritant) 6.8B (Reproductive / Developmental Toxicant)
6.9A (Target Organ Toxicant) 9.3C (Terrestrial Vertebrate Ecotoxicity)

HSNO CONTROLS: Tigger quantities for this substance
Approved Handler Test Certificate 250 litres (>5 L containers)
500 litres (≤5 L containers)
Location Test Certificate 50 litres (open container)
100 litres (closed container >5 L)
250 litres (closed container <5 L)
Hazardous Atmosphere Zone 1 litre (open continuously)
5 litres (open occassionally) 25 litres (decanting) 100 litres (closed containers)
Emergency Management Fire Extinguishers (250 L)
Emergency Response Plan (1000 L)
Secondary Containment 1000 litres
Signage 250 litres

16. Other Information

References:

1. International Programme on Chemical Safety, Methanol, Environmental Health Criteria, World Health Organization 1997.
2. Patty's Industrial Hygiene and Toxicology, 5th Edition.
3. Fire Protection Guide to Hazardous Materials, 13th Edition.
4. Lanigan, S., Final report on the Safety Assessment of Methyl Alcohol, International Journal of Toxicology., Volume 20, Supplement 1 (2001).
5. Forsberg, K., Quick Selection Guide to Chemical Protective Clothing.
6. Nelson, B.K., Teratological assessment of Methanol and Ethanol at high inhalation levels in rats, Fundamental and Applied Toxicology, Volume 5.
7. NIOSH Guide to Chemical Hazards
8. Hazardous Substance Data Base (HSDB).
9. Cheminfo.

Original Preparation Date: February 9, 2007

Prepared by: Kel-Ex Agencies Ltd., 319 Lynn Avenue, North Vancouver, B.C., Canada, V7J 2C4

Disclaimer: The information above is believed to be accurate and represents the best information currently available to us. Users should make their own investigations to determine the suitability of the information for their particular purposes. This document is intended as a guide to the appropriate precautionary handling of the material by a properly trained person using this product.

Methanex Corporation and its subsidiaries make no representations or warranties, either express or implied, including without limitation any warranties of merchantability, fitness for a particular purpose with respect to the information set forth herein or the product to which the information refers. Accordingly, Methanex Corp. will not be responsible for damages resulting from use of or reliance upon this information.

This Safety Data Sheet may not be changed, or altered in any way without the expressed knowledge and permission of Methanex Corporation.

Revisions:
Revised and re-issued Dec 20, 2011
Revised and re-issued Dec 5, 2013

MSDS3994

▸Material Safety Data Sheet

NFPA Hazard Code(Health, Flammability, Reactivity):
HPCA Hazard Code(Health, Flammability, Reactivity):
SIC CODE 20 (Food and Kindred Products)

Date last revised: 01-01-07

I. GENERAL INFORMATION

Product Name: **EYE WASH** Sterile Isotonic Buffered Solution	Trade Name & Synonyms of Hazardous Component(s): Sterile isotonic buffered solution.
Type of Formulation: Sterile Eye Wash	Formula: On file
Manufacturer/Distributor & Address: Altaire Pharmaceuticals Inc. P.O. BOX 849 Aquebogue, NY 11931	Manufacturer's Phone Number: (631) 722-5988

II. INGREDIENTS

Principal Hazardous Component(s):	Percent:	Threshold Limit Value (units):
N/A		

III. PHYSICAL DATA

Boiling Point(F)	Specific Gravity(H_2O = 1): 1.000 - 1.025
Vapor Pressure(mm Hg.):	Percent Volatile by Volume(%): 0%
Vapor Density (Air = 1):	Evaporation Rate(_____ =1): N/A
Solubility in Water - (g/100mL)25°C= Soluble	pH 7.15 - 7.25
Appearance & Odor: Clear colorless solution.	

▸Material Safety Data Sheet

IV. FIRE & EXPLOSION HAZARD DATA

Flash Point (Test Method): N/A	Auto Ignition Temperature: Water Solution

Flammable Limits: N/A Water solution LEL: UEL:

Extinguishing Media: N/A water based solution

Special Fire Fighting Procedures: N/A water based solution

Unusual Fire & Explosion Hazards: N/A water based solution

V. HEALTH HAZARD DATA

OSHA Permissible Exposure Limits: None

ACCGIH Threshold Limit Value: None

Carcinogen - NTP Program Not listed	Carcinogen - IRAC Program Not listed

Symptoms of Exposure: None listed at this time.

Medical Conditions Aggravated by Exposure: None listed at this time.

Primary Route(s)of entry: Ingestion, inhalation, absorption through skin.

Emergency First-Aid: Contact local medical facility.

▸Material Safety Data Sheet

VI. REACTIVITY DATA

Stability: ✓ Stable ____ Unstable	Conditions to Avoid: Excessive heat or cold
Incompatibility: None listed	Materials to Avoid: None listed
Hazardous Polymerization: ____ May Occur ✓ Will Not Occur:	Conditions to Avoid: None listed beyond above.

Hazardous Decomposition Products:

VII. ENVIRONMENTAL PROTECTION PROCEDURES

Spill Response: Absorb on absorbent materials, place in disposable container.

Waste Disposal Method: Dispose as per local, state and federal environmental regulations.

VIII. SPECIAL PROTECTION INFORMATION

Eye Protection: N/A

Skin Protection: N/A

Respiratory Protection (Specific Type): N/A

Ventilation Recommended: ADEQUATE

Other Protection: None required

IX. SPECIAL PRECAUTIONS

Hygienic Practices in Handling & Storage: Avoid excessive heat and cold.

Precautions for Repair & Maintenance of Contaminated Equipment: N/A

Other Precautions: N/A

Material Safety Data Sheet

IDENTITY	**Rapid Aid Instant Cold Pack**

Section I

Manufacturer's Name **Rapid Aid Ltd.**	Emergency Telephone Number **905-820-4788**
Address **4120A Sladeview Crescent Units 1-4**	Telephone Number for Information **905-820-4788**
Mississauga, Ontario	Date Prepared **December 17, 2007**
L5L 5Z3	Signature of Preparer *(optional)*

Section II - Hazard Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	%*(optional)*
Ammonium Nitrate	N/A	10 mg/M^3	N/A	

Section III - Physical/Chemical Characteristics

Boiling Point	**Decomposes @ 350°F**	Specific Gravity (H_2O = 1)	**1.725**
Vapor Pressure (mm Hg.)	**Not applicable**	Melting Point	**Not applicable**
Vapor Density (AIR = 1)	**Not applicable**	Evaporation Rate(Butyl Acetate = 1)	**Not applicable**
Solubility in Water: **Complete**			
Appearance and Odour : **White, Odourless solid chemical with water bag**			

Section IV - Fire and Explosion Hazard Data

Flash Point (Method Used)	Flammable Limits	LEL	UEL
Not Applicable	**N/A**	**N/A**	**N/A**

Extinguishing Media

Flood and cool hot nitrate with straight stream nozzles. Do not use slat water. Water is effective in desensitizing molten or contaminated nitrate.

Special Fire Fighting Procedures

Immediately ventilate structure. Do not use spray or fog nozzles. Use straight stream nozzles to cool and desensitize molten nitrate. Respiratory protection required for fire fighting personnel. When any fire is burning out of control and water cannot safely be applied to desensitize, nitrate fire crews should withdraw a safe distance and use unmanned fire lines

Unusual Fire and Explosion Hazards

Decomposes into flammable and hazardous nitrogen oxides. As an oxidizer, it yields nitrous oxide readily to stimulate the combustion of organic matter or ether fuel. In unconfined fire situations, ammonium nitrate fertilizer creates a self-limiting effect as the endothermic effect of its dissociation into ammonia and nitric acid absorbs the heat produced by the exothermic decomposition of nitrous oxide and water vapour. Ammonium nitrate fertilizer is not explosive. Detonation potential under confinement and high temperatures, or when heated with contaminants such as organic or carbonaceous material, metallic powders, acids, or combination with copper produces tetramine cupric hydrate, a salt with high sensitivity. Zonal decomposition a possibility.

Section V - Reactivity Data

Stability	Unstable	X	Conditions to Avoid
	Stable		Heat and fire. Insensitive to impact in dry form

Incompatibility *(Materials to Avoid)*

Chemical from damaged cold pack should not be mixed with acetic acids, metals, chlorides, organic matter, phosphorous, sodium, potassium, sulphur, inorganic zinc, copper. Copper represents the greatest contamination hazard

Hazardous Decomposition or Byproducts

Hazardous oxides of nitrogen.

Hazardous Polymerization	May Occur		Conditions to Avoid
	Will Not Occur	X	Heat and fire

Section VI - Health Hazard Data

Route(s) of Entry:	Eye contact; Skin contact; Inhalation; Ingestion

Health Hazards *(Acute and Chronic)*

Dry chemical of cold pack may be an eye irritant,
Dry chemical of cold pack is a skin irritant with prolonged contact,
Dry chemical of cold pack has slight to moderate toxicity when ingested,
Minimal hazard of inhalation under normal conditions.
No health hazards when dry chemical and water are in solution.

Carcinogenicity: N/A			

Signs and Symptoms of Exposure

Eye contact with dry chemical may result in eye discomfort and aggravation..
Skin contact with dry chemical may result in mechanical discomfort and rash with prolonged contact.
Swallowing large amounts of dry chemical may have serious or even fatal effects.
Inhalation of large amounts of dry chemical dust may have serious or even fatal effects.

Medical Conditions Generally Aggravated by Exposure
Not Available

Emergency and First Aid Procedures (for dry chemical of the Cold Pack)

Eyes
If material gets into the eyes, immediately flush eyes gently with water for at least 15 minutes while holding eyelids apart.
Seek immediate medical attention.

Skin
Wash with mild soap and water.

Swallowing
DO NOT induce vomiting. If person is conscious, dilute stomach contents with 48 oz. of water and seek medical attention. Contact poison control for advise.

Inhalation
Exposure to thermal decomposition – evacuate person to fresh air, give respiratory support.
Seek immediate medical attention.

Section VII - Precautions for Safe Handling and Use

Steps to Be Taken in Case Material is Released or Spilled **Sweep up material for disposal**
Waste Disposal Method **Dispose product in trash**
Precautions to Be taken in Handling and Storing Avoid contact with incompatible materials. Avoid exposure to heat sources. Avoid contamination with organic matter. Do not store near food stuff.
Other Precautions **None**

Section VIII - Control Measures

Respiratory Proctection *(Specify Type)* Adequate to control dust		
Ventilation	Local Exhaust **Not Required**	Special **Not Required**
	Mechanical *(General)* **Not Required**	Other **Not Required**
Protective Gloves **Conventional work gloves**		Eye Protection **Safety glasses with side shields**
Other Protective Clothing or Equipment **Not Required**		
Work/Hygienic Practices **Standard**		

THE TRIAD GROUP
19355 Janacek Court
Brookfield, Wisconsin 53045
Phone: 262-641-1500
Fax: 262-641-1428
Emergency: 262-641-1500

ISSUE DATE: 6 April, 2006 | **PRODUCT:** PVP Iodine Scrub Solution

SECTION II: HAZARDOUS INGREDIENTS / IDENTITY INFORMATION

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits	%
Iodine (CAS 7553-56-2)	STEL for I_2 vapor: 0.1 ppm (ceiling)			**0.7 – 1.2%**
Glycerin (CAS 56-81-5)	10 mg/m^3 (mist)			**1.2%**

SECTION III: PHYSICAL / CHEMICAL CHARACTERISTICS

Boiling Point:	> 200° F
Vapor Pressure (mm Hg.):	Not Available
Vapor Density (AIR = 1):	Not Available
Specific Gravity (H2O = 1):	1.027
Melting Point:	Not Applicable
Evaporation Rate (Butyl Acetate = 1):	Not Available
Solubility in Water:	Soluble
Appearance and Odor:	Reddish brown colored solution with iodine odor
pH:	3.0-4.5 s.u.

SECTION IV: FIRE AND EXPLOSION HAZARD DATA

Flash Point (Method Used):	>200° F
Flammable Limits:	NA
LEL:	NA
UEL:	NA
Extinguishing Media:	Water spray, dry chemical, carbon dioxide, alcohol foam
Special Fire Fighting Procedures:	NA
Unusual Fire and Explosion Hazards:	NA

SECTION V: REACTIVITY DATA

Stability
Unstable: No
Stable: Yes
Conditions to Avoid: Excessive heat

Incompatibility (Materials to Avoid): Strong oxidizers, acids, alkalis and unsaturated organic compounds

Hazardous Decomposition or Byproducts: Carbon Dioxide, Carbon Monoxide, and combustion products containing iodine.

Hazardous Polymerization
May Occur: No
Will Not Occur: Yes
Conditions to Avoid: NA

SECTION VI: HEALTH HAZARD DATA

Route(s) of Entry
Inhalation? NA
Skin? Yes
Ingestion? Yes

Health Hazards (Acute and Chronic): Acute: Local irritation and pruritus can occur.
Chronic: Long term treatment can provoke abnormal thyroid gland function, hepatic or renal insufficiencies, acidosis, “chemical” peritonitis, increased serum iodine levels.

Carcinogenicity
NTP? NA
IARC Monographs? NA
OSHA Regulated? NA

Signs and Symptoms of Exposure: Irritation of skin.

Medical Conditions Generally Aggravated by Exposure: Preexisting skin disorders

Emergency and First Aid Procedures:
Skin Contact: Wash affected area with water. Seek medical attention if irritation persists.
Eye Contact: Flush eyes with copious amounts of water. Seek medical attention if irritation persists
Ingestion: **DO NOT** induce vomiting. Seek medical attention.

SECTION VII: PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken in Case Material is Released or Spilled:	Prevent released material from entering sewer system. Vacuum and drum released material for disposal. Wash spill area with sodium thiosulfate solution and flush with water.
Waste Disposal Method:	Dispose of in accordance with local, state and federal regulations.
Precautions to Be Taken in Handling and Storing:	Store in cool, dry area away from incompatible materials.
Other Precautions:	**KEEP OUT OF REACH OF CHILDREN**

SECTION VIII: CONTROL MEASURES

Respiratory Protection (Specify Type): None normally required

Ventilation

Local Exhaust:	Recommended
Mechanical (General):	Recommended
Special:	NA
Other:	NA

Protective Gloves:	Chemical resistant gloves
Eye Protection:	Goggles or safety glasses
Other Protective Clothing or Equipment:	Chemical resistant clothing which will minimize contact with this material.
Work / Hygienic Practices:	Good hygienic practice

MATERIAL SAFETY DATA SHEET

Burn Spray	MSDS No.:	004
	Revision No.:	4
	Issue Date:	01/15/2008
	Exp. Date:	01/2011

PRODUCT AND COMPANY INFORMATION – SECTION 1	
Manufacturer/Distributor	Water-Jel Technologies
	50 Broad Street
	Carlstadt, NJ 07072
	201-507-8300
	800-275-3433
Product Name:	**Burn Spray**
Synonyms:	No information available
Intended Use:	Water based spray meeting ANSI Standard for burn treatment. Contains Lidocaine HCl (2%) for relief of minor burns. For external use only.

FOR CHEMICAL EMERGENCY, SPILL, LEAK, FIRE, EXPOSURE, OR ACCIDENT:
In the continental U.S.: 800-275-3433 **For additional information:** 201-507-8300

COMPOSITION INFORMATION – SECTION 2	
In accordance with 29 CFR § 1910.1200 (i) (1) the specific chemical identity of this product is being withheld as a trade secret.	
Chemical Name:	Lidocaine HCl
Percent:	PROPRIETARY
CAS Number:	6108-05-0
Exposure Limits:	None Established

HAZARDS IDENTIFICATION – SECTION 3	
EMERGENCY OVERVIEW & HAZARDS PRESENT TO MAN AND THE ENVIRONMENT	Acute effects are possible irritation and discomfort; chronic effects are possible with the ingestion of large amounts to the nervous system. Do not use over raw surface areas or blistered areas.
PRIMARY ROUTES OF EXPOSURE	Ingestion, Eyes, Inhalation
POTENTIAL HEALTH EFFECTS:	
Eyes:	May cause mild irritation.
Skin:	Prolonged skin contact may cause mild irritation.
Inhalation:	Inhalation of mist may cause respiratory irritation.
Ingestion:	Swallowing small amounts is not likely cause injury.
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:	Pre-existing skin or eye disorders may become aggravated through prolonged exposure.

MATERIAL SAFETY DATA SHEET

Burn Spray	MSDS No.:	004
	Revision No.:	4
	Issue Date:	01/15/2008
	Exp. Date:	01/2011

CHRONIC HEALTH EFFECTS:	
Eyes:	Prolonged skin contact may cause moderate irritation.
Skin:	Prolonged skin contact may cause mild irritation.
Inhalation:	Prolonged inhalation may cause moderate respiratory irritation.
Ingestion:	Swallowing large amount may cause injury.

FIRST AID MEASURES – SECTION 4	
SEEK MEDICAL ATTENTION FOR ALL CASES OF OVEREXPOSURE.	
FIRST AID MEASURES:	
Eyes:	Flush eyes with clear running water for a minimum of fifteen (15) minutes while holding eyelids open; if irritation persists, seek medical attention.
Skin:	Flush with clear running water for a minimum of fifteen (15) minutes; if irritation persists, seek medical attention.
Inhalation:	Remove victim to fresh air. If victim has stopped breathing give artificial respiration, preferable mouth to mouth, get medical attention immediately.
Ingestion:	DO NOT induce vomiting; seek immediate medical attention.
Instructions for Physician:	Treat symptomatically. Refer to individual constituents.

FIRE FIGHTINHG MEASURES – SECTION 5

NFPA Classification

Health	Fire	Reactivity	Other
1	0	0	N/A

FLAMMABILITY PROPERTIES

Flash Point:	N/A	**Method:**	Closed Cup		
Flammability Limits: (in air % by volume)		**LEL:**	N/A	**UEL:**	N/A

Autoignition Temperature:

N/A

Hazardous Combustion Products:

No Information available.

Extinguishing Media:

Water, water spray, dry chemicals, chemical foam, CO

Prohibited Extinguishing Media:

No information available.

Firefighting Instructions:

DO NOT enter confined fire space without full bunker gear (Helmet with face shield, bunker coats, gloves and rubber boots. Wear NIOSH/MSHA approved self contained breathing apparatus. Cool fire exposed containers with water.

Unusual Fire and Explosion Hazards:

No information available.

ACCIDENTAL RELEASE MEASURES – SECTION 6

Environmental Precautions:

No information available.

Cleanup Methods:

Small spills: Small spills may be flushed with large amounts of water.

Large spills: Large spills should be collected with approved absorbent and disposed in an appropriate container.

HANDLING & STORAGE – SECTION 7

Handling:	Keep container(s) tightly closed when not in use.
Storage:	Keep container(s) tightly closed when not in use. Store in a cool, dry area.
Specific Uses:	Water based spray meeting ANSI Standard for burn treatment. Contains Lidocaine HCl (2%) for relief of minor burns. For external use only.

EXPOSURE CONTROLS / PERSONAL PROTECTION – SECTION 8

EXPOSURE CONTROLS:

Exposure Limits Values:

	OSHA PEL:	ACGIH TLV:
Lidocaine HCl	Not Established	Not Established

Engineering Controls:

No information available.

PERSONAL PROTECTIVE EQUIPMENT:

Respiratory Protection:

None required.

Hand Protection:

None required.

Eye/Face Protection:

None required.

Skin Protection:

None required.

General Hygiene Considerations:

Practice safe work habits. Use according to label instructions.

Other Protective Equipment:

No information available.

PHYSICAL & CHEMICAL PROPERTIES – SECTION 9

PRODUCT:	**Burn Spray**
General Information:	
Appearance	Slightly cloudy to clear off-white liquid.
Odor	Medicinal, Slight Tea Tree Oil Scent
Important Health, Safety, and Environmental Information:	
Boiling Point	212°F
Melting Point	No information available.
Flash Point	No information available.
Explosive Properties	No information available.
Oxidizing Properties	No information available.
Specific Gravity *(H_2O = 1)*	0.997
Water Solubility	Complete
Partition Coefficient *(n-octanol/water)*	No information available.
Viscosity	No information available.
Vapor Pressure *(mm Hg)*	No information available.
Vapor Density *(Air = 1)*	No information available.
Evaporation Rate	No information available.
% Volatile (By Volume @ 68°F)	No information available.

STABILITY & REACTIVITY – SECTION 10

Stability:

This material is stable under normal conditions.

Conditions to avoid:

Extreme Temperatures.

Materials to avoid:

Strong oxidizing agents.

Hazardous Decomposition Products:

Decomposition will not occur if handled and stored properly. Thermal decomposition may produce carbon monoxide, small amounts of nitrogen oxides, halogenated compounds or propionaldehyde.

Hazardous Polymerization:

Will not occur.

TOXICOLOGICAL INFORMATION – SECTION 11

Type of Test	Route of Exposure	Effects	Species Observed	Dose Data
No information available.				

ECOLOGICAL INFORMATION – SECTION 12

Ecotoxicity:

No information available.

Mobility:

No information available.

Persistence and Degradability:

No information available.

Bio accumulative Potential:

No information available.

DISPOSAL CONSIDERATION – SECTION 13

Dispose of in accordance with Local, State, and Federal regulations. Products classified as non-hazardous may become hazardous waste upon contact with other products. Refer to "40 CFR Protection of Environment Parts 260-299" for complete waste disposal regulations. Consult your Local, State or Federal Environmental Protection Agency before disposing of any chemicals.

TRANSPORT INFORMATION – SECTION 14

DOT CLASSIFICATION:

UN Number:	Not Required for Domestic Transportation.

MATERIAL SAFETY DATA SHEET

Burn Spray	MSDS No.:	004
	Revision No.:	4
	Issue Date:	01/15/2008
	Exp. Date:	01/2011

Class:	Not Regulated for Domestic Transportation.
Proper Shipping Name:	
Packing Group:	
Marine Pollutant:	
Other Information:	
IATA CLASSIFICATION:	
Un Number:	Not Regulated for International Air Transportation.
Class:	
Proper Shipping Name:	
Packing Group:	
Marine Pollutant:	
Other Information:	
IMDG CLASSIFICATION:	
Un Number:	Not Regulated for International Water Transportation.
Class:	
Proper Shipping Name:	
Packing Group:	
Marine Pollutant:	
Other Information:	

REGULATORY INFORMATION – SECTION 15	
US REGULATIONS	
ACGIH	Not Established
CAA Section 112	Not Listed
CERCLA	Not Listed
IARC	Not Listed
NTP	Not Listed
OSHA	Not Established
SARA Title III	Not Listed
TSCA	Not Listed
STATE REGULATIONS	
MA substance List	Not Listed
NJ RTK Hazardous Substance List	Not Listed
PA Hazardous Substance List	Not Listed
Canadian WHMIS	Not Listed

Burn Spray	MSDS No.:	004
	Revision No.:	4
	Issue Date:	01/15/2008
	Exp. Date:	01/2011

To the best of our knowledge, the information contained herein is accurate. However, neither Water-Jel Technologies, nor any of its subsidiaries assumes any liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

WATER-JEL TECHNOLOGIES

MATERIAL SAFETY DATA SHEET

Hydrocortisone Cream 1%	MSDS No.:	009
	Revision No.:	2
	Date:	12/02/04

PRODUCT AND COMPANY INFORMATION – SECTION 1	
Manufacturer/Distributor	Water-Jel Technologies
	50 Broad Street
	Carlstadt, NJ 07072
	201-507-8300
	800-275-3433
Product Name:	**Hydrocortisone Cream 1%**
Synonyms:	Topical Cream, Skin Cream
Intended Use:	Temporary relief of itching associated with minor skin irritation and rashes. For external use only. Not for use on children under 2 years old.

FOR CHEMICAL EMERGENCY, SPILL, LEAK, FIRE, EXPOSURE, OR ACCIDENT:
In the continental U.S.: 800-275-3433 **For additional information:** 201-507-8300

COMPOSITION INFORMATION – SECTION 2		
In accordance with 29 CFR § 1910.1200 (i) (1) the specific chemical identity of this product is being withheld as a trade secret.		
Chemical Name:	Cetyl Alcohol	
Percent:	Proprietary	
CAS Number:	36653-82-4	
Exposure Limits:	None Established	
Chemical Name:	Germaben II	
Percent:	Proprietary	
CAS Number:	No information available.	
Exposure Limits:	None Established	
Chemical Name:	Glycerin	
Percent:	Proprietary	
CAS Number:	56-81-5	
Exposure Limits:	ACGIH TWA (Glycerin Mist): Total Dust: 15 mg/m^3 Respirable Fraction: 5 mg/m^3	OSHA PEL (Glycerin Mist): Total Dust: 10 mg/m^3 Respirable Fraction: 5 mg/m^3
Chemical Name:	Glyceryl Stearate (Glyceryl Monostearate)	
Percent:	Proprietary	
CAS Number:	31566-31-3	
Exposure Limits:	TWA (Stearates): 10 mg/m^3	

Hydrocortisone Cream 1%	MSDS No.:	009
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Chemical Name:	Hydrocortisone Acetate
Percent:	Proprietary
CAS Number:	50-03-3
Exposure Limits:	None Established
Chemical Name:	White Mineral Oil
Percent:	Proprietary
CAS Number:	8042-47-5
Exposure Limits:	None Established
Chemical Name:	Peg 100
Percent:	Proprietary
CAS Number:	25322-68-3
Exposure Limits:	None Established
Chemical Name:	Stearic Acid
Percent:	Proprietary
CAS Number:	57-11-4
Exposure Limits:	None Established

HAZARDS IDENTIFICATION – SECTION 3	
EMERGENCY OVERVIEW & HAZARDS PRESENT TO MAN AND THE ENVIRONMENT	May cause irritation to eyes and may cause irritation of the digestive tract when ingested.
PRIMARY ROUTES OF EXPOSURE	Eye contact, Ingestion
POTENTIAL HEALTH EFFECTS:	
Eyes:	May cause irritation, characterized by a burning sensation, redness, tearing, inflammation, dryness, and possible other effects.
Skin:	No adverse conditions expected.
Inhalation:	Unlikely route of exposure.
Ingestion:	May cause irritation of the digestive tract.
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:	No information available.
CHRONIC HEALTH EFFECTS:	
Eyes:	Flush eyes with clear running water for a minimum of fifteen (15) minutes while holding eyelids open; if irritation persists, seek medical attention.
Skin:	No adverse conditions expected.
Inhalation:	Unlikely route of exposure.
Ingestion:	Rinse out mouth and drink lots of water. In case of unusual symptoms, seek medical attention and show physician the container details.

Hydrocortisone Cream 1%	MSDS No.:	009
	Revision No.:	2
	Date:	12/02/04

FIRST AID MEASURES – SECTION 4	
SEEK MEDICAL ATTENTION FOR ALL CASES OF OVEREXPOSURE.	
FIRST AID MEASURES:	
Eyes:	Flush immediately with large amounts of water. If redness or irritation persists, contact a physician.
Skin:	No adverse conditions expected.
Inhalation:	Unlikely route of exposure.
Ingestion:	Contact a physician immediately.
Instructions for Physician:	Available date does not identify any conditions.

FIRE FIGHTINHG MEASURES – SECTION 5

NFPA Classification

Health	Fire	Reactivity	Other
1	0	0	N/A

FLAMMABILITY PROPERTIES

Flash Point:	N/A	**Method:**	N/A		
Flammability Limits: (in air % by volume)		**LEL:**	N/A	**UEL:**	N/A

Autoignition Temperature:

N/A

Hazardous Combustion Products:

Carbon Monoxide, Carbon Dioxide

Extinguishing Media:

Use extinguishing media appropriate for the surrounding fire. Use water spray, foam or dry chemical.

Prohibited Extinguishing Media:

In fires involving large quantities of this product, the use of large streams of water should be avoided.

Firefighting Instructions:

Use self-contained breathing apparatus when fighting fires that involve this material.

Unusual Fire and Explosion Hazards:

Carbon monoxide and carbon dioxide may be generated.

ACCIDENTAL RELEASE MEASURES – SECTION 6

Environmental Precautions:

No information available.

Cleanup Methods:

Small spills: Spills should be collected with approved inert absorbent for disposal.

Large spills: Spills should be collected with approved absorbent for disposal.

HANDLING & STORAGE – SECTION 7

Handling:	Keep this and other chemicals out of reach of children.
Storage:	Do not store or mix with strong acids or oxidizers.
Specific Uses:	Temporary relief of itching associated with minor skin irritation and rashes. For external use only. Not for use on children under two (2) years old.

EXPOSURE CONTROLS / PERSONAL PROTECTION – SECTION 8

EXPOSURE CONTROLS:

Exposure Limits Values:

	OSHA PEL:	ACGIH TLV:
Stearates (Glyceryl Stearate)	Not Established	10 mg/m^3
Glycerin Mist (Glycerin)	Total Dust: 15 mg/m^3 Respirable Fraction: 5 mg/m^3	Total Dust: 10 mg/m^3 Respirable Fraction: 5 mg/m^3

Engineering Controls:

Local Exhaust is recommended.

PERSONAL PROTECTIVE EQUIPMENT:

Respiratory Protection:

None required under normal conditions.

Hand Protection:

None required under normal conditions.

Eye/Face Protection:

Eye protection, as necessary to prevent excessive contact.

Skin Protection:

None required under normal conditions.

General Hygiene Considerations:

Practice safe work habits. Use according to label instructions.

Other Protective Equipment:

Eye wash stations should be nearby and ready for use.

PHYSICAL & CHEMICAL PROPERTIES – SECTION 9

PRODUCT:	**Hydrocortisone Cream 1%**
General Information:	
Appearance	White homogeneous cream
Odor	Slightly fatty odor
Important Health, Safety, and Environmental Information:	
Boiling Point	135°C 275°F
Melting Point	60°C (140°F)
Flash Point	N/A
Explosive Properties	No information available.
Oxidizing Properties	No information available.
Specific Gravity *(H_2O = 1)*	0.81
Water Solubility	Miscible
Partition Coefficient *(n-octanol/water)*	No information available.
Viscosity	No information available.
Vapor Pressure *(mm Hg)*	No information available.
Vapor Density *(Air = 1)*	No information available.
Evaporation Rate	0.07
% Volatile *(By Volume @ 68°F)*	65

STABILITY & REACTIVITY – SECTION 10

Stability:

This material is stable under normal conditions.

Conditions to avoid:

Extreme heat

Materials to avoid:

Strong oxidants, Strong Acids

Hazardous Decomposition Products:

Carbon Monoxide, Carbon Dioxide

Hazardous Polymerization:

Will not occur.

TOXICOLOGICAL INFORMATION – SECTION 11

Type of Test	Route of Exposure	Effects	Species Observed	Dose Data
LD_{50} – (Cetyl Alcohol)	Oral	Death	Rodent - Rat	5 gm/kg
LD_{50} – (Glycerin)	Oral	Death	Rodent - Rat	12600 mg/kg
LD_{50} – (Glyceril Stearate)	Intraperitoneal	Death	Rodent - Mouse	200 mg/kg
LD_{50} – (Hydrocortisone Acetate)	Subcutaneous	Death	Rodent - Rat	250 mg/kg
LD_{50} – (Mineral Oil)	Oral	Death	Rodent - Mouse	22 gm/kg
LD_{50} – (Stearic Acid)	Intravenous	Death	Rodent - Rat	21500 ug/kg

ECOLOGICAL INFORMATION – SECTION 12

Ecotoxicity:

No information available.

Mobility:

No information available.

Persistence and Degradability:

No information available.

Bio accumulative Potential:

No information available.

DISPOSAL CONSIDERATION – SECTION 13

Dispose of in accordance with Local, State, and Federal regulations.

TRANSPORT INFORMATION – SECTION 14	
DOT CLASSIFICATION:	
UN Number:	Not regulated for Domestic Transport.
Class:	
Proper Shipping Name:	
Packing Group:	
Marine Pollutant:	
Other Information:	
IATA CLASSIFICATION:	
Un Number:	Not Regulated for International Air Transport.
Class:	
Proper Shipping Name:	
Packing Group:	
Marine Pollutant:	
Other Information:	
IMDG CLASSIFICATION:	
Un Number:	Not Regulated for International Water Transport.
Class:	
Proper Shipping Name:	
Packing Group:	
Marine Pollutant:	
Other Information:	

REGULATORY INFORMATION – SECTION 15	
US REGULATIONS	
ACGIH	TWA (Glycerin Mist): Total Dust: 15 mg/m^3 Respirable Fraction: 5 mg/m^3
	TWA (Stearates): 10 mg/m^3
CAA Section 112	Not Listed
CERCLA	Not Listed
IARC	Not Listed
NTP	Not Listed
OSHA	OSHA PEL (Glycerin Mist): Total Dust: 10 mg/m^3 Respirable Fraction: 5 mg/m^3

MATERIAL SAFETY DATA SHEET

Hydrocortisone Cream 1%	MSDS No.:	009
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SARA Title III	Not Listed
TSCA	Not Listed
STATE REGULATIONS	
MA substance List	Not Listed
NJ RTK Hazardous Substance List	Not Listed
PA Hazardous Substance List	Not Listed
Canadian WHMIS	Not Listed

OTHER INFORMATION – SECTION 16	
Revision Number	**Revision Date**
2	04/28/05

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MATERIAL SAFETY DATA SHEET

Neomycin Antibiotic Ointment	MSDS No.:	013
	Revision No.:	3
	Issue Date:	01/15/2008
	Exp. Date:	01/2011

PRODUCT AND COMPANY INFORMATION – SECTION 1	
Manufacturer/Distributor	Water-Jel Technologies
	50 Broad Street
	Carlstadt, NJ 07072
	201-507-8300
	800-275-3433
Product Name:	**Neomycin Antibiotic Ointment**
Synonyms:	Antibiotic Ointment, Antibiotic Cream, Neomycin Cream
Intended Use:	First Aid antibiotic ointment to help prevent infection in minor cuts, scrapes and burns. For external use only.

FOR CHEMICAL EMERGENCY, SPILL, LEAK, FIRE, EXPOSURE, OR ACCIDENT:
In the continental U.S.: 800-275-3433 **For additional information:** 201-507-8300

COMPOSITION INFORMATION – SECTION 2	
In accordance with 29 CFR § 1910.1200 (i) (1) the specific chemical identity of this product is being withheld as a trade secret.	
Chemical Name:	Petrolatum USP
Percent:	Proprietary
CAS Number:	8009-03-8
Exposure Limits:	Not Established
Chemical Name:	Neomycin Sulfate USP
Percent:	Proprietary
CAS Number:	1405-10-3
Exposure Limits:	Not Established

HAZARDS IDENTIFICATION – SECTION 3	
EMERGENCY OVERVIEW & HAZARDS PRESENT TO MAN AND THE ENVIRONMENT	Warning! May cause eye and skin irritation.
PRIMARY ROUTES OF EXPOSURE	Skin
POTENTIAL HEALTH EFFECTS:	
Eyes:	This product is minimally irritating to the eyes upon direct contact.

Skin:	This product is minimally irritating to the skin upon direct contact. **NOTE:** Neomycin sulfate may cause cutaneous sensitization. A precise incidence of hypersensitivity reactions (primarily skin rash) due to topical neomycin is not known. Discontinue promptly if sensitization or irritation occurs.
Inhalation:	This product has a low vapor pressure and is not expected to present an inhalation hazard at ambient conditions. Caution should be taken to prevent aerosolization or misting of this product.
Ingestion:	Do not ingest. This product is practically non-toxic by ingestion. This product has laxative properties and may result in abdominal cramps and diarrhea.
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:	No information available.
CHRONIC HEALTH EFFECTS:	
Eyes:	No information available.
Skin:	When using neomycin-containing products to control secondary infection in the chronic dermatoses, such as chronic otitis extema or stasis dermatitis, it should be borne in mind that the skin in these conditions is more liable than is normal skin to become sensitized to many substances, including neomycin.
Inhalation:	Exposure to a large single dose or repeated smaller doses of petrolatum by inhalation can lead to lipid pneumonia or lipid granuloma of the lung. These are low-grade, chronic, localized tissue reactions. Shortness of breath and cough are the most common symptoms.
Ingestion:	Exposure to a large single dose or repeated smaller doses of petrolatum by ingestion leading to aspiration can lead to lipid pneumonia or lipid granuloma of the lung. These are low-grade, chronic, localized tissue reactions. Shortness of breath and cough are the most common symptoms.

FIRST AID MEASURES – SECTION 4	
SEEK MEDICAL ATTENTION FOR ALL CASES OF OVEREXPOSURE.	
FIRST AID MEASURES:	
Eyes:	Immediately flush eyes with large amounts of water and continue flushing until irritation subsides. If material is hot, treat for thermal burns and take victim to hospital immediately.

Skin:	Remove contaminated clothing. Wash contaminated area thoroughly with soap and water. If material is hot, submerge injured area in cold water. If victim is severely burned, remove to a hospital immediately.
Inhalation:	This material has a low vapor pressure and is not expected to present an inhalation exposure at ambient conditions. If vapor or mist is generated when the material is heated or handled, remove victim from exposure.
Ingestion:	Do not induce vomiting due to aspiration hazard. If vomiting should occur, lower head below knees to avoid aspiration.
Instructions for Physician:	Exposure to a large single dose or repeated smaller doses of petrolatum by inhalation, aspiration, or ingestion leading to aspiration, can lead to lipid pneumonia or lipid granuloma of the lung. These are low-grade, chronic, localized tissue reactions. Shortness of breath and cough are the most common symptoms.

FIRE FIGHTINHG MEASURES – SECTION 5

NFPA Classification

Health	**Fire**	**Reactivity**	**Other**
0	1	0	N/A

FLAMMABILITY PROPERTIES

Flash Point:	Higher than 93.3°C (200°F)	**Method:**	Closed Cup		
Flammability Limits: (in air % by volume)		**LEL:**	N/A	**UEL:**	N/A

Autoignition Temperature:

No information available.

Hazardous Combustion Products:

Carbon monoxide, carbon dioxide.

Extinguishing Media:

Use dry chemical, foam, or carbon dioxide.

Prohibited Extinguishing Media:

No information available.

Firefighting Instructions:

Water may be ineffective but can be used to cool containers exposed to heat or flame. Caution should be exercised when using water or foam as frothing may occur, especially if sprayed into containers of hot, burning liquid.

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Unusual Fire and Explosion Hazards:

Dense smoke may be generated while burning. Carbon monoxide, carbon dioxide, and other oxides may be generated as products of combustion.

ACCIDENTAL RELEASE MEASURES – SECTION 6

Environmental Precautions:

Contain spill immediately. Do not allow spill to enter sewers or watercourses.

Cleanup Methods:

Small spills: Absorb with appropriate inert material such as sand, clay, etc. and dispose of into a suitable container.

Large spills: Large spills maybe picked up using vacuum pumps, shovels, buckets, or other means and placed in drums or other suitable containers.

HANDLING & STORAGE – SECTION 7

Handling:	Avoid breathing vapors or mist. Avoid contact with eyes. Avoid prolonged or repeated contact with skin. Wash thoroughly after handling. Wash clothing prior to reuse. May be slippery when spilled.
Storage:	Do not transfer to unmarked containers. Store in closed containers away from heat, sparks, open flame, or oxidizing materials.
Specific Uses:	First aid antibiotic ointment to help prevent infection in minor cuts, scrapes and burns. For external use only.

EXPOSURE CONTROLS / PERSONAL PROTECTION – SECTION 8

EXPOSURE CONTROLS:

Exposure Limits Values:

	OSHA PEL:	ACGIH TLV:
Petrolatum USP	Not Established	Not Established

Engineering Controls:

If vapor or mist is generated when the material is heated or handled, adequate ventilation in accordance with good engineering practice must be provided to maintain concentrations below the specified or flammable limits.

PERSONAL PROTECTIVE EQUIPMENT:

Respiratory Protection:

Respiratory protection is not required under conditions of normal use. If vapor or mist is generated when the material is heated or handled, use an organic vapor respirator with a dust and mist filter. All respirators must be NIOSH certified.

Hand Protection:

For prolonged or repeated exposures, use impervious gloves. If handling hot material, material use insulated protective gloves.

Eye/Face Protection:

Eye protection is not required under conditions of normal use. If material is handled such that it could be splashed into eyes, wear plastic face shield or splash-proof safety goggles.

Skin Protection:

No skin protection is required for single, short duration exposures. For prolonged or repeated exposures, use impervious clothing (boots, aprons, etc.) over parts of the body subject to exposure. If handling hot material, use insulated protective clothing (boots, aprons, etc.) Launder soiled clothes. Properly dispose of contaminated leather articles including shoes, which cannot be decontaminated.

General Hygiene Considerations:

Consumption of food and beverage should be avoided in work areas where hydrocarbons are present. Always wash hands and face with soap and water before eating, drinking, or smoking.

Other Protective Equipment:

No information available.

PHYSICAL & CHEMICAL PROPERTIES – SECTION 9

PRODUCT:	**Neomycin Antibiotic Ointment**
General Information:	
Appearance	Off-white, lustrous ointment
Odor	Odorless
Important Health, Safety, and Environmental Information:	
Boiling Point	650°F (343.3°C)
Melting Point	125-130°F (51.7 – 54.4°C)
Flash Point	Higher than 93.3°C (200°C)
Explosive Properties	No information available.
Oxidizing Properties	No information available.
Specific Gravity *(H_2O = 1)*	0.86 – 0.87
Water Solubility	Insoluble in water
Partition Coefficient *(n-octanol/water)*	No information available.
Viscosity	No information available.
Vapor Pressure *(mm Hg)*	No information available.
Vapor Density *(Air = 1)*	No information available.
Evaporation Rate	No information available.
% Volatile (By Volume @ 68°F)	No information available.

STABILITY & REACTIVITY – SECTION 10

Stability:

Stable

Conditions to avoid:

Heat, sparks, flame.

Materials to avoid:

May react with strong oxidizing agents.

Hazardous Decomposition Products:

Carbon monoxide, carbon dioxide, and other oxides may be generated as products of combustion.

Hazardous Polymerization:

Will not occur.

TOXICOLOGICAL INFORMATION – SECTION 11

Type of Test	Route of Exposure	Effects	Species Observed	Dose Data
No information available.				

ECOLOGICAL INFORMATION – SECTION 12

Ecotoxicity:

No information available.

Mobility:

No information available.

Persistence and Degradability:

No information available.

Bio accumulative Potential:

No information available.

DISPOSAL CONSIDERATION – SECTION 13

All disposals of this material must comply with federal, state, and local regulations.

TRANSPORT INFORMATION – SECTION 14

DOT CLASSIFICATION:

UN Number:	Not Regulated for domestic transport.
Class:	
Proper Shipping Name:	
Packing Group:	
Marine Pollutant:	

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Other Information:	

MATERIAL SAFETY DATA SHEET

Neomycin Antibiotic Ointment	MSDS No.:	013
	Revision No.:	3
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	Exp. Date:	01/2011

IATA CLASSIFICATION:	
Un Number:	Not Regulated for international air transport.
Class:	
Proper Shipping Name:	
Packing Group:	
Marine Pollutant:	
Other Information:	
IMDG CLASSIFICATION:	
Un Number:	Not Regulated for international water transport.
Class:	
Proper Shipping Name:	
Packing Group:	
Marine Pollutant:	
Other Information:	

REGULATORY INFORMATION – SECTION 15	
US REGULATIONS	
ACGIH	Not Established
CAA Section 112	Not Listed
CERCLA	Not Listed
IARC	Not Listed
NTP	Not Listed
OSHA	Not Established
SARA Title III	Not Listed
TSCA	Not Listed
STATE REGULATIONS	
MA substance List	Not Listed
NJ RTK Hazardous Substance List	Not Listed
PA Hazardous Substance List	Not Listed
Canadian WHMIS	Uncontrolled product according to WHMIS classification criteria.

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MATERIAL SAFETY DATA SHEET

Antiseptic Spray	MSDS No.:	001
	Revision No.:	4
	Issue Date	01/15/2008
	Exp. Date:	01/2011

PRODUCT AND COMPANY INFORMATION – SECTION 1	
Manufacturer/Distributor	Water-Jel Technologies
	50 Broad Street
	Carlstadt, NJ 07072
	201-507-8300
	800-275-3433
Product Name:	**Antiseptic Spray**
Synonyms:	Cut Spray, Scrape Spray
Intended Use:	Antiseptic spray containing Benzalkonium Chloride to help prevent infection from minor cuts, burns, and scrapes. For external use only.

FOR CHEMICAL EMERGENCY, SPILL, LEAK, FIRE, EXPOSURE, OR ACCIDENT:
In the continental U.S.: 800-275-3433 **For additional information:** 201-507-8300

COMPOSITION INFORMATION – SECTION 2	
In accordance with 29 CFR § 1910.1200 (i) (1) the specific chemical identity of this product is being withheld as a trade secret.	
Chemical Name:	Purified Water
Percent:	Proprietary
CAS Number:	7732-18-5
Exposure Limits:	None Established

HAZARDS IDENTIFICATION – SECTION 3	
EMERGENCY OVERVIEW & HAZARDS PRESENT TO MAN AND THE ENVIRONMENT	Poses little or no immediate hazard.
PRIMARY ROUTES OF EXPOSURE	Inhalation
POTENTIAL HEALTH EFFECTS:	
Eyes:	May cause mild irritation.
Skin:	Substance may cause slight skin irritation. Contact with heated product may cause thermal burns.
Inhalation:	Practically non-toxic if inhaled.
Ingestion:	Practically non-toxic if ingested.
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:	Available data does not identify any conditions.

CHRONIC HEALTH EFFECTS:	
Eyes:	No information available.
Skin:	Mild to severe dermatitis.
Inhalation:	High concentration in immediate area can displace oxygen and can cause dizziness, unconsciousness, and even death with longer exposure. Keep people away from such vapors without self-contained breathing apparatus.
Ingestion:	No information available.

FIRST AID MEASURES – SECTION 4

SEEK MEDICAL ATTENTION FOR ALL CASES OF OVEREXPOSURE.

FIRST AID MEASURES:	
Eyes:	First aid not normally required.
Skin:	Flush eyes with clear running water for a minimum of fifteen (15) minutes while holding eyelids open; if irritation persists, seek medical attention.
Inhalation:	Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get immediate medical attention.
Ingestion:	First aid not normally required.
Instructions for Physician:	No information available.

FIRE FIGHTINHG MEASURES – SECTION 5

NFPA Classification

Health	Fire	Reactivity	Other
0	0	0	N/A

FLAMMABILITY PROPERTIES

Flash Point:	N/A	**Method:**	N/A		
Flammability Limits: (in air % by volume)		**LEL:**	N/A	**UEL:**	N/A

Autoignition Temperature:

No information available.

Hazardous Combustion Products:

No Information available.

Extinguishing Media:

No extinguishing media is required.

Prohibited Extinguishing Media:

No information available.

Firefighting Instructions:

No special fire fighting instructions are required.

Unusual Fire and Explosion Hazards:

Rapid temperature rise of liquid can result in explosive vaporization, particularly if in a sealed container.

ACCIDENTAL RELEASE MEASURES – SECTION 6

Environmental Precautions:

No information available.

Cleanup Methods:

Small spills: Small quantities can be mopped or wiped up with rags.

Large spills: Large quantities should be directed to collecting basin or drain with dikes or swabs..

HANDLING & STORAGE – SECTION 7

Handling:	No special handling is required.
Storage:	No special storage is required.
Specific Uses:	Antiseptic Spray containing Benzalkonium Chloride to help prevent infection from minor cuts, burns, and scrapes. For external use only.

EXPOSURE CONTROLS / PERSONAL PROTECTION – SECTION 8

EXPOSURE CONTROLS:

Exposure Limits Values:

	OSHA PEL:	ACGIH TLV:
Purified Water	Not Established	Not Established

Engineering Controls:

If hot vapor exist, remove from environment using local exhaust systems.

PERSONAL PROTECTIVE EQUIPMENT:
Respiratory Protection: PPE not normally required.
Hand Protection: Use insulating gloves if dealing with hot liquid.
Eye/Face Protection: Goggles or full-face splash shield if dealing with hot liquid.
Skin Protection: Use heat protective garment when exposed to large quantities of heated vapor.
General Hygiene Considerations: No information available.
Other Protective Equipment: No information available.

PHYSICAL & CHEMICAL PROPERTIES – SECTION 9	
PRODUCT:	**Antiseptic Spray**
General Information:	
Appearance	Clear, water-like solution
Odor	Slight Medicinal Odor
Important Health, Safety, and Environmental Information:	
Boiling Point	100°C (212°F)
Melting Point	N/A
Flash Point	N/A
Explosive Properties	N/A
Oxidizing Properties	N/A
Specific Gravity *(H_2O = 1)*	1
Water Solubility	Complete
Partition Coefficient *(n-octanol/water)*	N/A
Viscosity	N/A
Vapor Pressure *(mm Hg)*	17.53
Vapor Density *(Air = 1)*	N/A
Evaporation Rate	N/A

% Volatile *(By Volume @ 68°F)*	100

STABILITY & REACTIVITY – SECTION 10

Stability:

This material is stable under normal conditions.

Conditions to avoid:

Exposure to direct current electricity causes instability.

Materials to avoid:

Strong acids and bases can cause rapid heating. Reaction with sodium metal can result in explosion.

Hazardous Decomposition Products:

Hydrogen, Oxygen

Hazardous Polymerization:

Will not occur.

TOXICOLOGICAL INFORMATION – SECTION 11

Type of Test	Route of Exposure	Effects	Species Observed	Dose Data
No information available.				

ECOLOGICAL INFORMATION – SECTION 12

Ecotoxicity:

No information available.

Mobility:

No information available.

Persistence and Degradability:

No information available.

Bio accumulative Potential:

No information available.

DISPOSAL CONSIDERATION – SECTION 13

All disposals of this material must comply with federal, state, and local regulations.

Antiseptic Spray	MSDS No.:	001
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TRANSPORT INFORMATION – SECTION 14	
DOT CLASSIFICATION:	
UN Number:	Not Regulated for Domestic Transport.
Class:	
Proper Shipping Name:	
Packing Group:	
Marine Pollutant:	
Other Information:	
IATA CLASSIFICATION:	
Un Number:	Not Regulated for International Air Transport.
Class:	
Proper Shipping Name:	
Packing Group:	
Marine Pollutant:	
Other Information:	
IMDG CLASSIFICATION:	
Un Number:	Not Regulated for International Water Transport.
Class:	
Proper Shipping Name:	
Packing Group:	
Marine Pollutant:	
Other Information:	

REGULATORY INFORMATION – SECTION 15	
US REGULATIONS	
ACGIH	Not Established
CAA Section 112	Not Listed
CERCLA	Not Listed
IARC	Not Listed
NTP	Not Listed
OSHA	Not Established
SARA Title III	Not Listed
TSCA	Not Listed
STATE REGULATIONS	
MA substance List	Not Listed
NJ RTK Hazardous Substance List	Not Listed
PA Hazardous Substance List	Not Listed
Canadian WHMIS	Not Listed

Antiseptic Spray	MSDS No.:	001
	Revision No.:	4
	Issue Date	01/15/2008
	Exp. Date:	01/2011

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SAFETY DATA SHEET

Creation Date 21-May-2012 **Revision Date** 16-May-2014 **Revision Number** 1

1. Identification

Product Name **Sodium hydroxide, 50 wt% solution in water**

Cat No. : **AC380210000; AC380210025; AC380210100; AC380215000**

Synonyms Caustic soda

Recommended Use Laboratory chemicals.

Uses advised against No Information available

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Entity / Business Name
Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Corrosive to metals	Category 1
Skin Corrosion/irritation	Category 1
Serious Eye Damage/Eye Irritation	Category 1
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system.	

Label Elements

Signal Word
Danger

Hazard Statements
May be corrosive to metals
Causes severe skin burns and eye damage
May cause respiratory irritation

Precautionary Statements
Prevention
Do not breathe dust/fume/gas/mist/vapors/spray
Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Keep only in original container
Response
Immediately call a POISON CENTER or doctor/physician
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Skin
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Ingestion
IF SWALLOWED: Rinse mouth. DO NOT induce vomiting
Spills
Absorb spillage to prevent material damage
Storage
Store locked up
Store in corrosive resistant polypropylene container with a resistant inliner
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
None identified

3. Composition / information on ingredients

Component	CAS-No	Weight %
Sodium hydroxide	1310-73-2	50

4. First-aid measures

General Advice Take off contaminated clothing and shoes immediately.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.

Skin Contact Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Immediate medical attention is required.

Inhalation Move to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth resuscitation if victim ingested or inhaled the substance; induce artificial respiration with a respiratory medical device. Immediate medical attention is required.

Ingestion Do not induce vomiting. Call a physician or Poison Control Center immediately.

Most important symptoms/effects Causes burns by all exposure routes. Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated: Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media Substance is nonflammable; use agent most appropriate to extinguish surrounding fire.

Unsuitable Extinguishing Media Carbon dioxide (CO2)

Flash Point Not applicable
Method - No information available

Autoignition Temperature	Not applicable
Explosion Limits	
Upper	No data available
Lower	No data available
Oxidizing Properties	Not oxidising
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Corrosive Material. Non-combustible, substance itself does not burn but may decompose upon heating to produce corrosive and/or toxic fumes. Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products
Sodium oxides Carbon monoxide (CO) Carbon dioxide (CO_2)
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
3	0	1	N/A

6. Accidental release measures

Personal Precautions	Wear self-contained breathing apparatus and protective suit. Evacuate personnel to safe areas. Ensure adequate ventilation. Do not get in eyes, on skin, or on clothing.
Environmental Precautions	Avoid release to the environment. See Section 12 for additional ecological Information.
Methods for Containment and Clean Up	Wear self-contained breathing apparatus and protective suit. Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling	Use only under a chemical fume hood. Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Do not breathe vapors or spray mist. Do not ingest.
Storage	Keep containers tightly closed in a dry, cool and well-ventilated place. Corrosives area.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Sodium hydroxide	Ceiling: 2 mg/m³	(Vacated) Ceiling: 2 mg/m³ TWA: 2 mg/m³	IDLH: 10 mg/m³ Ceiling: 2 mg/m³

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Sodium hydroxide 1310-73-2 (50)	Ceiling: 2 mg/m³	Ceiling: 2 mg/m³	CEV: 2 mg/m³

Engineering Measures	Use only under a chemical fume hood. Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin and body protection	Wear appropriate protective gloves and clothing to prevent skin exposure.
Respiratory Protection	Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Clear, Viscous
Odor	Odorless
Odor Threshold	No information available
pH	13 Alkaline
Melting Point/Range	> 12 °C / 53.6 °F
Boiling Point/Range	> 145 °C / 293 °F
Flash Point	Not applicable
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	14 mmHg
Vapor Density	> 1.0
Relative Density	1.500
Solubility	No information available
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	Not applicable
Decomposition temperature	No information available
Viscosity	No information available

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under recommended storage conditions. Air sensitive. Water reactive.

Conditions to Avoid Incompatible products. Excess heat. Exposure to air. Exposure to moist air or water.

Incompatible Materials Acids, Organic materials, Metals, Water

Hazardous Decomposition Products Sodium oxides, Carbon monoxide (CO), Carbon dioxide (CO_2)

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions Corrosive to metals.

11. Toxicological information

Acute Toxicity

Product Information

Oral LD50	Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.
Dermal LD50	Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.
Vapor LC50	Based on ATE data, the classification criteria are not met. ATE > 20 mg/l.

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Sodium hydroxide	Not listed	1350 mg/kg (Rabbit)	Not listed

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation No information available

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Sodium hydroxide	1310-73-2	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Respiratory system
STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects, both acute and delayed Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated: Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Do not empty into drains. Large amounts will affect pH and harm aquatic organisms.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Sodium hydroxide	Not listed	45.4 mg/L LC50 96 h	Not listed	Not listed

Persistence and Degradability Soluble in water Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility . Will likely be mobile in the environment due to its water solubility.

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT

UN-No UN1824
Proper Shipping Name SODIUM HYDROXIDE SOLUTION
Hazard Class 8
Packing Group II

TDG

UN-No UN1824
Proper Shipping Name SODIUM HYDROXIDE SOLUTION
Hazard Class 8
Packing Group II

IATA

UN-No UN1824
Proper Shipping Name SODIUM HYDROXIDE SOLUTION
Hazard Class 8
Packing Group II

IMDG/IMO

UN-No UN1824
Proper Shipping Name SODIUM HYDROXIDE SOLUTION
Hazard Class 8
Packing Group II

15. Regulatory information

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Sodium hydroxide	X	X	-	215-185-5	-		X	X	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313 Not applicable

SARA 311/312 Hazardous Categorization

Acute Health Hazard	Yes
Chronic Health Hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Sodium hydroxide	X	1000 lb	-	-

Clean Air Act Not applicable

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Sodium hydroxide	1000 lb	-

California Proposition 65 This product does not contain any Proposition 65 chemicals

State Right-to-Know

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Sodium hydroxide	X	X	X	-	X

U.S. Department of Transportation

Reportable Quantity (RQ):	N
DOT Marine Pollutant	N
DOT Severe Marine Pollutant	N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

Canada
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

WHMIS Hazard Class E Corrosive material

16. Other information

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 21-May-2012
Revision Date 16-May-2014
Print Date 16-May-2014
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

Disclaimer
The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of SDS

SAFETY DATA SHEET

Revision Date 10-Feb-2015 **Revision Number** 1

1. Identification

Product Name **Naphthalene-d8**

Cat No. : **AC174960000; AC174960010; AC174960050**

Synonyms (2H8)Naphthalene

Recommended Use Laboratory chemicals.

Uses advised against No Information available

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Entity / Business Name
Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Acute oral toxicity	Category 4
Acute dermal toxicity	Category 4
Acute Inhalation Toxicity - Dusts and Mists	Category 4

Label Elements

Signal Word
Warning

Hazard Statements
Harmful if swallowed
Harmful in contact with skin
Harmful if inhaled

Precautionary Statements
Prevention

Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Wear protective gloves/protective clothing/eye protection/face protection
Avoid breathing dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area

Inhalation

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a POISON CENTER or doctor/physician if you feel unwell

Skin

IF ON SKIN: Wash with plenty of soap and water
Call a POISON CENTER or doctor/physician if you feel unwell
Wash contaminated clothing before reuse

Ingestion

IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
Rinse mouth

Disposal

Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)

May form combustible dust concentrations in air

3. Composition / information on ingredients

Component	CAS-No	Weight %
(2H8)Naphthalene	1146-65-2	100

4. First-aid measures

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Obtain medical attention.

Skin Contact Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. In the case of skin irritation or allergic reactions see a physician.

Inhalation Remove from exposure, lie down. Move to fresh air. If symptoms persist, call a physician. If breathing is difficult, give oxygen. If not breathing, give artificial respiration.

Ingestion Never give anything by mouth to an unconscious person. Drink plenty of water. Call a physician immediately. If possible drink milk afterwards.

Most important symptoms/effects No information available.
Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media Cool closed containers exposed to fire with water spray. Carbon dioxide (CO_2). Dry chemical.

Unsuitable Extinguishing Media No information available

Flash Point 78 °C / 172.4 °F
Method - No information available

Autoignition Temperature 526.1 °C / 979 °F
Explosion Limits
Upper 5.9%
Lower 0.9%
Sensitivity to Mechanical Impact No information available
Sensitivity to Static Discharge No information available

Specific Hazards Arising from the Chemical
Flammable. Dust can form an explosive mixture in air. Combustible material.

Hazardous Combustion Products
Carbon monoxide (CO) Carbon dioxide (CO_2)
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
2	1	1	N/A

6. Accidental release measures

Personal Precautions Ensure adequate ventilation. Use personal protective equipment.
Environmental Precautions See Section 12 for additional ecological information.

Methods for Containment and Clean Up Sweep up and shovel into suitable containers for disposal. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment.

7. Handling and storage

Handling Do not get in eyes, on skin, or on clothing. Take precautionary measures against static discharges. Remove and wash contaminated clothing before re-use. Avoid breathing vapors or mists. Do not ingest. Use only in area provided with appropriate exhaust ventilation. Wash thoroughly after handling. Use explosion-proof equipment. Use only non-sparking tools. Use only in well-ventilated areas.

Storage Keep in a dry, cool and well-ventilated place. Keep away from heat and sources of ignition.

8. Exposure controls / personal protection

Exposure Guidelines This product does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Engineering Measures Ensure adequate ventilation, especially in confined areas. Use explosion-proof electrical/ventilating/lighting/equipment.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Solid
Appearance	White
Odor	Odorless
Odor Threshold	No information available

pH	No information available
Melting Point/Range	81 - 83 °C / 177.8 - 181.4 °F
Boiling Point/Range	No information available
Flash Point	78 °C / 172.4 °F
Evaporation Rate	No information available
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	5.9%
Lower	0.9%
Vapor Pressure	0.3 mmHg @ 25 °C
Vapor Density	4.4
Relative Density	No information available
Solubility	No information available
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	526.1 °C / 979 °F
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	C10 D8
Molecular Weight	136.22

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under recommended storage conditions. Hygroscopic.

Conditions to Avoid Keep away from open flames, hot surfaces and sources of ignition. Incompatible products. Exposure to moist air or water.

Incompatible Materials Strong oxidizing agents

Hazardous Decomposition Products Carbon monoxide (CO), Carbon dioxide (CO_2)

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information No acute toxicity information is available for this product

Component Information

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation No information available

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
(2H8)Naphthalene	1146-65-2	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known
STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed No information available
Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity
Do not empty into drains.

Persistence and Degradability No information available
Bioaccumulation/ Accumulation No information available.

Mobility No information available.

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT Not regulated
TDG Not regulated
IATA
- **UN-No** 1334
- **Proper Shipping Name** NAPHTHALENE, CRUDE
- **Hazard Class** 4.1
- **Packing Group** III

IMDG/IMO
- **UN-No** 1334
- **Proper Shipping Name** NAPHTHALENE, CRUDE
- **Hazard Class** 4.1
- **Packing Group** III

15. Regulatory information

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
(2H8)Naphthalene	-	-	-	214-552-7	-		-	-	-	-	-

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.

Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313 Not applicable

SARA 311/312 Hazardous Categorization

Acute Health Hazard	No
Chronic Health Hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act Not applicable

Clean Air Act Not applicable

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA
Not applicable

California Proposition 65 This product does not contain any Proposition 65 chemicals

State Right-to-Know Not applicable

U.S. Department of Transportation

Reportable Quantity (RQ):	N
DOT Marine Pollutant	N
DOT Severe Marine Pollutant	N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

Canada
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

WHMIS Hazard Class B3 Combustible liquid
D1B Toxic materials

16. Other information

Prepared By Regulatory Affairs
Thermo Fisher Scientific

Email: EMSDS.RA@thermofisher.com

Revision Date	10-Feb-2015
Print Date	10-Feb-2015
Revision Summary	This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

Disclaimer

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End of SDS

Fisher Scientific

Part of Thermo Fisher Scientific

SAFETY DATA SHEET

Creation Date 12-Mar-2009 **Revision Date** 15-Dec-2015 **Revision Number** 4

1. Identification

Product Name **Nitric acid (65 - 70%)**

Cat No. : **A198C-212, A200-212, A200-212LC, A200-500, A200-500LC, A200-612GAL, A200C-212, A200S-212, A200S-212LC, A200S-500, A200SI-212, A467-1, A467-2, A467-250, A467-500, A483-212; S719721**

Synonyms Azotic acid; Engraver's acid; Aqua fortis

Recommended Use Laboratory chemicals.

Uses advised against No Information available

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Oxidizing liquids	Category 2
Corrosive to metals	Category 1
Skin Corrosion/irritation	Category 1 A
Serious Eye Damage/Eye Irritation	Category 1
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system.	

Label Elements

Signal Word
Danger

Hazard Statements
May cause fire or explosion; strong oxidizer
May be corrosive to metals
Causes severe skin burns and eye damage
May cause respiratory irritation

Precautionary Statements
Prevention
Do not breathe dust/fume/gas/mist/vapors/spray
Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Use only outdoors or in a well-ventilated area
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep/Store away from clothing/ other combustible materials
Take any precaution to avoid mixing with combustibles
Keep only in original container
Response
Immediately call a POISON CENTER or doctor/physician
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Skin
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Ingestion
IF SWALLOWED: Rinse mouth. DO NOT induce vomiting
Fire
In case of fire: Use CO2, dry chemical, or foam for extinction
Spills
Absorb spillage to prevent material damage
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Store in corrosive resistant polypropylene container with a resistant inliner
Store in a dry place
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
None identified

Unknown Acute Toxicity
.? percent of the mixture consists of ingredient(s) of unknown acute toxicity

3. Composition / information on ingredients

Component	CAS-No	Weight %
Nitric acid	7697-37-2	65 - 70
Water	7732-18-5	30 - 35

4. First-aid measures

General Advice Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.

	Immediate medical attention is required.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. Remove and wash contaminated clothing before re-use. Call a physician immediately.
Inhalation	If breathing is difficult, give oxygen. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Remove from exposure, lie down. Call a physician immediately.
Ingestion	Do not induce vomiting. Never give anything by mouth to an unconscious person. Clean mouth with water. Call a physician immediately.
Most important symptoms/effects	Causes burns by all exposure routes. . Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation: Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	CO_2, dry chemical, dry sand, alcohol-resistant foam.
Unsuitable Extinguishing Media	No information available
Flash Point	Not applicable
Method -	No information available
Autoignition Temperature	No information available
Explosion Limits	
Upper	No data available
Lower	No data available
Oxidizing Properties	Oxidizer
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors. The product causes burns of eyes, skin and mucous membranes. Oxidizer: Contact with combustible/organic material may cause fire. May ignite combustibles (wood paper, oil, clothing, etc.).

Hazardous Combustion Products
Nitrogen oxides (NOx) Thermal decomposition can lead to release of irritating gases and vapors
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

NFPA

Health	Flammability	Instability	Physical hazards
4	0	0	OX

6. Accidental release measures

Personal Precautions	Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Ensure adequate ventilation. Use personal protective equipment.
Environmental Precautions	Should not be released into the environment. Do not flush into surface water or sanitary sewer system. See Section 12 for additional ecological information.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Sweep up and shovel into suitable containers for disposal.

7. Handling and storage

Handling Use only under a chemical fume hood. Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Do not ingest. Do not breathe vapors or spray mist. Keep away from clothing and other combustible materials.

Storage Keep containers tightly closed in a cool, well-ventilated place. Do not store near combustible materials.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Nitric acid	TWA: 2 ppm STEL: 4 ppm	(Vacated) TWA: 2 ppm (Vacated) TWA: 5 mg/m³ (Vacated) STEL: 4 ppm (Vacated) STEL: 10 mg/m³ TWA: 2 ppm TWA: 5 mg/m³	IDLH: 25 ppm TWA: 2 ppm TWA: 5 mg/m³ STEL: 4 ppm STEL: 10 mg/m³

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Nitric acid	TWA: 2 ppm TWA: 5.2 mg/m³ STEL: 4 ppm STEL: 10 mg/m³	TWA: 2 ppm TWA: 5 mg/m³ STEL: 4 ppm STEL: 10 mg/m³	TWA: 2 ppm STEL: 4 ppm

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures Use only under a chemical fume hood. Ensure that eyewash stations and safety showers are close to the workstation location. Ensure adequate ventilation, especially in confined areas.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166. Tightly fitting safety goggles. Face-shield.

Skin and body protection Long sleeved clothing.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Keep away from food, drink and animal feeding stuffs. When using, do not eat, drink or smoke. Contaminated work clothing should not be allowed out of the workplace. Provide regular cleaning of equipment, work area and clothing. Avoid contact with skin, eyes and clothing. For environmental protection remove and wash all contaminated protective equipment before re-use. Wear suitable gloves and eye/face protection.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Clear Colorless, Light yellow
Odor	Strong Acrid
Odor Threshold	No information available
pH	< 1.0 (0.1M)

Melting Point/Range	-41 °C / -41.8 °F
Boiling Point/Range	Not applicable °C / °F
Flash Point	Not applicable
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	0.94 kPa (20°C)
Vapor Density	No information available
Specific Gravity	1.40
Solubility	miscible
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	HNO3
Molecular Weight	63.02

10. Stability and reactivity

Reactive Hazard Yes

Stability Oxidizer: Contact with combustible/organic material may cause fire.

Conditions to Avoid Incompatible products. Combustible material. Excess heat. Exposure to air or moisture over prolonged periods.

Incompatible Materials Combustible material, Strong bases, Reducing agents, Metals, Powdered metals, Organic materials, Aldehydes, Alcohols, Cyanides, Ammonia, Strong reducing agents

Hazardous Decomposition Products Nitrogen oxides (NOx), Thermal decomposition can lead to release of irritating gases and vapors

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Oral LD50 Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.

Dermal LD50 Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.

Vapor LC50 Based on ATE data, the classification criteria are not met. ATE > 20 mg/l.

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Nitric acid	Not listed	Not listed	LC50 = 2500 ppm. (Rat) 1h
Water	-	Not listed	Not listed

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Causes severe burns by all exposure routes

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico

Nitric acid	7697-37-2	Not listed	Not listed	Not listed	Not listed	Not listed
Water	7732-18-5	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Respiratory system
STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation: Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Do not empty into drains. Large amounts will affect pH and harm aquatic organisms. Contains a substance which is:. Harmful to aquatic organisms. The product contains following substances which are hazardous for the environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Nitric acid	Not listed	LC50: = 72 mg/L, 96h (Gambusia affinis)	Not listed	Not listed

Persistence and Degradability Miscible with water Persistence is unlikely based on information available.
Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its water solubility.

Component	log Pow
Nitric acid	-2.3

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT

UN-No UN2031
Proper Shipping Name NITRIC ACID
Hazard Class 8
Subsidiary Hazard Class 5.1
Packing Group II

TDG

UN-No UN2031
Proper Shipping Name NITRIC ACID
Hazard Class 8
Subsidiary Hazard Class 5.1
Packing Group II

IATA

UN-No UN2031

Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

IMDG/IMO

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Nitric acid	X	X	-	231-714-2	-		X	X	X	X	X
Water	X	X	-	231-791-2	-		X	-	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Nitric acid	7697-37-2	65 - 70	1.0

SARA 311/312 Hazard Categories

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	Yes

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Nitric acid	X	1000 lb	-	-

Clean Air Act Not applicable

OSHA Occupational Safety and Health Administration

Component	Specifically Regulated Chemicals	Highly Hazardous Chemicals
Nitric acid	-	TQ: 500 lb

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Nitric acid	1000 lb	1000 lb

California Proposition 65 This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Nitric acid	X	X	X	X	X
Water	-	-	X	-	-

U.S. Department of Transportation

Reportable Quantity (RQ): Y
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security
This product contains the following DHS chemicals:

Component	DHS Chemical Facility Anti-Terrorism Standard
Nitric acid	2000 lb STQ

Other International Regulations

Mexico - Grade No information available

Canada
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

WHMIS Hazard Class
C Oxidizing materials
E Corrosive material
D2B Toxic materials

16. Other information

Prepared By Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 12-Mar-2009
Revision Date 15-Dec-2015
Print Date 15-Dec-2015
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the

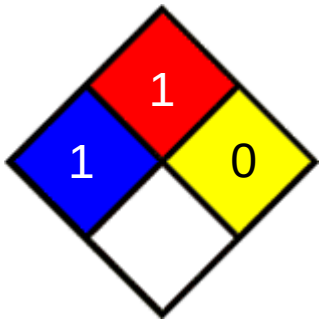
date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

SAFETY DATA SHEET

SECTION 1: PRODUCT AND COMPANY INFORMATION			
PRODUCT TYPE:	Activated Carbon		
PRODUCT NAME:	ORC Carbon		
COMPANY ID:	Evoqua Water Technologies LLC 181 Thorn Hill Drive, Warrendale, PA 15086		
TELEPHONE NUMBER:	**INFORMATION:**	**CORPORATE**	866.926.8420
	MEDICAL EMERGENCY:	**CHEMTREC**	800.424.9300
	TRANSPORTATION EMERGENCY:	**CHEMTREC**	800.424.9300
DATE PREPARED:	May 18, 2015	**REVISION:** 0	

SECTION 2: HAZARD(S) IDENTIFICATION

HMIS RATINGS		NFPA RATINGS	GUIDE
HEALTH	1		4 – EXTREME/SEVERE 3 – HIGH/SERIOUS 2 – MODERATE 1 - SLIGHT 0 – MINIMUM ~~W~~ – WATER REACTIVE OX - OXIDIZER
FLAMMABILITY	1		
PHYSICAL HAZARD	0		
PERSONAL PROTECTION	E		

PICTOGRAM	SIGNAL WORD	HAZARD STATEMENT
	WARNING	H315: Causes skin irritation H320: Causes eye irritation

PRECAUTIONARY STATEMENT(S)	
PREVENTION	P261: Avoid breathing dust/fume P264: Wash thoroughly after handling.
RESPONSE	P305: IF IN EYES: Irrigate for 15 minutes P304: IF INHALED: Remove to fresh air
STORAGE	P402: Store in a dry place. P403: Store in a well ventilated place. P404: Store in a closed container.

OTHER HAZARDS
NONE

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

PERCENT BY WEIGHT	COMMON NAME (Ingredient / Component)	CAS NO.	IMPURITIES
100%	Carbon	7440-44-0	NONE

SECTION 4: FIRST-AID MEASURES	
NECESSARY FIRST AID INSTRUCTIONS	
INHALATION FIRST AID	Remove affected person to fresh air. Give artificial respiration ONLY if breathing has stopped and give CPR ONLY if there is no breathing and no pulse. Obtain medical attention immediately.
SKIN CONTACT FIRST AID	Wash skin for 5 minutes with flowing water and soap. Clothing should be washed before reuse. Obtain medical assistance if irritation develops.
EYE CONTACT FIRST AID	Immediately irrigate eyes with flowing water continuously for 15 minutes while holding eyelids open. Contacts should be removed before or during flushing. Get medical assistance if irritation develops.
INGESTION FIRST AID:	Do not induce vomiting. Obtain medical attention immediately.
DESCRIPTION OF MOST IMPORTANT SYMPTOMS	
No Additional Information Available.	
RECOMMENDATIONS FOR IMMEDIATE MEDICAL CARE	
No Additional Information Available.	

SECTION 5: FIRE-FIGHTING MEASURES	
SUITABLE EXTINGUISHING MEDIA	Water spray, carbon Dioxide, Foam or Dry Chemical
UNSUITABLE EXTINGUISHING MEDIA	None
SPECIFIC HAZARDS	Avoid producing suspensions of dust during handling and avoid exposure of suspensions to sources of ignition. Suspensions of - 40 mesh particles may explode if exposed to strong ignition sources. Carbon monoxide and carbon dioxide gas may be emitted upon combustion of material Contact with strong oxidizers such as ozone or liquid oxygen may cause rapid combustion.
PERSONAL PROTECTIVE EQUIPMENT	In the event of a fire, wear full protective clothing and NIOSH approved self-contained breathing apparatus with full face piece, operated in positive pressure mode.

SECTION 6: ACCIDENTAL RELEASE MEASURES	
PERSONAL PRECAUTIONS, PROTECTIVE EQUIPMENT AND EMERGENCY PROCEDURES	
PERSONAL PRECAUTIONS	Handle in accordance with good industrial hygiene and safety practices. These practices include avoiding unnecessary exposure and removal of a material from eyes, skin, and clothing.
ENVIRONMENTAL PRECAUTIONS	The material, in its original state, is not harmful to the environment.
CONTAINMENT AND CLEAN-UP	Clean up spills in a manner that does not disperse dust into the air. Avoid introducing materials into waterway.
OTHER INFORMATION	None.

SECTION 7: HANDLING AND STORAGE	
PRECAUTIONS FOR SAFE HANDLING	Avoid dispersion into air. Keep containers dry and closed. Follow good handling and housekeeping practices to minimize spills, generation of airborne dusts, and accumulation of dusts on exposed surfaces. Use with adequate exhaust ventilation to

	draw dust away from workers' breathing zones. Prevent or minimize exposures to dusts by using appropriate respirators, gloves and eye protection. Wash exposed skin areas thoroughly with soap and water. Use caution when pouring, using pneumatic transport, swirling, etc. as this material can become electrostatically charged and present a dust explosion hazard.
CONDITIONS FOR SAFE STORAGE	Avoid spilling material so as to avoid creating a dust suspension. Store at ambient atmospheric conditions. Product should be stored in a closed dry container. Maintain good housekeeping procedures. Store away from strong oxidizers such as ozone, liquid oxygen, chlorine, permanganate, etc.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION			
ENGINEERING CONTROLS	Provide ventilation if necessary to minimize exposure. General ventilation is usually acceptable, but local mechanical exhaust ventilation is preferred at sources of air contamination such as open process equipment.		
RESPIRATORY PROTECTION	If use conditions generate dust levels above the TLV / PEL, wear a NIOSH-approved particulate respirator or a NIOSH-approved cartridge respirator fitted with dust filters.		
SKIN PROTECTION	Wear appropriate dust resistant clothing and gloves.		
EYE/FACE PROTECTION	Safety glasses with side shields. If eye contact or dusty conditions are likely, wear dust tight goggles.		
EXPOSURE LIMITS/GUIDELINES	Exposure limits have not been established for this material. However, the following are widely accepted limits for exposure to otherwise nontoxic particulates:		
	RESULT	**OSHA 8 HR** mg/m^3	**ACGIH TLV 8 HR** mg/m^3
PARTICULATES NOT OTHERWISE REGULATED (PNOR)	TWA	15 (total) 5 (respirable)	- - - - - -
PARTICULATES NOT OTHERWISE CLASSIFIED (PNOC)	TWA	- - - - - -	10 (inhalable) 3 (respirable)

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES			
COLOR	Black	**MOLECULAR WEIGHT**	NA
ODOR	NONE	**ODOR THERSHOLD**	NONE
pH VALUE	NA	**VAPOR PRESSURE**	0
MELTING POINT	NA	**VAPOR DENSITY**	SOLID
FREEZING POINT	NA	**RELATIVE DENSITY**	0.4 to 0.7
INITIAL BOILING POINT	NA	**SOLUBILITY**	NOT SOLUABLE
FLASHPOINT	NA	**PARTITION COEFFICEINT**	NA
EVAPORATION RATE	NA	**AUTO IGNITION TEMP.**	>220˚ C
FLAMMABILITY	>220˚ C	**DECOMP. TEMP.**	NA
UEL	NA	**VISCOSITY**	NA
LEL	NA		

SECTION 10: STABILITY AND REACTIVITY	
REACTIVIVITY	NA
CHEMICAL STABILITY	Stable
POSSIBILITY OF HAZARDOUS REACTIONS	None
CONDITIONS TO AVOID	Contact with strong oxidizers such as ozone, liquid oxygen, chlorine, permanganate, etc. may result in rapid combustion. Avoid contact with strong acids.
HAZAROUS DECOMPOSITION PRODUCTS	Hazardous decomposition will produce carbon oxides.

SECTION 11: TOXICOLOGICAL INFORMATION		
INHALATION	ACUTE	Inhalation of carbon dust is mildly irritating to the lungs and can immediately give rise to an increased mucociliary transport and airway resistance mediated by the vagus. Inhalation LC50 (Rat) > 64.4 mg / l
	CHRONIC	There are no known chronic inhalation effects
SKIN	ACUTE	Skin contact is expected to be slightly irritating. The primary skin irritation index (rabbit) is 0.
	CHRONIC	There are no known chronic dermal effects.
EYE	ACUTE	Eye contact can cause conjunctivitis, epithelial hyperplasia of the cornea, as well as eczematous inflammation of the eyelids.
INGESTION	ACUTE	Activated carbon is practically nontoxic. The probable oral lethal dose (human) is greater than 15 g / kg; more than one quart (2.2 lbs) for a 150 lb person.
	CHRONIC	There are no known chronic ingestion effects.
LD50		
LC50		
ACUTE TOXICITY ESTIMATES		
CARCINOGENICITY/MUTAGENICITY		There are no known carcinogenic/mutagenic effects.
REPRODUCTIVE EFFECTS		There are no known reproductive effects.
NEUROTOXICITY		There are no known neurotoxic effects.
OTHER EFFECTS		No other effects of carbon are known.
TARGET ORGANS		Target organs include the respiratory system and the cardiovascular system.

SECTION 12: ECOLOGICAL INFORMATION
The material, in its original state, is not harmful to the environment.

SECTION 13: DISPOSAL CONSIDERATIONS	
SPILL/LEAK PROCEDURES	Clean spills in a manner that does not disperse dust into the air, preferably a wet-down procedure or vacuum.
CLEANUP	If material is not contaminated, spilled media can be re-bagged. Material that cannot be used or chemically reprocessed and empty containers should be disposed of in accordance with all applicable regulations. Product containers should be thoroughly emptied before disposal.
REGULATORY REQUIREMENTS	Generators of waste material are required to evaluate all waste for compliance with RCRA and any local disposal procedures and regulations. NOTE: State and local regulations may be more stringent than federal regulations.
DISPOSAL	Material that cannot be used or chemically reprocessed and empty containers should be disposed of in accordance with all applicable regulations. Product containers should be thoroughly emptied before disposal. Warning: Wet activated carbon depletes oxygen from the air and therefore dangerously low levels of oxygen may be encountered. Whenever workers enter a vessel containing activated carbon, the vessel's oxygen content should be determined and work procedures for potentially low oxygen areas should be followed.

SECTION 14: TRANSPORT INFORMATION		
LAND – DOT	**UN/NA IDENTIFICATION NUMBER:**	Not Applicable to unused finished product
	UN-PROPER SHIPPING NAME:	Not Applicable to unused finished product
	TRANSPORT HAZARD CLASS:	Not Applicable to unused finished product
	PACKING GROUP:	Not Applicable to unused finished product
	MARINE POLLUTANT:	Not Applicable to unused finished product
	HAZARD CLASS:	Not Applicable to unused finished product

WATER – IMO/IMDG	**UN/NA IDENTIFICATION NUMBER:**	Not Applicable to unused finished product
	UN-PROPER SHIPPING NAME:	Not Applicable to unused finished product
	TRANSPORT HAZARD CLASS:	Not Applicable to unused finished product
	PACKING GROUP:	Not Applicable to unused finished product
	MARINE POLLUTANT:	Not Applicable to unused finished product
AIR – ICAO/IATA *For product quantities less than 0.5 Kg*	**UN/NA IDENTIFICATION NUMBER:**	Not Applicable to unused finished product
	UN-PROPER SHIPPING NAME:	Not Applicable to unused finished product
	TRANSPORT HAZARD CLASS:	Not Applicable to unused finished product
	PACKING GROUP:	Not Applicable to unused finished product
	MARINE POLLUTANT:	Not Applicable to unused finished product
This material does not meet the definition of a self-heating substance (Class 4.2) as determined by the test protocol for a "self-heating substance" United Nations Transportation of Dangerous Goods, Manual of Tests and Criteria, Part III, Section 33.3.1.6 – Test N.4 – Test Method for Self-Heating Substances.		

SECTION 15: REGULATORY INFORMATION	
OSHA	Hazard Communication Standard: Irritant
OSHA	Process Safety Standard: No
CAA	Section 112r: No
CERCLA	Section 103: No RQ: None
SARA	Section 302: No; SARA Section 304: No; SARA Section 313: No
SARA HAZARD CATEGORIES 311/312	**Acute:** Yes Chronic: No **Fire:** No **Reactive:** No **Sudden Pressure Release:** No
TSCA	The ingredients of this product are on the TSCA Inventory List.

SECTION 16: OTHER INFORMATION	
DISCLAIMER:	The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the user thereof. It is the buyer's responsibility to ensure that its activities comply with federal, state, provincial and local laws.
REVISION INDICATOR:	Revision 0: (This SDS replaces the former MSDS for this product pursuant to OSHA 1910.1200(g) Appendix D. The MSDS for this product should be considered obsolete).

Hydrosil International LTD.
125 Prairie Lake Road - East Dundee, IL 60118
Phone: 847-844-0680
Emergency Phone: 847-844-0680
Fax: 847-844-0799

Back to HS-200 page

HS-200

Media to Remove Oil, Heavy Metals and Similar Organics from Water Safety Data Sheet

Revision date : 2017

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 - Product Identifier

Product Name: HS-200

1.2 - Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture : Filtration

1.3 - Details of the supplier of the safety data sheet

Hydrosil International Ltd.
125 Prairie Lake Rd
East Dundee, IL 60118

T 847-844-0680 - F 847-844-0799
www.hydrosilintl.com

1.4 - Emergency telephone number

Emergency number : 1-847-844-0680

Section 2: Hazards Identification

2.1 - Classification of the substance or mixture

GHS-US classification
Eye Dam. 1 H318
STOT SE 3 H335

2.2 - Label Elements

GHS-US labeling
Hazard pictograms (GHS-US) :

Signal word (GHS-US) : Danger
Hazard statements (GHS-US) :

H318 - Causes serious eye damage
H335 - May cause respiratory irritation

Precautionary statements (GHS-US) :

P261 - Avoid breathing dust/fume/gas/mist/vapors/spray
P271 - Use only outdoors or in a well-ventilated area
P280 - Wear protective gloves/protective clothing/eye protection/face protection
P304+P340 - IF INHALED: Remove person to fresh air and keep comfortable for breathing
P305+P351+P338 - If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P310 - Immediately call a POISON CENTER/doctor/…
P312 - Call a POISON CENTER/doctor/…/if you feel unwell
P403+P233 - Store in a well-ventilated place. Keep container tightly closed
P405 - Store locked up
P501 - Dispose of contents/container to ...

2.3 - Other Hazards

No additional information available

2.4 - Unknown acute toxicity (GHS US)

No data available

SECTION 3: Composition/information on ingredients

3.1 - Substances

Not applicable

3.2 - Mixture

Name	Product Identifier	%	GHS-US Classification
Zeolite	(CAS No.) 1318-02-1	85.2 - 86.2	STOT SE 3, H335
Water	(CAS No.) 7732-18-5	8.4 - 11.4	Not classified
N,N,N-Trimethyl-1-hexadecanaminium chloride	(CAS No.) 112-02-7	3.4 - 5.4	Skin Irrit. 2, H315 Eye Dam. 1, H318 Aquatic Acute 1, H400

SECTION 4: First aid measures

4.1 - Description of first aid measures

First-aid measures after inhalation : Remove person to fresh air. If not breathing, administer CPR or artificial respiration. Get immediate medical attention.
First-aid measures after skin contact : If skin reddening or irritation develops, seek medical attention.
First-aid measures after eye contact : Immediately flush eyes with plenty of water for at least 15 minutes. If irritation persists get medical attention.
First-aid measures after ingestion : If the material is swallowed, get immediate medical attention or advice. DO NOT induce vomiting unless directed to do so by medical personnel.

4.2 - Most important symptoms and effects, both acute and delayed

Symptoms/injuries after inhalation : May cause respiratory irritation.
Symptoms/injuries after skin contact : Causes skin irritation.
Symptoms/injuries after eye contact : Causes serious eye irritation.
Symptoms/injuries after ingestion : May be harmful if swallowed.

4.3 - Indication of any immediate medical attention and special treatment needed

No additional information available

SECTION 5: Firefighting measures

5.1 - Extinguishing media

Suitable extinguishing media : If involved with fire, flood with plenty of water.
Unsuitable extinguishing media : None.

5.2 - Special hazards arising from the substance or mixture

Fire hazard : None known.
Explosion hazard : None known.

5.3 - Advice for firefighters

Protection during firefighting : Firefighters should wear full protective gear.

SECTION 6: Accidental release measures

6.1 - Personal precautions, protective equipment and emergency procedures

General measures : Avoid contact with the skin and the eyes.
For non-emergency personnel : No additional information available
For emergency responders : No additional information available

6.2 - Environmental precautions

None.

6.3 - Methods and material for containment and cleaning up

For containment : If possible, stop flow of product.
Methods for cleaning up : Shovel or sweep up and put in a closed container for disposal.

6.4 - Reference to other sections

No additional information available

SECTION 7: Handling and storage

7.1 - Precautions for safe handling

Precautions for safe handling : Wet carbon/coal removes oxygen from air causing a severe hazard to workers inside carbon vessels or confined spaces.

7.2 - Conditions for safe storage, including any incompatibilities

Storage conditions : Protect containers from physical damage. Store in dry, cool, well-ventilated area.

7.3 - Specific end use(s)

No additional information available

SECTION 8: Exposure controls/personal protection

8.1 - Control parameters

No additional information available

8.2 - Exposure controls

Appropriate engineering controls : Local exhaust and general ventilation must be adequate to meet exposure standards.
Hand protection : Use impervious gloves.
Eye protection : Safety glasses.
Skin and body protection : Wear suitable working clothes.
Respiratory protection : If airborne concentrations are above the applicable exposure limits, use NIOSH approved respiratory protection.

SECTION 9: Physical and chemical properties

9.1 - Information on basic physical and chemical properties

Physical state : Solid
Appearance : Irregular shaped.
Color : White
Odor : No data available
Odor threshold : No data available
pH : No data available
Relative evaporation rate (butyl acetate=1) : No data available
Melting point : No data available
Freezing point : No data available
Boiling point : No data available
Flash point : No data available
Self ignition temperature : No data available
Decomposition temperature : No data available
Flammability (solid, gas) : No data available
Vapor pressure : No data available
Relative vapor density at 20 °C : No data available
Relative density : 57-59 lb/ft3
Solubility : No data available
Log Pow : No data available
Log Kow : No data available
Viscosity, kinematics : No data available
Viscosity, dynamic : No data available
Explosive properties : No data available
Oxidizing properties : No data available
Explosive limits : No data available

9.1 - Other information

No additional information available

SECTION 10: Stability and Reactivity

10.1 - Reactivity

No additional information available

10.2 - Chemical stability

Stable under normal conditions.

10.3 - Possibility of hazardous reactions

Will not occur

10.4 - Conditions to avoid

None

10.5 - Incompatible materials

Strong oxidizing and reducing agents.

10.6 - Hazardous decomposition products

Organic chlorides, amines, hydrogen chloride may be produced.

SECTION 11: Toxicological information

11.1 - Information on toxicological effects

Acute toxicity : Not classified

Zeolite (1318-02-1)	
LD50 oral rat	5000 mg/kg
LD50 dermal rabbit	> 2000 mg/kg
LC50 inhalation rat (mg/l)	2.4 mg/l (Exposure time: 1 h)
ATE (oral)	5000 mg/kg

Skin corrosion/irritation : Not classified
Serious eye damage/irritation : Causes serious eye damage.
Respiratory or skin sensitization : Not classified
Germ cell mutagenicity : Not classified
Carcinogenicity : Not classified

Zeolite (1318-02-1)	
IARC group	3

Reproductive toxicity : Not classified
Specific target organ toxicity (single exposure) : May cause respiratory irritation.
Specific target organ toxicity (repeated exposure) : Not classified
Aspiration hazard : Not classified

SECTION 12: Ecological information

12.1 - Toxicity

Zeolite (1318-02-1)	
LC50 fishes 1	1800 mg/l (Exposure time: 96 h - Species: Brachydanio rerio [semi-static])
EC50 Daphnia 1	1000 - 1800 mg/l (Exposure time: 48 h - Species: Daphnia magna)
EC50 other aquatic organisms 1	18 mg/l (Exposure time: 96 h - Species: Desmodesmus subspicatus)
LC50 fish 2	3200 - 5600 mg/l (Exposure time: 96 h - Species: Oryzias latipes [semi-static])

12.2 - Persistence and degradability

No additional information available

12.3 - Bioaccumulative potential

No additional information available

12.4 - Mobility in soil

No additional information available

12.5 - Other adverse effects

No additional information available

SECTION 13: Disposal considerations

13.1 - Waste treatment methods

Waste disposal recommendations : Dispose of contents/container in accordance with local/regional/national/international regulations.

SECTION 14: Transport information

In accordance with DOT / ADR / RID / ADNR / IMDG / ICAO / IATA

14.1 - UN number

Not applicable

14.2 - UN proper shipping name

Not applicable

SECTION 15: Regulatory information

15.1 - US Federal regulations

15.2 - US State regulations

No additional information available

SECTION 16: Other information

Full text of H-phrases:

Aquatic Acute 1	Hazardous to the aquatic environment - Acute Hazard Category 1
Eye Dam. 1	Serious eye damage/eye irritation Category 1
Skin Irrit. 2	skin corrosion/irritation Category 2
STOT SE 3	Specific target organ toxicity (single exposure) Category 3
H315	Causes skin irritation
H318	Causes serious eye damage
H335	May cause respiratory irritation
H400	Very toxic to aquatic life

NFPA health hazard : 2 - Intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt
medical attention is given.
NFPA fire hazard : 0 - Materials that will not burn.
NFPA reactivity : 0 - Normally stable, even under fire exposure conditions, and are not reactive with water

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SAFETY DATA SHEET

Version 4.7
Revision Date 10/07/2014
Print Date 02/26/2015

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Xylenes

Product Number : 247642
Brand : Sigma-Aldrich

CAS-No. : 1330-20-7

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA

Telephone : +1 800-325-5832
Fax : +1 800-325-5052

1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Flammable liquids (Category 3), H226
Acute toxicity, Inhalation (Category 4), H332
Acute toxicity, Dermal (Category 4), H312
Skin irritation (Category 2), H315
Acute aquatic toxicity (Category 2), H401
Chronic aquatic toxicity (Category 2), H411

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Warning

Hazard statement(s)
H226 Flammable liquid and vapour.
H312 + H332 Harmful in contact with skin or if inhaled
H315 Causes skin irritation.
H411 Toxic to aquatic life with long lasting effects.

Precautionary statement(s)
P210 Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P233 Keep container tightly closed.
P240 Ground/bond container and receiving equipment.
P241 Use explosion-proof electrical/ ventilating/ lighting/ equipment.

P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P303 + P361 + P353	IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P304 + P340	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P312	Call a POISON CENTER or doctor/ physician if you feel unwell.
P322	Specific measures (see supplemental first aid instructions on this label).
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.
P391	Collect spillage.
P403 + P235	Store in a well-ventilated place. Keep cool.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.2 Mixtures

Synonyms : Xylene mixture of isomers

Formula : C_8H_{10}

Molecular weight : 106.17 g/mol

Hazardous components

Component		Classification	Concentration
Xylene			
CAS-No. EC-No. Index-No.	1330-20-7 215-535-7 601-022-00-9	Flam. Liq. 3; Acute Tox. 4; Skin Irrit. 2; Aquatic Acute 2; Aquatic Chronic 2; H226, H312 + H332, H315, H411	>= 90 - <= 100 %
Ethylbenzene			
CAS-No. EC-No. Index-No.	100-41-4 202-849-4 601-023-00-4	Flam. Liq. 2; Acute Tox. 4; Aquatic Acute 2; Aquatic Chronic 2; H225, H332, H411	>= 20 - < 30 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Carbon oxides

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.
For personal protection see section 8.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up
Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
Keep away from sources of ignition - No smoking.Take measures to prevent the build up of electrostatic charge.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Xylene	1330-20-7	TWA	100 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Eye & Upper Respiratory Tract irritation Central Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		STEL	150 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Eye & Upper Respiratory Tract irritation Central Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		STEL	150 ppm 655 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		TWA	100 ppm 435 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		TWA	100 ppm 435 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
Ethylbenzene	100-41-4	TWA	20 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Cochlear impair Kidney damage (nephropathy) Upper Respiratory Tract irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans		
		TWA	100 ppm 435 mg/m3	USA. NIOSH Recommended Exposure Limits
		ST	125 ppm 545 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	100 ppm 435 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		TWA	100 ppm 435 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		STEL	125 ppm 545 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Xylene	1330-20-7	Methylhippuric acids	1,500.0000 mg/g	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift (As soon as possible after exposure ceases)			
		Methylhippuric acids	1,500.0000 mg/g	Urine	ACGIH - Biological Exposure Indices (BEI)
		End of shift (As soon as possible after exposure ceases)			
Ethylbenzene	100-41-4	Ethylbenzene		In end-exhaled air	ACGIH - Biological Exposure Indices (BEI)

		Not critical

8.2 Exposure controls

Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection
Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Fluorinated rubber
Minimum layer thickness: 0.7 mm
Break through time: 480 min
Material tested:Vitoject® (KCL 890 / Aldrich Z677698, Size M)

Splash contact
Material: Fluorinated rubber
Minimum layer thickness: 0.7 mm
Break through time: 480 min
Material tested:Vitoject® (KCL 890 / Aldrich Z677698, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Complete suit protecting against chemicals, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: clear, liquid Colour: colourless
b)	Odour	No data available
c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	< 0 °C (< 32 °F)
f)	Initial boiling point and	137 - 140 °C (279 - 284 °F) - lit.

	boiling range	
g)	Flash point	25 °C (77 °F) - closed cup
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	Upper explosion limit: 7 %(V) Lower explosion limit: 1.1 %(V)
k)	Vapour pressure	24 hPa (18 mmHg) at 37.70 °C (99.86 °F)
l)	Vapour density	3.67 - (Air = 1.0)
m)	Relative density	0.86 g/mL at 25 °C (77 °F)
n)	Water solubility	No data available
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information

Relative vapour density	3.67 - (Air = 1.0)

10. STABILITY AND REACTIVITY

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
Vapours may form explosive mixture with air.

10.4 Conditions to avoid
Heat, flames and sparks.

10.5 Incompatible materials
Strong oxidizing agents

10.6 Hazardous decomposition products
Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
No data available

Inhalation: No data available

Dermal: No data available

No data available

Skin corrosion/irritation
No data available

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity

No data available

Carcinogenicity

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Ethylbenzene)

IARC: 3 - Group 3: Not classifiable as to its carcinogenicity to humans (Xylene)

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity
No data available
No data available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

Additional Information
RTECS: Not available

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Liver - Irregularities - Based on Human Evidence
Stomach - Irregularities - Based on Human Evidence
Stomach - Irregularities - Based on Human Evidence (Ethylbenzene)

12. ECOLOGICAL INFORMATION

12.1 Toxicity
No data available

12.2 Persistence and degradability
No data available

12.3 Bioaccumulative potential
No data available

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects
An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.
Toxic to aquatic life.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product
Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 1307 Class: 3 Packing group: III
Proper shipping name: Xylenes
Reportable Quantity (RQ): 100 lbs
Marine pollutant: No
Poison Inhalation Hazard: No

IMDG
UN number: 1307 Class: 3 Packing group: III EMS-No: F-E, S-D
Proper shipping name: XYLENES
Marine pollutant: No

IATA
UN number: 1307 Class: 3 Packing group: III
Proper shipping name: Xylenes

15. REGULATORY INFORMATION

SARA 302 Components
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Ethylbenzene	100-41-4	2007-07-01
Xylene	1330-20-7	1993-04-24

SARA 311/312 Hazards
Fire Hazard, Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Ethylbenzene	100-41-4	2007-07-01
Xylene	1330-20-7	1993-04-24

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Ethylbenzene	100-41-4	2007-07-01
Xylene	1330-20-7	1993-04-24

New Jersey Right To Know Components

	CAS-No.	Revision Date
Ethylbenzene	100-41-4	2007-07-01
Xylene	1330-20-7	1993-04-24

California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer.	CAS-No.	Revision Date
Ethylbenzene	100-41-4	2007-09-28

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Flam. Liq.	Flammable liquids
H225	Highly flammable liquid and vapour.
H226	Flammable liquid and vapour.
H312	Harmful in contact with skin.
H312 + H332	Harmful in contact with skin or if inhaled
H315	Causes skin irritation.
H332	Harmful if inhaled.
H401	Toxic to aquatic life.
H411	Toxic to aquatic life with long lasting effects.
Skin Irrit.	Skin irritation

HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	3
Physical Hazard	0

NFPA Rating

Health hazard:	2
Fire Hazard:	3
Reactivity Hazard:	0

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Preparation Information

Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 4.7 Revision Date: 10/07/2014 Print Date: 02/26/2015

SAFETY DATA SHEET

1. Identification

Product identifier **PAH-Mixture 610/525/550**

Other means of identification

Item M-PPH10M1

Recommended use For Laboratory Use Only

Recommended restrictions None known.

Manufacturer/Importer/Supplier/Distributor information

Manufacturer

Company name Chem Service, Inc.

Address 660 Tower Lane
West Chester, PA 19380
United States

Telephone Toll Free 800-452-9994
Direct 610-692-3026

Website www.chemservice.com

E-mail info@chemservice.com

Emergency phone number Chemtrec US 800-424-9300
Chemtrec outside US +1 703-527-3887

2. Hazard(s) identification

Physical hazards	Flammable liquids	Category 2
Health hazards	Acute toxicity, oral	Category 3
	Acute toxicity, dermal	Category 3
	Acute toxicity, inhalation	Category 3
	Serious eye damage/eye irritation	Category 2A
	Carcinogenicity	Category 1B
	Reproductive toxicity	Category 2
	Specific target organ toxicity, single exposure	Category 1
	Specific target organ toxicity, repeated exposure	Category 1
Environmental hazards	Hazardous to the aquatic environment, acute hazard	Category 2
	Hazardous to the aquatic environment, long-term hazard	Category 2

OSHA defined hazards Not classified.

Label elements

Signal word Danger

Hazard statement Highly flammable liquid and vapor. Toxic if swallowed. Toxic in contact with skin. Causes serious eye irritation. Toxic if inhaled. May cause cancer. Suspected of damaging fertility or the unborn child. Causes damage to organs. Causes damage to organs through prolonged or repeated exposure. Toxic to aquatic life. Toxic to aquatic life with long lasting effects.

Precautionary statement

Prevention Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Keep away from heat/sparks/open flames/hot surfaces. - No smoking. Use only outdoors or in a well-ventilated area. Keep container tightly closed. Ground/bond container and receiving equipment. Use explosion-proof electrical/ventilating/lighting equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Do not breathe mist or vapor. Wash thoroughly after handling. Do not eat, drink or smoke when using this product. Avoid release to the environment. Wear protective gloves/protective clothing/eye protection/face protection.

Response	If swallowed: Immediately call a poison center/doctor. If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. If inhaled: Remove person to fresh air and keep comfortable for breathing. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Call a poison center/doctor. Specific treatment (see this label). Rinse mouth. If eye irritation persists: Get medical advice/attention. Take off immediately all contaminated clothing and wash it before reuse. In case of fire: Use appropriate media to extinguish. Collect spillage.
Storage	Store in a well-ventilated place. Keep container tightly closed. Store in a well-ventilated place. Keep cool. Store locked up.
Disposal	Dispose of contents/container in accordance with local/regional/national/international regulations.
Hazard(s) not otherwise classified (HNOC)	Static accumulating flammable liquid can become electrostatically charged even in bonded and grounded equipment. Sparks may ignite liquid and vapor. May cause flash fire or explosion.
Supplemental information	0.97% of the mixture consists of component(s) of unknown acute oral toxicity. 0.97% of the mixture consists of component(s) of unknown acute dermal toxicity. 0.85% of the mixture consists of component(s) of unknown acute inhalation toxicity. 99.87% of the mixture consists of component(s) of unknown acute hazards to the aquatic environment. 99.87% of the mixture consists of component(s) of unknown long-term hazards to the aquatic environment.

3. Composition/information on ingredients

Mixtures

Chemical name	Common name and synonyms	CAS number	%
Methanol		67-56-1	90 - 100
1,12-Benzoperylene		191-24-2	0.01
1,2:5,6-Dibenzanthracene		53-70-3	0.01
1,2-Benzanthracene		56-55-3	0.01
Acenaphthene		83-32-9	0.01
Acenaphthylene		208-96-8	0.01
Anthracene		120-12-7	0.01
Benzo(a)pyrene		50-32-8	0.01
Benzo(b)fluoranthene		205-99-2	0.01
Benzo(k)fluoranthene		207-08-9	0.01
Chrysene		218-01-9	0.01
Fluoranthene		206-44-0	0.01
Fluorene		86-73-7	0.01
Indeno(1,2,3-C,D)pyrene		193-39-5	0.01
Naphthalene		91-20-3	0.01
Phenanthrene		85-01-8	0.01
Pyrene		129-00-0	0.01

*Designates that a specific chemical identity and/or percentage of composition has been withheld as a trade secret.

4. First-aid measures

Inhalation	Remove victim to fresh air and keep at rest in a position comfortable for breathing. Oxygen or artificial respiration if needed. Do not use mouth-to-mouth method if victim inhaled the substance. Induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Call a POISON CENTER or doctor/physician.
Skin contact	Take off immediately all contaminated clothing. Rinse skin with water/shower. Call a POISON CENTER or doctor/physician if you feel unwell. Get medical attention if irritation develops and persists.
Eye contact	Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention if irritation develops and persists.
Ingestion	Call a physician or poison control center immediately. Rinse mouth. Do not induce vomiting without advice from poison control center. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs. Do not use mouth-to-mouth method if victim ingested the substance. Induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device.
Most important symptoms/effects, acute and delayed	Symptoms may include stinging, tearing, redness, swelling, and blurred vision. Prolonged exposure may cause chronic effects.

Indication of immediate medical attention and special treatment needed	Provide general supportive measures and treat symptomatically. Thermal burns: Flush with water immediately. While flushing, remove clothes which do not adhere to affected area. Call an ambulance. Continue flushing during transport to hospital. In case of shortness of breath, give oxygen. Keep victim warm. Keep victim under observation. Symptoms may be delayed.
General information	Take off immediately all contaminated clothing. IF exposed or concerned: Get medical advice/attention. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Wash contaminated clothing before reuse.

5. Fire-fighting measures

Suitable extinguishing media	Alcohol resistant foam. Water fog. Carbon dioxide (CO2). Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only.
Unsuitable extinguishing media	Do not use water jet as an extinguisher, as this will spread the fire.
Specific hazards arising from the chemical	Vapors may form explosive mixtures with air. Vapors may travel considerable distance to a source of ignition and flash back. This product is a poor conductor of electricity and can become electrostatically charged. If sufficient charge is accumulated, ignition of flammable mixtures can occur. To reduce potential for static discharge, use proper bonding and grounding procedures. This liquid may accumulate static electricity when filling properly grounded containers. Static electricity accumulation may be significantly increased by the presence of small quantities of water or other contaminants. Material will float and may ignite on surface of water. During fire, gases hazardous to health may be formed.
Special protective equipment and precautions for firefighters	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Fire-fighting equipment/instructions	In case of fire and/or explosion do not breathe fumes. Move containers from fire area if you can do so without risk.
Specific methods	Use standard firefighting procedures and consider the hazards of other involved materials.
General fire hazards	Highly flammable liquid and vapor.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Immediately evacuate personnel to safe areas. Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Keep out of low areas. Eliminate all ignition sources (no smoking, flares, sparks, or flames in immediate area). Wear appropriate protective equipment and clothing during clean-up. Do not breathe mist or vapor. Fully encapsulating, vapor protective clothing should be worn for spills and leaks with no fire. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ventilate closed spaces before entering them. Use appropriate containment to avoid environmental contamination. Transfer by mechanical means such as vacuum truck to a salvage tank or other suitable container for recovery or safe disposal. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8 of the SDS.
Methods and materials for containment and cleaning up	Eliminate all ignition sources (no smoking, flares, sparks, or flames in immediate area). Take precautionary measures against static discharge. Use only non-sparking tools. Keep combustibles (wood, paper, oil, etc.) away from spilled material. This material is classified as a water pollutant under the Clean Water Act and should be prevented from contaminating soil or from entering sewage and drainage systems which lead to waterways. Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal. Following product recovery, flush area with water. Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination. Never return spills to original containers for re-use. For waste disposal, see section 13 of the SDS.
Environmental precautions	Avoid release to the environment. Contact local authorities in case of spillage to drain/aquatic environment. Prevent further leakage or spillage if safe to do so. Do not contaminate water. Avoid discharge into drains, water courses or onto the ground. Use appropriate containment to avoid environmental contamination.

7. Handling and storage

Precautions for safe handling

Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Vapors may form explosive mixtures with air. Do not handle, store or open near an open flame, sources of heat or sources of ignition. Protect material from direct sunlight. Minimize fire risks from flammable and combustible materials (including combustible dust and static accumulating liquids) or dangerous reactions with incompatible materials. Handling operations that can promote accumulation of static charges include but are not limited to: mixing, filtering, pumping at high flow rates, splash filling, creating mists or sprays, tank and container filling, tank cleaning, sampling, gauging, switch loading, vacuum truck operations. Take precautionary measures against static discharges. All equipment used when handling the product must be grounded. Use non-sparking tools and explosion-proof equipment. Do not breathe mist or vapor. Do not taste or swallow. Avoid contact with skin. Avoid contact with eyes. Avoid contact during pregnancy/while nursing. Avoid prolonged exposure. Avoid contact with clothing. Use only outdoors or in a well-ventilated area. Wear appropriate personal protective equipment. Observe good industrial hygiene practices. When using, do not eat, drink or smoke. Wash hands thoroughly after handling. Wash contaminated clothing before reuse. Avoid release to the environment. Do not empty into drains.

For additional information on equipment bonding and grounding, refer to the Canadian Electrical Code in Canada, (CSA C22.1), or the American Petroleum Institute (API) Recommended Practice 2003, "Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents" or National Fire Protection Association (NFPA) 77, "Recommended Practice on Static Electricity" or National Fire Protection Association (NFPA) 70, "National Electrical Code".

Conditions for safe storage, including any incompatibilities

Store locked up. Keep away from heat, sparks and open flame. Prevent electrostatic charge build-up by using common bonding and grounding techniques. Avoid spark promoters. Eliminate sources of ignition. Ground/bond container and equipment. These alone may be insufficient to remove static electricity. Store in original tightly closed container. Store in a cool, dry place out of direct sunlight. Store in a well-ventilated place. Refrigeration recommended. Store away from incompatible materials (see Section 10 of the SDS). Keep in an area equipped with sprinklers.

8. Exposure controls/personal protection

Occupational exposure limits

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value
Methanol (CAS 67-56-1)	PEL	260 mg/m3 200 ppm
Naphthalene (CAS 91-20-3)	PEL	50 mg/m3 10 ppm

US. ACGIH Threshold Limit Values

Components	Type	Value
Methanol (CAS 67-56-1)	STEL	250 ppm
	TWA	200 ppm
Naphthalene (CAS 91-20-3)	STEL	15 ppm
	TWA	10 ppm

US. NIOSH: Pocket Guide to Chemical Hazards

Components	Type	Value
Methanol (CAS 67-56-1)	STEL	325 mg/m3 250 ppm
	TWA	260 mg/m3 200 ppm
Naphthalene (CAS 91-20-3)	STEL	75 mg/m3 15 ppm
	TWA	50 mg/m3 10 ppm

Biological limit values

ACGIH Biological Exposure Indices

Components	Value	Determinant	Specimen	Sampling Time
Methanol (CAS 67-56-1)	15 mg/l	Methanol	Urine	*

* - For sampling details, please see the source document.

Exposure guidelines

US - California OELs: Skin designation

Methanol (CAS 67-56-1) Can be absorbed through the skin.

US - Minnesota Haz Subs: Skin designation applies

Methanol (CAS 67-56-1)	Skin designation applies.

US - Tennesse OELs: Skin designation

Methanol (CAS 67-56-1)	Can be absorbed through the skin.

US ACGIH Threshold Limit Values: Skin designation

Methanol (CAS 67-56-1)	Can be absorbed through the skin.
Naphthalene (CAS 91-20-3)	Can be absorbed through the skin.

US NIOSH Pocket Guide to Chemical Hazards: Skin designation

Methanol (CAS 67-56-1)	Can be absorbed through the skin.

Appropriate engineering controls Explosion-proof general and local exhaust ventilation. Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Provide eyewash station.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear eye/face protection. Wear safety glasses with side shields (or goggles).

Skin protection

Hand protection Wear protective gloves.

Other Wear appropriate chemical resistant clothing.

Respiratory protection If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn.

Thermal hazards Wear appropriate thermal protective clothing, when necessary.

General hygiene considerations When using, do not eat, drink or smoke. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance

Physical state	Liquid.
Form	Liquid
Color	Not available.
Odor	Not available.
Odor threshold	Not available.
pH	Not available.
Melting point/freezing point	-144.04 °F (-97.8 °C) estimated
Initial boiling point and boiling range	148.46 °F (64.7 °C) estimated
Flash point	53.6 °F (12.0 °C) estimated
Evaporation rate	Not available.
Flammability (solid, gas)	Not available.

Upper/lower flammability or explosive limits

Flammability limit - lower (%)	7.3 % estimated
Flammability limit - upper (%)	Not available.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	169.3 hPa estimated
Vapor density	Not available.
Relative density	Not available.

Solubility(ies)

Solubility (water)	Not available.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	867.2 °F (464 °C) estimated
Decomposition temperature	Not available.
Viscosity	Not available.

Other information

Density	0.786933 g/cm3 estimated
Flammability class	Flammable IB estimated
Percent volatile	99 % estimated
Specific gravity	0.79 estimated
VOC (Weight %)	99 % estimated

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Material is stable under normal conditions.
Possibility of hazardous reactions	Hazardous polymerization does not occur.
Conditions to avoid	Avoid heat, sparks, open flames and other ignition sources. Avoid temperatures exceeding the flash point. Contact with incompatible materials.
Incompatible materials	Strong oxidizing agents.
Hazardous decomposition products	No hazardous decomposition products are known.

11. Toxicological information

Information on likely routes of exposure

Ingestion	Toxic if swallowed.
Inhalation	Toxic by inhalation. May cause damage to organs by inhalation.
Skin contact	Toxic in contact with skin.
Eye contact	Causes serious eye irritation.
Symptoms related to the physical, chemical and toxicological characteristics	Symptoms may include stinging, tearing, redness, swelling, and blurred vision.

Information on toxicological effects

Acute toxicity Toxic by inhalation. Toxic if swallowed. Toxic in contact with skin. Expected to be a low hazard for usual industrial or commercial handling by trained personnel.

Components	Species	Test Results
Anthracene (CAS 120-12-7)		
Acute		
Dermal		
LD50	Rat	> 1320 mg/kg
Oral		
LD50	Mouse	> 17000 mg/kg
		> 17 g/kg
	Rat	> 16000 mg/kg
Other		
LD50	Mouse	430 mg/kg
Benzo(a)pyrene (CAS 50-32-8)		
Acute		
Other		
LD50	Mouse	250 mg/kg
Chrysene (CAS 218-01-9)		
Acute		
Other		
LD50	Mouse	> 320 mg/kg
TDL0	Mouse	200 mg/kg
Fluoranthene (CAS 206-44-0)		
Acute		
Dermal		
LD50	Rabbit	3180 mg/kg

Components	Species	Test Results
Methanol (CAS 67-56-1)		
Acute		
Dermal		
LD50	Rabbit	15800 mg/kg
Inhalation		
LC50	Mouse	79.43 mg/l, 134 Minutes
	Rat	> 115.9 mg/l, 4 Hours
		64000 ppm, 4 Hours
		82.1 mg/l, 6 Hours
Oral		
LD50	Monkey	6000 mg/kg
	Mouse	7300 mg/kg
	Pig	> 5000 mg/kg
	Rabbit	14.4 g/kg
	Rat	5628 mg/kg
Other		
LD50	Guinea pig	3556 mg/kg
	Hamster	8555 mg/kg
	Mouse	4100 mg/kg
	Rabbit	1826 mg/kg
	Rat	2131 mg/kg
Naphthalene (CAS 91-20-3)		
Acute		
Dermal		
LD50	Rabbit	> 2 g/kg
	Rat	> 2500 mg/kg
Inhalation		
LC50	Rat	> 78 ppm, 4 Hours
		> 0.4 mg/l, 4 Hours
Oral		
LD50	Guinea pig	1200 mg/kg
	Mouse	533 mg/kg
	Rat	490 mg/kg
Other		
LD50	Mouse	100 mg/kg
Phenanthrene (CAS 85-01-8)		
Acute		
Oral		
LD50	Mouse	700 mg/kg
Other		
LD50	Mouse	56 mg/kg

* Estimates for product may be based on additional component data not shown.

Skin corrosion/irritation Prolonged skin contact may cause temporary irritation.

Serious eye damage/eye irritation Causes serious eye irritation.

Respiratory or skin sensitization

Respiratory sensitization Not available.

Skin sensitization This product is not expected to cause skin sensitization.

Germ cell mutagenicity No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.

Carcinogenicity May cause cancer.

IARC Monographs. Overall Evaluation of Carcinogenicity

1,12-Benzoperylene (CAS 191-24-2)	3 Not classifiable as to carcinogenicity to humans.
1,2:5,6-Dibenzanthracene (CAS 53-70-3)	2A Probably carcinogenic to humans.
1,2-Benzanthracene (CAS 56-55-3)	2B Possibly carcinogenic to humans.
Acenaphthene (CAS 83-32-9)	3 Not classifiable as to carcinogenicity to humans.
Anthracene (CAS 120-12-7)	3 Not classifiable as to carcinogenicity to humans.
Benzo(a)pyrene (CAS 50-32-8)	1 Carcinogenic to humans.
Benzo(b)fluoranthene (CAS 205-99-2)	2B Possibly carcinogenic to humans.
Benzo(k)fluoranthene (CAS 207-08-9)	2B Possibly carcinogenic to humans.
Chrysene (CAS 218-01-9)	2B Possibly carcinogenic to humans.
Fluoranthene (CAS 206-44-0)	3 Not classifiable as to carcinogenicity to humans.
Fluorene (CAS 86-73-7)	3 Not classifiable as to carcinogenicity to humans.
Indeno(1,2,3-C,D)pyrene (CAS 193-39-5)	2B Possibly carcinogenic to humans.
Naphthalene (CAS 91-20-3)	2B Possibly carcinogenic to humans.
Phenanthrene (CAS 85-01-8)	3 Not classifiable as to carcinogenicity to humans.
Pyrene (CAS 129-00-0)	3 Not classifiable as to carcinogenicity to humans.

US. National Toxicology Program (NTP) Report on Carcinogens

1,2:5,6-Dibenzanthracene (CAS 53-70-3)	Reasonably Anticipated to be a Human Carcinogen.
1,2-Benzanthracene (CAS 56-55-3)	Reasonably Anticipated to be a Human Carcinogen.
Benzo(a)pyrene (CAS 50-32-8)	Reasonably Anticipated to be a Human Carcinogen.
Benzo(b)fluoranthene (CAS 205-99-2)	Reasonably Anticipated to be a Human Carcinogen.
Benzo(k)fluoranthene (CAS 207-08-9)	Reasonably Anticipated to be a Human Carcinogen.
Indeno(1,2,3-C,D)pyrene (CAS 193-39-5)	Reasonably Anticipated to be a Human Carcinogen.
Naphthalene (CAS 91-20-3)	Reasonably Anticipated to be a Human Carcinogen.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

Reproductive toxicity	Suspected of damaging fertility or the unborn child.
Specific target organ toxicity - single exposure	Causes damage to organs.
Specific target organ toxicity - repeated exposure	Causes damage to organs through prolonged or repeated exposure.
Aspiration hazard	Not available.
Chronic effects	Prolonged inhalation may be harmful. Causes damage to organs through prolonged or repeated exposure.

12. Ecological information

Ecotoxicity Toxic to aquatic life with long lasting effects. Accumulation in aquatic organisms is expected.

Components		Species	Test Results
Acenaphthene (CAS 83-32-9)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	1.102 - 1.475 mg/l, 48 hours
Fish	LC50	Fathead minnow (Pimephales promelas)	0.52 - 0.71 mg/l, 96 hours
Anthracene (CAS 120-12-7)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	0.081 - 0.112 mg/l, 48 hours
Fish	LC50	Bluegill (Lepomis macrochirus)	0.0045 mg/l, 96 hours
Fluoranthene (CAS 206-44-0)			
Aquatic			
Fish	LC50	Fathead minnow (Pimephales promelas)	0.0054 - 0.0085 mg/l, 96 hours
Fluorene (CAS 86-73-7)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia pulex)	0.212 mg/l, 48 hours
Fish	LC50	Rainbow trout,donaldson trout (Oncorhynchus mykiss)	0.55 - 1.21 mg/l, 96 hours
Methanol (CAS 67-56-1)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	> 10000 mg/l, 48 hours
Fish	LC50	Fathead minnow (Pimephales promelas)	> 100 mg/l, 96 hours

Components		Species	Test Results
Naphthalene (CAS 91-20-3)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	1.09 - 3.4 mg/l, 48 hours
Fish	LC50	Pink salmon (Oncorhynchus gorbuscha)	1.11 - 1.68 mg/l, 96 hours
Phenanthrene (CAS 85-01-8)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	0.185 - 0.243 mg/l, 48 hours
Fish	LC50	Sheepshead minnow (Cyprinodon variegatus)	0.438 - 0.523 mg/l, 96 hours
Pyrene (CAS 129-00-0)			
Aquatic			
Fish	LC50	Rainbow trout,donaldson trout (Oncorhynchus mykiss)	> 2 mg/l, 96 hours

* Estimates for product may be based on additional component data not shown.

Persistence and degradability No data is available on the degradability of this product.

Bioaccumulative potential No data available.

Partition coefficient n-octanol / water (log Kow)

1,12-Benzoperylene	6.63
1,2:5,6-Dibenzanthracene	6.5
1,2-Benzanthracene	5.79
Acenaphthene	3.92
Acenaphthylene	4.07
Anthracene	4.45
Benzo(a)pyrene	5.97
Benzo(b)fluoranthene	6.6
Benzo(k)fluoranthene	6.84
Chrysene	5.73
Fluoranthene	5.16
Methanol	-0.77
Naphthalene	3.3
Phenanthrene	4.57
Pyrene	4.88

Mobility in soil No data available.

Other adverse effects No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

13. Disposal considerations

Disposal instructions Collect and reclaim or dispose in sealed containers at licensed waste disposal site. This material and its container must be disposed of as hazardous waste. Do not allow this material to drain into sewers/water supplies. Do not contaminate ponds, waterways or ditches with chemical or used container. Dispose of contents/container in accordance with local/regional/national/international regulations.

Local disposal regulations Dispose in accordance with all applicable regulations.

Hazardous waste code The waste code should be assigned in discussion between the user, the producer and the waste disposal company.

US RCRA Hazardous Waste U List: Reference

1,2:5,6-Dibenzanthracene (CAS 53-70-3)	U063
1,2-Benzanthracene (CAS 56-55-3)	U018
Benzo(a)pyrene (CAS 50-32-8)	U022
Chrysene (CAS 218-01-9)	U050
Fluoranthene (CAS 206-44-0)	U120
Indeno(1,2,3-C,D)pyrene (CAS 193-39-5)	U137
Methanol (CAS 67-56-1)	U154
Naphthalene (CAS 91-20-3)	U165

Waste from residues / unused products Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).

Contaminated packaging Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

UN number	UN1230
UN proper shipping name	Methanol, solution, MARINE POLLUTANT
Transport hazard class(es)	
Class	3
Subsidiary risk	-
Label(s)	3
Packing group	II
Environmental hazards	
Marine pollutant	Yes
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Special provisions	IB2, T7, TP2
Packaging exceptions	150
Packaging non bulk	202
Packaging bulk	242

IATA

UN number	UN1230
UN proper shipping name	Methanol solution
Transport hazard class(es)	
Class	3
Subsidiary risk	6.1(PGI, II)
Packing group	II
Environmental hazards	No.
ERG Code	3L
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Other information	
Passenger and cargo aircraft	Allowed.
Cargo aircraft only	Allowed.

IMDG

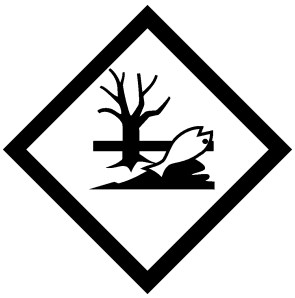
UN number	UN1230
UN proper shipping name	METHANOL SOLUTION, MARINE POLLUTANT
Transport hazard class(es)	
Class	3
Subsidiary risk	6.1(PGI, II)
Packing group	II
Environmental hazards	
Marine pollutant	Yes
EmS	F-E, S-D
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not available.

DOT

IATA; IMDG

Marine pollutant



15. Regulatory information

US federal regulations

This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.
One or more components are not listed on TSCA.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

1,12-Benzoperylene (CAS 191-24-2)	Listed.
1,2:5,6-Dibenzanthracene (CAS 53-70-3)	Listed.
1,2-Benzanthracene (CAS 56-55-3)	Listed.
Acenaphthene (CAS 83-32-9)	Listed.
Acenaphthylene (CAS 208-96-8)	Listed.
Anthracene (CAS 120-12-7)	Listed.
Benzo(a)pyrene (CAS 50-32-8)	Listed.
Benzo(b)fluoranthene (CAS 205-99-2)	Listed.
Benzo(k)fluoranthene (CAS 207-08-9)	Listed.
Chrysene (CAS 218-01-9)	Listed.
Fluoranthene (CAS 206-44-0)	Listed.
Fluorene (CAS 86-73-7)	Listed.
Indeno(1,2,3-C,D)pyrene (CAS 193-39-5)	Listed.
Methanol (CAS 67-56-1)	Listed.
Naphthalene (CAS 91-20-3)	Listed.
Phenanthrene (CAS 85-01-8)	Listed.
Pyrene (CAS 129-00-0)	Listed.

SARA 304 Emergency release notification

Pyrene (CAS 129-00-0)	5000 LBS

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories

Immediate Hazard - Yes
Delayed Hazard - Yes
Fire Hazard - Yes
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance

Chemical name	CAS number	Reportable quantity	Threshold planning quantity	Threshold planning quantity, lower value	Threshold planning quantity, upper value
Pyrene	129-00-0	5000		1000 lbs	10000 lbs

SARA 311/312 Hazardous chemical

No

SARA 313 (TRI reporting)

Chemical name	CAS number	% by wt.
Methanol	67-56-1	90 - 100

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

1,12-Benzoperylene (CAS 191-24-2)
1,2:5,6-Dibenzanthracene (CAS 53-70-3)
1,2-Benzanthracene (CAS 56-55-3)
Acenaphthene (CAS 83-32-9)
Acenaphthylene (CAS 208-96-8)
Anthracene (CAS 120-12-7)
Benzo(a)pyrene (CAS 50-32-8)
Benzo(b)fluoranthene (CAS 205-99-2)
Benzo(k)fluoranthene (CAS 207-08-9)
Chrysene (CAS 218-01-9)
Fluoranthene (CAS 206-44-0)
Fluorene (CAS 86-73-7)
Indeno(1,2,3-C,D)pyrene (CAS 193-39-5)
Methanol (CAS 67-56-1)
Naphthalene (CAS 91-20-3)
Phenanthrene (CAS 85-01-8)
Pyrene (CAS 129-00-0)

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

US state regulations

US. Massachusetts RTK - Substance List

1,12-Benzoperylene (CAS 191-24-2)
1,2:5,6-Dibenzanthracene (CAS 53-70-3)
1,2-Benzanthracene (CAS 56-55-3)
Acenaphthene (CAS 83-32-9)
Acenaphthylene (CAS 208-96-8)
Anthracene (CAS 120-12-7)
Benzo(a)pyrene (CAS 50-32-8)
Benzo(b)fluoranthene (CAS 205-99-2)
Benzo(k)fluoranthene (CAS 207-08-9)
Chrysene (CAS 218-01-9)
Fluoranthene (CAS 206-44-0)
Fluorene (CAS 86-73-7)
Indeno(1,2,3-C,D)pyrene (CAS 193-39-5)
Methanol (CAS 67-56-1)
Naphthalene (CAS 91-20-3)
Phenanthrene (CAS 85-01-8)
Pyrene (CAS 129-00-0)

US. New Jersey Worker and Community Right-to-Know Act

1,12-Benzoperylene (CAS 191-24-2)	500 LBS
1,2:5,6-Dibenzanthracene (CAS 53-70-3)	500 LBS
1,2-Benzanthracene (CAS 56-55-3)	500 LBS
Anthracene (CAS 120-12-7)	500 LBS
Benzo(a)pyrene (CAS 50-32-8)	500 LBS
Benzo(b)fluoranthene (CAS 205-99-2)	500 LBS
Benzo(k)fluoranthene (CAS 207-08-9)	500 LBS
Chrysene (CAS 218-01-9)	500 LBS
Fluoranthene (CAS 206-44-0)	500 LBS
Indeno(1,2,3-C,D)pyrene (CAS 193-39-5)	500 LBS
Methanol (CAS 67-56-1)	500 LBS
Naphthalene (CAS 91-20-3)	500 LBS
Phenanthrene (CAS 85-01-8)	500 LBS
Pyrene (CAS 129-00-0)	500 LBS

US. Pennsylvania RTK - Hazardous Substances

1,12-Benzoperylene (CAS 191-24-2)
1,2:5,6-Dibenzanthracene (CAS 53-70-3)
1,2-Benzanthracene (CAS 56-55-3)
Acenaphthene (CAS 83-32-9)
Acenaphthylene (CAS 208-96-8)
Anthracene (CAS 120-12-7)

Benzo(a)pyrene (CAS 50-32-8)
Benzo(b)fluoranthene (CAS 205-99-2)
Benzo(k)fluoranthene (CAS 207-08-9)
Chrysene (CAS 218-01-9)
Fluoranthene (CAS 206-44-0)
Fluorene (CAS 86-73-7)
Indeno(1,2,3-C,D)pyrene (CAS 193-39-5)
Methanol (CAS 67-56-1)
Naphthalene (CAS 91-20-3)
Phenanthrene (CAS 85-01-8)
Pyrene (CAS 129-00-0)

US. Rhode Island RTK

1,12-Benzoperylene (CAS 191-24-2)
1,2:5,6-Dibenzanthracene (CAS 53-70-3)
1,2-Benzanthracene (CAS 56-55-3)
Acenaphthene (CAS 83-32-9)
Acenaphthylene (CAS 208-96-8)
Anthracene (CAS 120-12-7)
Benzo(a)pyrene (CAS 50-32-8)
Benzo(b)fluoranthene (CAS 205-99-2)
Benzo(k)fluoranthene (CAS 207-08-9)
Chrysene (CAS 218-01-9)
Fluoranthene (CAS 206-44-0)
Fluorene (CAS 86-73-7)
Indeno(1,2,3-C,D)pyrene (CAS 193-39-5)
Methanol (CAS 67-56-1)
Naphthalene (CAS 91-20-3)
Phenanthrene (CAS 85-01-8)
Pyrene (CAS 129-00-0)

US. California Proposition 65

WARNING: This product contains a chemical known to the State of California to cause cancer and birth defects or other reproductive harm.

US - California Proposition 65 - CRT: Listed date/Carcinogenic substance

1,2:5,6-Dibenzanthracene (CAS 53-70-3)	Listed: January 1, 1988
1,2-Benzanthracene (CAS 56-55-3)	Listed: July 1, 1987
Benzo(a)pyrene (CAS 50-32-8)	Listed: July 1, 1987
Benzo(b)fluoranthene (CAS 205-99-2)	Listed: July 1, 1987
Benzo(k)fluoranthene (CAS 207-08-9)	Listed: July 1, 1987
Chrysene (CAS 218-01-9)	Listed: January 1, 1990
Indeno(1,2,3-C,D)pyrene (CAS 193-39-5)	Listed: January 1, 1988
Naphthalene (CAS 91-20-3)	Listed: April 19, 2002

US - California Proposition 65 - CRT: Listed date/Developmental toxin

Methanol (CAS 67-56-1)	Listed: March 16, 2012

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	No
Canada	Domestic Substances List (DSL)	No
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	No
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	No
Korea	Existing Chemicals List (ECL)	No
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	No
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	No

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date 08-15-2014

Version # 01

NFPA ratings

Health: 2
Flammability: 3
Instability: 0

Disclaimer

The above information is believed to be correct on the date it was last revised and must not be considered all inclusive. The information has been obtained only by a search of available literature and is only a guide for handling the chemicals. OSHA regulations require that if other hazards become evident, an upgraded SDS must be made available to the employee within three months. RESPONSIBILITY for updates lies with the employer and not with CHEM SERVICE, Inc.

Persons not specifically and properly trained should not handle this chemical or its container. This product is furnished FOR LABORATORY USE ONLY! Our products may NOT BE USED as drugs, cosmetics, agricultural or pesticide products, food additives or as household chemicals.

This Safety Data Sheet (SDS) is intended only for use with Chem Service, Inc. products and should not be relied on for use with materials from any other supplier even if the chemical name(s) on the product are identical! Whenever using an SDS for a solution or mixture the user should refer to the SDS for every component of the solution or mixture. Chem Service warrants that this SDS is based upon the most current information available to Chem Service at the time it was last revised. THIS WARRANTY IS EXCLUSIVE, AND CHEM SERVICE, INC. MAKES NO OTHER WARRANTY, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. This SDS is provided gratis and CHEM SERVICE, INC. SHALL NOT BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR CONTINGENT DAMAGES.

This product is furnished FOR LABORATORY USE ONLY.

Ascent Battery Supply, LLC
1325 Walnut Ridge Drive
Hartland, Wisconsin 53029

Safety Data Sheet (SDS) — Nickel Cadmium (NiCd) Batteries

The information and recommendations below are believed to be accurate at the date of document preparation. Ascent Battery Supply makes no warranty or merchantability or any other warranty, express or implied, with respect to this information and assumes no liability resulting from its use. This SDS provides guidelines for safe use and handling of product. It does not, and cannot, advise all possible situations. All specific uses of this product must be evaluated by the end user to determine if additional safety precautions should be taken.

SECTION 1 - IDENTIFICATION

Product Name	Nickel Cadmium Battery		
Common Name(s)	NiCd, NiCad, Nickel Cadmium		
Synonyms	Nickel Cadmium Rechargeable Battery		
DOT Description	Dry Battery		
Chemical Name	Nickel Cadmium Secondary Battery		
Distributed By	Ascent Battery Supply, LLC	**Emergency Number**	INFOTRAC (800) 535-5053
Address	1325 Walnut Ridge Drive Hartland, Wisconsin 53029	**International Emergency Number**	INFOTRAC (352) 323-3500 (Collect)

SECTION 2 – HAZARD(S)

Unusual Fire and Explosion Hazards Cells may rupture when exposed to excessive heat. This could result in the release of flammable or corrosive materials.

SECTION 3 – COMPOSITION

Chemical Name	CAS No.	Wt. Percentage %
Nickel	7440-02-0	15-22%
Potassium Hydroxide	1310-58-3	1.5-3%
Mercury	7439-79-6	≤5 ppm
Lead	7439-92-1	≤10 ppm
Cadmium	7440-43-9	18-26%
Other/Housing	n/a	balance

SECTION 4 – FIRST AID MEASURES

Inhalation Get fresh air. If symptoms persist seek medical attention

Eyes and Skin **Skin:** Flush with copious quantities of flowing lukewarm water for a minimum of 15 minutes; wash with soap and water

Eyes: Flush with copious quantities of flowing lukewarm water for a minimum of 15 minutes; get immediate medical attention.

Ingestion Ingestion of battery chemicals can be harmful. Call The National Battery Ingestion Hotline (202-625-3333) 24 hours a day, for procedures treating ingestion of chemicals. Do not induce vomiting.

SECTION 5 – FIRE-FIGHTING MEASURES

Extinguisher Media Use CO_2, foam or dry chemical extinguishers. Sand may also be used.

Special Fire Fighting Procedures Wear self-contained breathing apparatus to avoid inhalation of hazardous decomposition products.

SECTION 6 – ACCIDENTAL RELEASE MEASURES

In case of accidental rupture or release: prevent skin and eye contact and collect all released material in a plastic lined metal container. Leaking batteries should be handled with gloves. Wear protective clothing. Use a self-contained breathing apparatus if in the presence of chemical vapor. See also: sections 4, 5, and 8.

SECTION 7 – HANDLING AND STORAGE

1. Store in a dry place with ambient temperature between -20°C(-4°F) and 35°C(95°F).
2. Do not store unpacked cells together: avoid cells shorting to one another – especially in a charged state.
3. Do not mix new and used batteries.
4. Do not disassemble.
5. Do not store with conductive objects.
6. Store away from flame or spark hazards.

SECTION 8 – EXPOSURE/PERSONAL PROTECTION

Respiratory Protection	None required under normal handling conditions
Gloves	Wear gloves if cell is ruptured, corroded, or leaking materials
Safety Glasses	Always wear safety glasses with working with battery cells

SECTION 9 – PHYSICAL/CHEMICAL PROPERTIES

Boiling Point	N/A	**Melting Point**	N/A
Vapor Pressure	N/A	**Vapor Density**	N/A
Specific Gravity	N/A	**Evaporation Rate**	N/A
Solubility in Water	N/A	**Appearance and Odor**	Cylindrical, solid object, odorless

SECTION 10 – STABILITY & REACTIVITY

Reactivity in Water	N/A	**Auto-Ignition Temperature**	N/A
Flash Point	N/A	**Flammable Limits in Air, by vol.**	N/A
Percent Volatile By Volume	N/A		
Stable	Avoid electrically shorting the cell. Under normal conditions this product is stable and will not decompose.		
Incompatibility (materials to avoid)	N/A		

SECTION 11 – TOXICOLOGICAL INFORMATION

Threshold Limit Value	N/A
Signs and Symptoms of Exposure	None. (In fire or rupture situations, refer to sections 4, 5, & 8.)
Medical Conditions Generally Caused by Exposure	Chemicals may cause burns to skin, eyes, gastrointestinal tract and mucous membranes. Inhalation of electrolyte vapors may cause irritation of the upper respiratory tract and lungs.
Routes of Entry	Skin, Eyes, Ingestion (swallowing)

SECTION 12 – ECOLOGICAL INFORMATION

Hazardous Decomposition Products N/A

Hazardous Polymerization Will not occur

Under normal use these batteries do not release internal ingredients into the environment. Damaged or abused batteries may release small amounts of cadmium, nickel or carbon oxides. Do not carelessly discard, as small amounts of cadmium may be released into storm or surface water. Do not discard batteries into a fire. Dispose of properly or recycle.

SECTION 13 - DISPOSAL

Dispose of batteries according to all Federal, State and local laws and regulations.

SECTION 14 – TRANSPORT

These batteries must be packaged in a way that prevents the dangerous evolution of heat and protects the terminals from short circuit. When properly packaged and labeled, these dry batteries are not subject to dangerous goods regulation for the purpose of transportation and fall under special provision of the agencies listed in Section 15.

SECTION 15 – REGULATORY INFORMATION

IATA Not considered to be 'dangerous goods' when packaged properly
DOT Not considered to be a 'hazardous material' when packaged properly
ICAO Not subject when packaged properly
IMDG Not subject when packaged properly
UN2800 Exempted when packaged properly

SECTION 16 - OTHER

Document Control No:	SDS20008 – Ascent SDS for Nickel Cadmium (NiCd) Batteries	**Revision:**	1	**Effective Date:**	01-02-2015

SAFETY DATA SHEET (SDS)

PRODUCT IDENTITY (as indicated on label) | PRODUCT CODE

Sun X SPF 30 Sunscreen Broad Spectrum Spray | **COR10**

SECTION 1. COMPANY IDENTIFICATION:

DISTRIBUTOR'S NAME: CoreTex Products, Inc.	EMERGENCY TELEPHONE NUMBER: 1-800-255-3924 - 24 HOURS
ADDRESS: 1850 Sunnyside Court Bakersfield, Ca 93308	TELEPHONE NUMBER FOR INFO: 877-684-5774
Revision Number: A3	DATE PREPARED: 8/28/2014

SECTION 2. HAZARDOUS INGREDIENTS/IDENTITY INFORMATION:

The identity of individual components of this mixture is proprietary information and regarded to be a trade secret. However, based on the health hazard determination of contained ingredients present at a concentration greater than one percent, this mixture presents the following hazard:

HAZARDOUS COMPONENTS	% (RANGE)	CAS NO.	OSHA PEL	ACGIH TLV
N/A	N/A	N/A	N/A	N/A

SECTION 3. HAZARDS IDENTIFICATION:

I. EMERGENCY OVERVIEW

TYPE OF HAZARD: Eye irritant, spilled material can cause a slip hazard

APPEARANCE: None known

II. POTENTIAL HEALTH EFFECTS

INHALATION: May irritate

SKIN CONTACT: Not irritating

EYE CONTACT: May irritate eye

INGESTION: May be harmful if ingested

CHRONIC EFFECTS AD MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE:

Not established

SECTION 4. FIRST AID MEASURES:

SKIN: Wash with soap and water if irritation should appear. See a doctor if irritation persists.

EYES: Wash eye with copious amounts of water. See doctor if irritation persists.

INGESTION: If swallowed, give victim a glass of water or milk. Seek medical help. Never give anything by mouth to an unconscious person. Do not induce vomiting.

INHALATION: Move person into fresh air. If breathing stops, qualified personnel should administer artificial respiration.

Distributor's Name: CoreTex Products, Inc.
Emergency Telephone Number: 1-800-255-3924
Product Identity: **Sun X SPF 30 Sunscreen Broad Spectrum**

SECTION 5. FIRE FIGHTING MEASURES:

FLAMMABILITY CLASSIFICATION: N/A **FLASHPOINT:** N/A
EXTINGUISHING MEDIA: Will not support combustion. All recognized methods acceptable
UNUSUAL FIRE AND EXPLOSION HAZARDS: Will not support combustion.
SPECIAL FIRE FIGHTING PROCEDURES: Keep containers cool and vapors down with water spray. Prevent runoff from entering sewers and public waterways. Wear SCBA in chemical fires.

SECTION 6. ACCIDENTAL RELEASE MEASURES:

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:
Caution, slip hazard. Wipe up small spills with an absorbent material. For large spills, pick up with vacuum or an absorbent material. Place waste in appropriate container for disposal.
WASTE DISPOSAL METHOD: Consult local, state, and federal regulations. Do not reuse empty container.

SECTION 7. HANDLING AND STORAGE:

HANDLING AND STORAGE PRECAUTIONS: In the event of acciden contact with eyes, irrigate with copious amounts of water to exposed area promptly. Store in a cool (under 120° F) dry location away from heat. Use with adequate ventilation.
OTHER PRECAUTIONS: Follow label directions carefully. Keep out of reach of childern. Keep container tightly seald when not in use. Do not contaminate water, food or feed by use or storage. Do not swallow. Avoid inhaling mist and vapors.

SECTION 8. EXPOSURE CONTROLS AND PERSONAL PROTECTION:

RESPIRATORY PROTECTION (specify type): Not usually necessary. Use with adequate ventilation Use NIOSH/MSHA approved respirator if PELs or TLVs are exceeded.
VENTILATION: Normal ventilation
PROTECTIVE GLOVES: N.A.
EYE PROTECTION: Keep out of eyes. Wear protective glasses when applicable

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES:

BOILING RANGE: N.A. **VAPOR DENSITY (Air = 1):** N.A. **VAPOR PRESSURE:** N.A.
EVAPORATION RATE (Butyl Acetate = 1): N.A.
SPECIFIC GRAVITY AT 25/25 C 0.95 -1.05
APPEARANCE AND ODOR: Off-white to Light Yellow. Characteristic odor.
SOLUBILITY IN WATER: In-soluble
ph (RANGE): 7.5-9.5
VISCOSITY: 1,500 - 2,500cps.

Distributor's Name: CoreTex Products, Inc.
Emergency Telephone Number: 1-800-255-3924
Product Identity: **Sun X SPF 30 Sunscreen Broad Spectrum**

SECTION 10. STABILITY AND REACTIVITY:

STABILITY: Stable
INCOMPATIBILITY (materials to avoid): None known
HAZARDOUS DECOMPOSITION PRODUCTS: None known
HAZARDOUS POLMERIZATION: Will Not Occur
CONDITIONS TO AVOID: None known

SECTION 11. TOXICOLOGICAL INFORMATION:

HEALTH WARNING: No Data Available.
CARCINOGENICITY: No Data Available.

SECTION 12. ECOLOGICAL INFORMATION:

Not established

SECTION 13. DISPOSAL CONSIDERATIONS:

Dispose of in accordance with local, state and federal regulations regarding health, air and water pollution.

SECTION 14. TRANSPORT INFORMATION:

DOT CLASSIFICATION: Not classified
SHIPPING NAME: N.A.
HAZARD CLASS: N.A.
OTHER PERTINENT INFORMATION: N.A.

This material is not subject to the transportation regulations of DOT, ICAO, IMO and the ADR.

SECTION 15. REGULATORY INFORMATION:

TSCA: N.A.
SARA, Title III, Section 313 (40CFR 372): N.A.
CALIFORNIA PROPOSITION 65: N.A.

SECTION 16. OTHER INFORMATION:

SUPERCEDES: Revision # A2

N.A.- Not applicable

Safety Data Sheets (SDS)

SECTION 1-IDENTIFICATION

Product name: Toluene

Other names:-

Proper shipping name: Toluene

Recommended use of the chemical and restrictions on use:
The major use of toluene is as a mixture added to gasoline to improve octane ratings. Used as a solvent for paint, resins, lacquers inks & adhesives. Component of solvent blends and thinners. Used in the manufacture of chemicals, dyes, explosives, benzoic acid. Some grades of toluene may contain traces of xylene and benzene.
The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.
WARNING: Intentional misuse by concentrating/inhaling contents may be lethal.

Manufacturer/Supplier Name: Taiwan SM Corp., Kaohsiung plant
Address: NO.7, Industrial 1st Rd, Lin-Yuan Kaohsiung County 83203, Taiwan, R.O.C.
Phone No.: 886-7-6414511

Emergency phone No./Fax No.: 886-7-6414511 Ext. 221 (on duty), 886-7-6414517 (off duty)/886-7-6423828

SECTION 2-HAZARDS IDENTIFICATION

GHS Classification:

Flammable Liquid Category 2
Acute Toxicity (Oral) Category 4
Skin Corrosion/ Irritation Category 2
Serious Eye Damage/ Eye Irritation Category 2
Specific Target Organ Toxicity Repeated Exposure Category 2
Hazardous To The Aquatic Environment (Acute) Category 3
Aspiration Hazard Category 1

GHS Label elements:

Hazard symbols

Signal word

Danger

Hazard statements

Highly flammable liquid and vapor
Harmful if inhaled
Causes skin irritation
Causes serious eye irritation
May cause damage to organs through prolonged or repeated exposure.
May cause long lasting harmful effects to aquatic life.
May be fatal if swallowed and enters airways.

Precautionary statements

Use only in well ventilated area.
Control of exposure by mechanical ventilation in an unventilated or confined space.
Avoid breathing vapors and contact with skin and eyes.
Wear breathing apparatus/protective gloves/face protection.
Store in well-ventilated place.
Disposal must be in accordance with applicable federal, state, or local regulations.

Other hazards: —

SECTION 3-COMPOSITION/INFORMATION ON INGREDIENTS

CAS No.	Chemical Name	wt% by weight	EINECS No.
00108-88-3	Toluene	97.0 min.	203-625-9
Synonyms	**Methylbenzol; Methylbenzene; Toluol; Phenylmethane**		

SECTION 4-FIRST AID MEASURES

Description of necessary first aid measures

Eye:

1. Flush immediately with warm water for at least 20 minutes.
2. Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
3. If pain persists or recurs seek medical attention.
4. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin:

1. Removing contaminated clothing, shoes, and leathery wearings, cleaning procedure is available before reused or waste treatment.
2. Washing affected area thoroughly with soap and water for at least 20 minutes.
3. Call a Physician if irritation develops or persists.

Ingestion:

1. If spontaneous vomiting appears imminent or occurs, hold patient's head down, lower than their hips to help avoid possible aspiration of vomits.
2. If victim is conscious and alert, give 2～4 cupfuls of milk/water to dilute the substance in stomach.
3. Never give anything by mouth to an unconscious person.
4. Don't induce vomiting unless directed to do so by medical person.
5. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration.
6. Then seek for medical attention.

Inhalation:

1. Remove from further exposure and flush thoroughly with air.
2. Lay patient down. Keep warm and rested.
3. Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures.
4. If respiratory irritation, seek immediate medical assistance and call a physician.

Most important symptoms/effects, acute and delayed

Headache, fatigue, drowsiness, insomnia, anorexia and pain in limbs, nervousness, impairment of memory.

Indication of immediate medical attention and special treatment needed, if necessary

For acute or short term repeated exposures to toluene:

Inhalation:

1. Inhalation overexposure can produce toxic effects. Monitor for respiratory distress.
2. If cough or difficulty in breathing develops, evaluate for upper respiratory tract inflammation, bronchitis, and pneumonitis. Administer supplemental oxygen with assisted ventilation, as required.
3. This material (or a component) sensitizes the heart to the effects of sympathomimetic amines. Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in individuals exposed to this material.
4. Administration of sympathomimetic drugs should be avoided.

Ingestion:

1. If ingested, this material presents a significant aspiration and chemical pneumonitis hazard.
2. Induction of emesis is not recommended.
3. Consider activated charcoal and/or gastric lavage.
4. If patient is obtunded, protect the airway by cuffed endotracheal intubation or by placement of the body in a Trendelenburg and left lateral decubitus position.

SECTION 5-FIRE FIGHTING MEASURES

Extinguishing media

Foam、CO_2、Dry chemical、Water fog.

Specific hazards arising from the chemical

1. Liquid and vapor are highly flammable.
2. Severe fire hazard when exposed to heat, flame and/or oxidizers.
3. Vapor may travel a considerable distance to source of ignition.
4. Heating may cause expansion or decomposition leading to violent rupture of containers.
5. On combustion, may emit toxic fumes of carbon monoxide (CO).

Special protective equipment and precautions for fire-fighters

1. Firefighters must use full bunker gear including NIOSH-approved positive pressure self-contained breathing apparatus to protect against potential hazardous combustion or decomposition products and oxygen deficiencies.
2. Evacuate area and fight the fire from a maximum distance or use unmanned hose holders or monitor nozzles.
3. Cover pooling liquid with foam.
4. Containers can build pressure if exposed to radiant heat; cool adjacent containers with flooding quantities of water until well after the fire is out.
5. Withdraw immediately from the area if there is a rising sound from a venting safety device or discoloration of vessels, tanks, or pipelines.
6. Be aware that burning liquid will float on water.
7. Notify appropriate authorities of potential fire and explosion hazard if liquid enter sewers or waterways

SECTION 6-ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedure

1. Personal protective equipment (specified in Section 8)
   Eyes : Chemical safety goggles are recommended, and a face shield is added when needed.
   Skin : Wear appropriate protective gloves to avoid skin contact.
   Clothing: When direct contact is likely, use rubberized clothings, apron and boots.
   Respiratory : When limits are exceeded, wear a respirator approved by NIOSH/MSHA for protection against organic dust, mists and vapors.
2. Remove all sources of ignition. No smoking, naked lights or ignition sources. Ventilate area of leak or spill.
3. Keep unnecessary and unprotected personnel from entering. Evacuate personnel from the danger area. Consult with an expert about the emergency procedures.

Environmental precautions

1. Prevent spillage from entering drains, surface, and groundwater.
2. Contain and recover liquid when possible. Use non-sparking tools and equipment.
3. Collect liquid in an appropriate container or absorb with an inert material (e.g. vermiculite, dry sand, earth), and place in a chemical waste container.
4. Report the accidental spill/release to Local/State government.

Methods and materials for containment and cleaning up

Minor spill:

1. Remove all ignition sources.
2. Clean up all spills immediately.
3. Avoid breathing vapors and contact with skin and eyes.
4. Control personal contact by using protective equipment.
5. Contain and absorb small quantities with vermiculite or other absorbent material.
6. Wipe up.
7. Collect residues in a flammable waste container.

Major spill

1. Clear area of personnel and move upwind.
2. Alert emergency responders and tell them location and nature of hazard.
3. May be violently or explosively reactive.
4. Wear breathing apparatus plus protective gloves.
5. Prevent spillage from entering drains or water course.
6. No smoking, naked lights or ignition sources. Increase ventilation.
7. Stop leak if safe to do so.
8. Water spray or fog may be used to disperse/absorb vapor.
9. Contain spill with sand, earth or vermiculite.
10. Use only spark-free shovels and explosion proof equipment.
11. Collect recoverable product into labeled containers for recycling..
12. Absorb remaining product with sand, earth or vermiculite.
13. Collect solid residues and seal in labeled drums for disposal.
14. Wash area and prevent runoff into drains.
15. If contamination of drains or waterways occurs, advise emergency services.

SECTION 7-HANDLING AND STORAGE

Precautions for safe handling

1. Wash thoroughly after handling.
2. Use only in well ventilated area.
3. Ground and bond containers when transferring.
4. Use spark-free tools and explosion proof equipment.
5. Empty containers retain product residue (liquid/vapor), and can be dangerous.
6. Do not pressurize, cut, weld, braze, solder, drill, or expose empty containers to heat, sparks or open flames.

Conditions for safe storage, including any incompatibilities

1. Store in original containers in approved flame-proof area.
2. No smoking, naked lights, heat or ignition sources.
3. DO NOT store in pits, depressions, basements or areas where vapors may be trapped.
4. Keep containers securely sealed.
5. Store away from incompatible materials in a cool, dry well ventilated area.
6. Protect containers against physical damage and check regularly for leaks.
7. Keep containers tightly closed and store in a cool, dry, well-ventilated place, plainly labeled, and out of closed vehicles.
8. Ground all equipment containing this material.
9. Observe manufacturer's storing and handling recommendations.
10. Containers should be able to withstand pressures expected from warming and cooling in storage. This flammable liquid should be stored in a separate safety cabinet or room. A refrigerated room is preferable for materials with a flash point temperature lower than 70°F (21°C).

SECTION 8-EXPOSURE CONTROLS, PERSONAL PROTECTION

OSHA - Final PELs : 200 ppm TWA.
OSHA Ceiling : 300ppm.
ACGIH : 50 ppm, skin -potential forcutaneous absorption.
NIOSH : 100 ppm TWA; 375 mg/m^3 TWA; 500 ppm IDLH.
Taiwan TWA : 100 ppm (skin).
Taiwan STEL : 125 ppm (skin).
Taiwan Ceiling : -------.
Taiwan BEI : 1 mg/l (before on duty).

Engineering control

1. Process should be located at least 17 meter (50 feet) away from open flames and all high temperature operations likely to cause ignition of the styrene monomer vapor.
2. In venting styrene monomer vapors, consideration should be given to possible halogenation of the vapors by low concentrations of free chlorine and bromine with the resultant formation of lacrimations.
3. Process should be designed so that the operator is not exposed to direct contact with Toluene or the vapor. The technical problems of designing equipment, providing adequate ventilation and operating procedures which promise maximum security and economy, can best be handled by competent engineers.
4. It is essential for safety that equipment be used and maintained as recommended by the manufacturer.
5. Tanks used to store or process Toluene should be closed vessels vented to a safe point of discharge in the outside atmosphere away from operating stations, roadways, and at least 17 meter (50 feet) from possible sources of ignitions. All sparks, flames, heated surface, or other sources of ignition should be kept away from all vents. It is advisable, to provide suction on vessels when inspection or observation openings are made, to minimize or eliminate escape of vapors.

Personal protective equipment

Eye Protection:
Safety glasses equipped with side shields are recommended as minimum protection in industrial settings. Chemical goggles should be worn during transfer operations or when there is a likelihood of misting, splashing, or spraying of this material. A suitable emergency eye wash water and safety shower should be located near the work station.

Skin protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Clothing:
Avoid skin contact. Wear long-sleeved fire-retardant garments (e.g., Nomex®) while working with flammable and combustible liquids. Additional chemical-resistant protective gear may be required if splashing or spraying conditions exist. This may include an apron, boots and additional facial protection. If product comes in contact with clothing, immediately remove soaked clothing and shower. Promptly remove and discard contaminated leather goods.

Respirators:
For known vapor concentrations above the occupational exposure guidelines (see below), use a NIOSH-approved organic vapor respirator if adequate protection is provided. Protection factors vary depending upon the type of respirator used. Respirators should be used in accordance with OSHA requirements (29 CFR 1910.134). For airborne vapor concentrations that exceed the recommended protection factors for organic vapor respirators, use a full-face, positive-pressure, supplied air respirator. Due to fire and explosion hazards, do not enter atmospheres containing concentrations greater than 10% of the lower flammable limit of this product.

SECTION 9-PHYSICAL AND CHEMICAL PROPERTIES

Appearance : Transparent liquid	Upper/lower explosive limits : 1.2%～7.1%
Odour : pleasant aromatic petroleum odour	Vapor Pressure : 22 mmHg @20℃/68℉
Odour threshold : 0.16～37 ppm (detect) 1.9～69 ppm (recognition)	Vapor Density : 3.1 (air=1)
PH : Not available	Relative density : 0.86 (water=1)
Melting/Freezing Point : －95 ℃	Solubility in water : 54～58 mg/100 ml
Initial boiling point/boiling range : 110.6 ℃	Partition coefficient : 2.73 (n-octanol/water)
Flash point : 4.4 ℃ (closed cup)	Auto-ignition temperature : 480℃
Evaporation Rate : 2.24 (BuAc=1)	Decomposition temperature : Not available
Flammability (solid/gas) : Not available	Viscosity : 0.6 mPa.s max @20℃
Molecular Formula : $C_6H_5CH_3$	Molecular Weight : 92.056

SECTION 10-STABILITY AND REACTIVITY

Reactivity
Vapor is explosive when exposed to heat or flame

Chemical stability
Stable at room temperature in closed containers under normal storage and handling conditions.

Possibility of hazardous reaction
Has not been reported.

Condition to avoid
Product is highly flammable – Keep away from sources of ignition. Avoid the higher temperatures. Keep away from open fire, heating elements and heat radiating surface and prevent from forming of the vapours mixtures with air in explosion limits.

Incompatible materials
Heat, flame, strong oxidizers, nitric and sulfuric acids, chlorine, nitrogen tetraoxide; will attack some forms of plastics, rubber, coatings.

Hazardous decomposition products
Carbon monoxide, carbon dioxide, hydrocarbons.

SECTION 11-TOXICOLOGICAL INFORMATION

Routes of exposure
Eye, Skin, inhalation, Ingestion.

Symptoms (treatments as indicated in Section 4)
Eye: The liquid produces a high level of eye discomfort and is capable of causing pain and severe conjunctivitis. Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated. There is evidence that material may produce eye irritation in some persons and produce eye damage 24 hours or more after instillation. Severe inflammation may be expected with pain. There may be damage to the cornea. Unless treatment is prompt and adequate there may be permanent loss of vision. Conjunctivitis can occur following repeated exposure.

Skin: Contact with the material may damage the health of the individual; systemic effects may result following absorption. The material may cause moderate inflammation of the skin either following direct contact or after a delay of some time. Repeated exposure can cause contact dermatitis which is characterized by redness, swelling and blistering. Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.

Ingestion: Accidental ingestion of the material may be harmful; animal experiments indicate that ingestion of less than 150 gram may be fatal or may produce serious damage to the health of the individual. Swallowing of the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis; serious consequences may result. (ICSC13733). Considered an unlikely route of entry in commercial/industrial environments. The liquid may produce gastrointestinal discomfort and may be harmful if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Inhalation: Inhalation of vapours or aerosols (mists, fumes), generated by the material during the course of normal handling, may be damaging to the health of the individual. There is some evidence to suggest that the material can cause respiratory irritation in some persons. The body's response to such irritation can cause further lung damage. Inhalation of vapours may cause drowsiness and dizziness. This may be accompanied by sleepiness, reduced alertness, loss of reflexes, lack of co-ordination, and vertigo. Inhalation of high concentrations of gas/vapour causes lung irritation with coughing and nausea, central nervous depression with headache and dizziness, slowing of reflexes, fatigue and inco-ordination. If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death. The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.

Chronic exposure: There has been some concern that this material can cause cancer or mutations but there is not enough data to make an assessment. Substance accumulation, in the human body, may occur and may cause some concern following repeated or long-term occupational exposure.

Toxicity
LD50: <870 mg/kg (rat, oral)
LC50: 6000 ppm/6h (rat, inhalation)

Chronic effect
Carcinogenicity:
ACGIH : A4-Not classifiable as a Human Carcinogen.
OSHA : Possible select carcinogen.
IARC : Group 3 carcinogen.

Epide miology: Not available.

Teratogenicity: Teratogenic effects have occurred in experimental animals.

Reproductive Effects: Adverse reproductive effects have occurred in experimental animals.

Neurotoxicity: Not available.

Mutagenicity: Not available.

SECTION 12-ECOLOGICAL INFORMATION

Ecotoxicity
LC_{50} (96 hr.) Fish: 7.3～22.8 mg/l
EC_{50} (48 hr.) Water flea: —
Biocencentration factor (BCF): 1.67～380

Persistence and degradability
1. The material are expected to form a slick on the surface of waters after release in calm sea conditions. This is expected to evaporate and enter the atmosphere where it will be degraded through reaction with hydroxyl radicals.
2. Some of the material will become associated with benthic sediments, and it is likely to be spread over a fairly wide area of sea floor. Marine sediments may be either aerobic or anaerobic. The material, in probability, is biodegradable, under aerobic conditions. Evidence also suggests that the hydrocarbons may be degradable under anaerobic conditions although such degradation in benthic sediments may be a relatively slow process.
3. Under aerobic conditions the material will degrade to water and carbon dioxide, while under aerobic processes it will produce water, methane, carbon dioxide and carbon dioxide.
4. Based on test results, as well as theoretical considerations, the potential for bioaccumulation may be high. Toxic effects are often observed in species such as blue mussel, daphnia, freshwater green algae, marine copepods and amphipods.

Half-life (Air): 10～104 hr
Half-life (Surface water): 96～528 hr
Half-life (Ground water): 168～672 hr
Half-life (Soil): 96～528 hr

Bioaccumulative potential
This material is not expected to significantly bioaccumulate.

Mobility in soil: —

Other adverse effects: —

SECTION 13-DISPOSAL CONSIDERATIONS

Residues and spilled material are hazardous waste due to ignitability. Disposal must be in accordance with applicable federal, state, or local regulations.
The container for this product can present explosion or fire hazards, even when emptied. To avoid risk of injury, do not cut, puncture, or weld on or near this container. Since the emptied containers retain product residue, follow label warnings even after container is emptied.

SECTION 14-TRANSPORTATION INFORMATION

US DOT	Shipping Name	Toluene	Hazard Labels	
	Hazard Class	3		
	UN Number	1294		
	Packing Group	II		
Sea(IMO/IMDG)	Shipping Name	Toluene	Hazard Labels	
	Hazard Class	3.2		
	UN Number	1294		
	Packing Group	II		
	IMDG Code Page	3285		
	MARPOL	Not a DOT "Marine Pollutant" per 49 CFR 171.8.		
Air(ICAO/IATA)	Shipping Name	Toluene	Hazard Labels	
	Hazard Class	3.2		
	Subsidiary Class	1294		
	Packing Group	II		
RID/ ADR	No information available.			
Canadian TDG	Shipping Name	Toluene	Hazard Labels	
	Hazard Class	3		
	UN Number	1294		
	Packing Group	II		
	Subsidiary Class	9.2		

SECTION 15-REGULATORY INFORMATION

US FEDERAL

TSCA

CAS# 108-88-3 is listed on the TSCA inventory.

Health & Safety Reporting List

CAS# 108-88-3: Effective Date: 10/4/82; Sunset Date: 10/4/92

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

SARA

Section 302 (RQ)

CAS# 108-88-3 : final RQ = 1000 pounds (454 kg)

Section 302 (TPQ)

None of the chemicals in this material have a TPQ.

SARA Codes

CAS# 108-88-3 : acute, flammable.

Section 313

This material contains Toluene (CAS# 108-88-3, 99% & 100%), which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 372.

Clean Air Act

CAS# 108-88-3 is listed as a hazardous air pollutant (HAP).

This material does not contain any Class 1 Ozone depletors.

This material does not contain any Class 2 Ozone depletors.

Clean Water Act

CAS# 108-88-3 is listed as a Hazardous Substance under the CWA.
CAS# 108-88-3 is listed as a Priority Pollutant under the Clean Water Act.
CAS# 108-88-3 is listed as a Toxic Pollutant under the Clean Water Act.

OSHA

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

Toluene can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

WARNING: This product contains Toluene, a chemical known to the state of California to cause birth defects or other reproductive harm.

California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols: XN F
Risk Phrases : R 10 Flammable.
R 20 Harmful by inhalation.
Safety Phrases : S 9 Keep container in a well-ventilated place.
S 16 Keep away from sources of ignition - No smoking.
S 25 Avoid contact with eyes.
S 29 Do not empty into drains.
S 33 Take precautionary measures against static discharges.

WGK (Water Danger/Protection)

CAS# 108-88-3: 2

United Kingdom Occupational Exposure Limits

CAS# 108-88-3: OES-United Kingdom, TWA 50 ppm TWA; 191 mg/m3 TWA.
CAS# 108-88-3: OES-United Kingdom, STEL 150 ppm STEL; 574 mg/m3 STEL.

CANADA

CAS#100-42-5 is listed on Canada's DSL/NDSL list.
This product has a WHMIS classification of B2, D2A (99%)/B3, D2A (100%).
CAS# 105-05-5 is not listed on Canada's Ingredient Disclosure List.

Exposure Limits

- CAS# 108-88-3: OEL-AUSTRALIA:TWA 100 ppm (375 mg/m3);STEL 150 ppm (560 mg/m3)
- OEL-BELGIUM:TWA 100 ppm (377 mg/m3);STEL 150 ppm (565 mg/m3)
- OEL-CZECHOSLOVAKIA:TWA 200 mg/m3;STEL 1000 mg/m3
- OEL-DENMARK:TWA 50 ppm (190 mg/m3);Skin
- OEL-FINLAND:TWA 100 ppm (375 mg/m3);STEL 150 ppm; Skin
- OEL-FRANCE:TWA 100 ppm (375 mg/m3);STEL 150 ppm (560 mg/m3)
- OEL-GERMANY:TWA 100 ppm (380 mg/m3)
- OEL-HUNGARY:TWA 100 mg/m3;STEL 300 mg/m3;Skin
- OEL-JAPAN:TWA 100 ppm (380 mg/m3)
- OEL-THE NETHERLANDS:TWA 100 ppm (375 mg/m3);Skin
- OEL-THE PHILIPPINES:TWA 100 ppm (375 mg/m3)
- OEL-POLAND:TWA 100 mg/m3
- OEL-RUSSIA:TWA 100 ppm; STEL 50 mg/m3
- OEL-SWEDEN:TWA 50 ppm (200 mg/m3);STEL 100 ppm (400 mg/m3);Skin
- OEL-SWITZERLAND:TWA 100 ppm (380 mg/m3);STEL 500 ppm
- OEL-THAILAND:TWA 200 ppm; STEL 300 ppm
- OEL-TURKEY:TWA 200 ppm (750 mg/m3)
- OEL-UNITED KINGDOM:TWA 100 ppm (375 mg/m3);STEL 150 ppm; Skin OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV

SECTION 16-OTHER INFORMATION

References and sources

1. CHEMINFO Data Bank, CCINFO CD, 2005-3
2. HAZARD TEXT Data Bank, TOMES PLUS CD, Vol.65, 2005
3. RETECS Data Bank, TOMES CPS CD, Vol.65, 2005
4. HSDB Data Bank, TOMES CPS CD, Vol.65, 2005
5. Hazardous Substance Data Bank, Environment Protection, Administration, Executive Yuan, ROC (Taiwan)
6. Chemwatch Data Bank, 2005-1
7. SDS, GHS in Taiwan, Council of Labor Affairs, Executive Yuan, ROC (Taiwan)

Version	Date	Remark
Version 1	06/01/1998	Original Version.
Version 2	04/20/2001	Updated 10 sections to 16 sections.
Version 3	08/01/2003	Updated “SECTION 9-PHYSICAL AND CHEMICAL PROPERTIES”.
Version 4	01/01/2006	Updated “SECTION 14-TRANSPORTATION INFORMATION”.
Version 5	08/05/2008	Updated each section by GHS SDS.
Prepared by	Safety & Environment Protection Section, Taiwan SM Corporation Kaohsiung Plant.	

Appendix B

Incident/Vehicle Accident Forms and WorkCare Information

Vehicle Accident Reporting

- Jeff Parsons, Health & Safety
  Jeffrey.Parsons@obg.com
  315-956-6070 | *c* 315-391-0638
- Meg Hermann, Legal
  Meg.Hermann@obg.com
  315-956-6624
- Lynnett Fangiullos, Finance
  Lynnett.Fangiullos@obg.com
  315-956-6636

Incident Reporting

- Contact WorkCare ASAP, and then Jeff Parsons within 24 hours
- Near Miss Reporting is done online within 3 days
  - » Search "Near Miss" on Aurora to submit a report (https://obrienandgere.sharepoint.com/sites/intranet/employee-resources/has/Pages/near-miss.aspx)

INCIDENT INVESTIGATION REPORT

Corporate H&S to complete:	☐ **Restricted Workday**	**(__ days)**	☐ **Spill**
☐ **First Aid / Notification**	☐ **Lost Workday**	**(__ days)**	☐ **Property Damage >$1,000**
☐ **Med. Treatment Only**	☐ **Fatality**	☐ **Near Miss (use Near Miss Program & electronic form)**	

PROJECT INFORMATION

Project/Office Name:		**Project Number:**	
Project/Office Address:		**State:**	**Zip:**
Project/Office Phone #:		**Today's Date:**	
Project/Regional Officer:		**Site Supervisor:**	
Project/Resource Manager:		**Foreman:**	
Project/Resource Supervisor:		**SSL:**	
Business Unit for Project:	(☐ NA for Office) ☐ AM ☐ CORP ☐ ENV ☐ EUI ☐ WAT		
Comments or Notes:			

INCIDENT INFORMATION

DATE and TIME (hrs) of Incident:	
Specific Location of Incident On-site:	
Supervisor at Time of Incident:	
Environmental Conditions:	
General Description of Work Being performed:	

☐ NA (☒ if no injury) INJURY INFORMATION

(Complete the Witness Interview section. – See page 3.)

Name:		**O'Brien & Gere Employment** (☒ appropriate status, company, & BU)**:**	
Gender:	☐ M ☐ F **DOB:**	**Status:**	☐ OBG Reg Status Full-Time ☐ OBG Temp Full-Time
Home Address:			☐ OBG Reg Status Part-Time ☐ OBG Temp Part-Time
		OBG Company:	☐ ENG ☐ OPS ☐ OGINA ☐ Limited
		OBG BU:	☐ AMO ☐ CORP ☐ ENV ☐ EUI ☐ WAT
Home Phone:		**Subcontractor or Agency Employment** (☒ appropriate below):	
Alternate Phone:		☐ ***Subcontractor** ☐ ***Labor Company/Agency** ☐ ***Other**	
Total Experience:	years months	***Name of Company:**	
OBG Experience:	Years months	**Union Status:** (☒ appropriate)	☐ NO ☐ YES-specify:
Nature of Injury, and Part of Body:			
WorkCare Called (888-449-7787)?	☐ NO ☐ YES (Minor injuries to O'Brien & Gere employees OR subs with WorkCare svc)		
Treatment at Hospital or Clinic?	☐ NO ☐ YES – specify:		
Hospital/Clinic Street Address:			
Employee was Working:	☐ Alone ☐ With Crew or Fellow Worker (get witness names)		
Specific Task at Time of Incident:			
Occupation/Craft at Time of Incident:			

☐ NA (☒ if no witness) WITNESS LIST

(Complete the Witness Interview section. – See page 3.)

Witness #1 Name:		**Contact Phone #**	
Witness #2 Name:		**Contact Phone #**	

FULLY COMPLETE THIS FORM AND SEND TO THE MANAGER OF CORPORATE H&S (Jeff Parsons) AND THE LEGAL/INSURANCE DEPARTMENT (Meg Hermann) WITHIN 24 HOURS

Email: Jeffrey.parsons@obg.com and meg.hermann@obg.com

Attach All Applicable Medical Reports & Other Support Documentation

DESCRIBE HOW THE INCIDENT OCCURRED

Describe in detail, and in chronological order, the events that lead to the accident, how the incident occurred, and any other facts you feel may be relevant to the investigation based on site observations and witness statements. Please avoid opinions or hearsay.

CASUAL FACTORS

Check all those that apply and identify corrective actions for each factor. Beginning with the most apparent or most direct cause of the incident, ask "WHY" five times to identify the sequence of events or conditions that contributed to the incident.

PROCEDURES	COMMUNICATION	MANAGEMENT/ORGANIZATION	HUMAN FACTORS
☐ Not available	☐ Misunderstood verbal directions	☐ Inadequate work planning	☐ Lack of experience or skill
☐ Difficult to use / understand	☐ No communication or untimely	☐ No pre-work safety review	☐ Infrequent performance
☐ Use of procedure was not required but should be	☐ Standard terminology or signals not used or are misunderstood	☐ Unclear assignment of responsibility or authority	☐ Operating equipment without authority
			☐ Operating equipment unsafely
☐ Followed Incorrectly	☐ Interference from noisy environment	☐ Unclear reporting relationship	☐ Taking unsafe position/posture
☐ Not followed	☐ Notifications late or not provided	☐ Improper delegation	☐ Poor judgment or Inappropriate risk taking
☐ Inadequate details	☐ Job/task safety analysis not reviewed with personnel	☐ Inadequate audits/inspections	☐ Physical impairment (explain)
☐ Situation not covered		☐ Inadequate incident reporting	☐ Drugs/alcohol (explain)
☐	☐ Poor coordination between affected groups or organizations	☐ Inadequate incident investigation	☐
WORK ENVIRONMENT		☐ Corrective actions not complete	**TRAINING**
☐ Housekeeping poor	☐	☐ Corrective actions inadequate	☐ Training not provided
☐ Temperature: Hot or Cold	**EQUIPMENT & TOOLS**	☐ Inadequate purchasing	☐ Training inadequate
☐ Poor lighting	☐ Wrong equipment/tool for the task	☐ Wrong person assigned to job	☐ Did not attend training
☐ High Noise	☐ Defective equipment/tools	☐ Lack of supervisor knowledge	☐ Training not appropriate for the job or task
☐ High Radiation Contamination	☐ PM not done or inadequate	☐ Inadequate/lack of safety mtgs	☐
☐ High Contamination	☐ Inadequate / removed guards	☐ Inadequate control of change	**ENGINEERING/DESIGN**
☐ Poor Visibility	☐ Inadequate isolation (LOTO)	☐ Mgmt resources inadequate	☐ Inadequate technical design
☐ Cramped quarters	☐ No inspection of tools / equipment	☐ Excessive work hours (fatigue)	☐ Inadequate specifications
☐	☐	☐ No or Inadequate enforcement	☐ Inadequate change mgmt
☐	☐	☐	☐

CORRECTIVE ACTIONS

List the corrective actions taken to minimize the possibility of a similar incident from occurring in the future. Assign specific individuals and completion dates for each corrective action. Use the table below track and document completion of corrective actions.

#	Description	Responsible Person	Target Completion	Actual Completion

REVIEWS

Prepared by: (print)		**Sign:**		**Date:**	
H&S Review: (print)		**Sign:**		**Date:**	

☐ NA (☒ if no injury or injury does not involve an O'Brien & Gere employee)

O'BRIEN & GERE EMPLOYEE INFORMATION RELEASE

I hereby authorize O'Brien & Gere or any of its representatives to be furnished any information and facts regarding this injury, including reports and records, results and diagnosis, treatment and prognosis, estimates of disability, and recommendations for further treatment. This information is to be used for the purpose of evaluating and handling my claim for injury as a result of an incident occurring on or about the above-noted date of injury and for no other purpose, now or in the future.

Employee Name:		**Date of Injury:**	
O'Brien & Gere Employee Signature:		**Date Signed:**	

WITNESS INTERVIEW

(To be completed when interviewing witnesses and injured personnel. Use as many copies of this page as necessary or obtain a copy of the separate Witness Interview Sheet.)

Please base all statements on personal observations and avoid hearsay. Describe what happened to the best of your recollection. The purpose of the investigation is to identify corrective actions that will prevent similar occurrences. Confidentiality of statements cannot be guaranteed. Please be advised that providing false information or intentionally omitting key information will be considered falsification of company documents.

Incident Location:

Full Name:

Occupation or Craft:

Employer Name:

Employer Address:

Employer Phone Number or Other Contact Phone Number:

How are you connected with others involved in the incident?

When did you see or hear the incident happen?

What attracted your attention to the incident?

When you first saw the incident, where were people and equipment positioned? (Attached sketches if necessary)

What did the area look like or what was happening in the area? List events in order of their occurrence.

Do you have any observations or information that may be related to the incident?

Witness Signature:		**Date:**	
Witness Print Name:			

INCIDENT DATE: **INCIDENT CLASSIFICATION:** **COUNTERS AFFECTED:** **Brand –** ESR | **Office –** _____

SHORT DESCRIPTION:

INCIDENT SUMMARY:

ROOT CAUSE & CONTRIBUTING FACTORS:

1)

PICTURE/SKETCH/DIAGRAM:

CORRECTIVE ACTIONS:

1)

VEHICLE ACCIDENT REPORT

COMPANY DRIVER INFORMATION

Driver Name:

Office: Cell Phone:

Office Phone: Home Phone:

Home Address:

Company Vehicle Information

Vehicle Owner: ☐ OBG ☐ Merchants Lease ☐ Rental Company (name):

Year: Make/Model:

Plate No.: VIN No.:

Company Passenger Information

Name: Phone:

Address:

OTHER VEHICLE INFORMATION

Owner: Phone:

Address:

Driver: Phone:

Address:

Year: Make/Model: Plate No.:

Insurance Co.: Policy No.:

Other Vehicle Passenger Information or Injured Pedestrians

Name #1: Phone #1:

Address #1:

Name #2: Phone #2:

Address #2:

ACCIDENT FACTS

Date: Time: ***LOCATION*** Address No.:

Street: City & State: Zip:

Were Police present? ☐ Yes ☐ No Police Dept.:

Were any citations issued? ☐ Yes ☐ No If yes, for what?

INJURIES

Were there any injuries? ☐ Yes ☐ No If yes:

Who: Nature:

Who: Nature:

ACCIDENT DESCRIPTION

DAMAGE TO VEHICLE(S) – TAKE PHOTOS

Taken By: Date:

INFORMATION TO BE EXCHANGED WITH OTHER DRIVERS:

- Your name, address, date of birth and driver's license number
- Vehicle Owner and Address
- Insurance Policy Number
- Insurance Company Name & Address
- Insurance Agent Name & Address

WorkCare® Making Health Count

FACT SHEET

EARLY INCIDENT INTERVENTION®

Immediate Access to Clinical Advice for Work Related Incidents

INTRODUCTION

WorkCare, Inc. (WorkCare) and O'Brien & Gere have partnered together to promote Incident Intervention®, a resource designed to support company safety goals/targets—while reducing runaway-costs associated with workplace injuries and illnesses.

PURPOSE

Early Incident Intervention provides O'Brien & Gere employees with **IMMEDIATE** telephonic access to WorkCare clinicians at the time of a presumed, non-emergency workplace injury or illness.

Utilizing WorkCare within the first hour of an incident, known as the "Golden Hour," allows licensed clinicians the ability to suggest interventions that are consistent with healthcare guidelines specific to the injury or illness.

> *"…helps the worker traverse the unpredictable terrain of work-related injuries and illness."*

PRINCIPLES OF EARLY INCIDENT INTERVENTION

- Utilizes principles of the "Golden Hour."
- Provides workers immediate support at the time of an incident.
- Focuses on providing the right care, at the right time in the right setting.

BENEFITS FOR EMPLOYEES

- Immediate access to a licensed clinician who can provide recommendations regarding your symptoms and possible outcomes.
- Professional guidance on appropriate first aid measures
- Professional advice regarding the need for additional medical evaluation or treatment.

BENEFITS FOR O'BRIEN & GERE

- Point of contact for non-emergency medical clinicians.
- Triages the incident to determine risk and urgency, suggesting interventions that are consistent with healthcare guidelines. Maintains communication with clinicians to ensure accurate and timely reporting.

In case of an Emergency dial **911**

Incident Intervention®

Right Care at the Right Time in the Right Setting

To report an onsite injury or illness to an **O'Brien & Gere Employee** that may require clinical consultation call:

888-II-XPRTS or

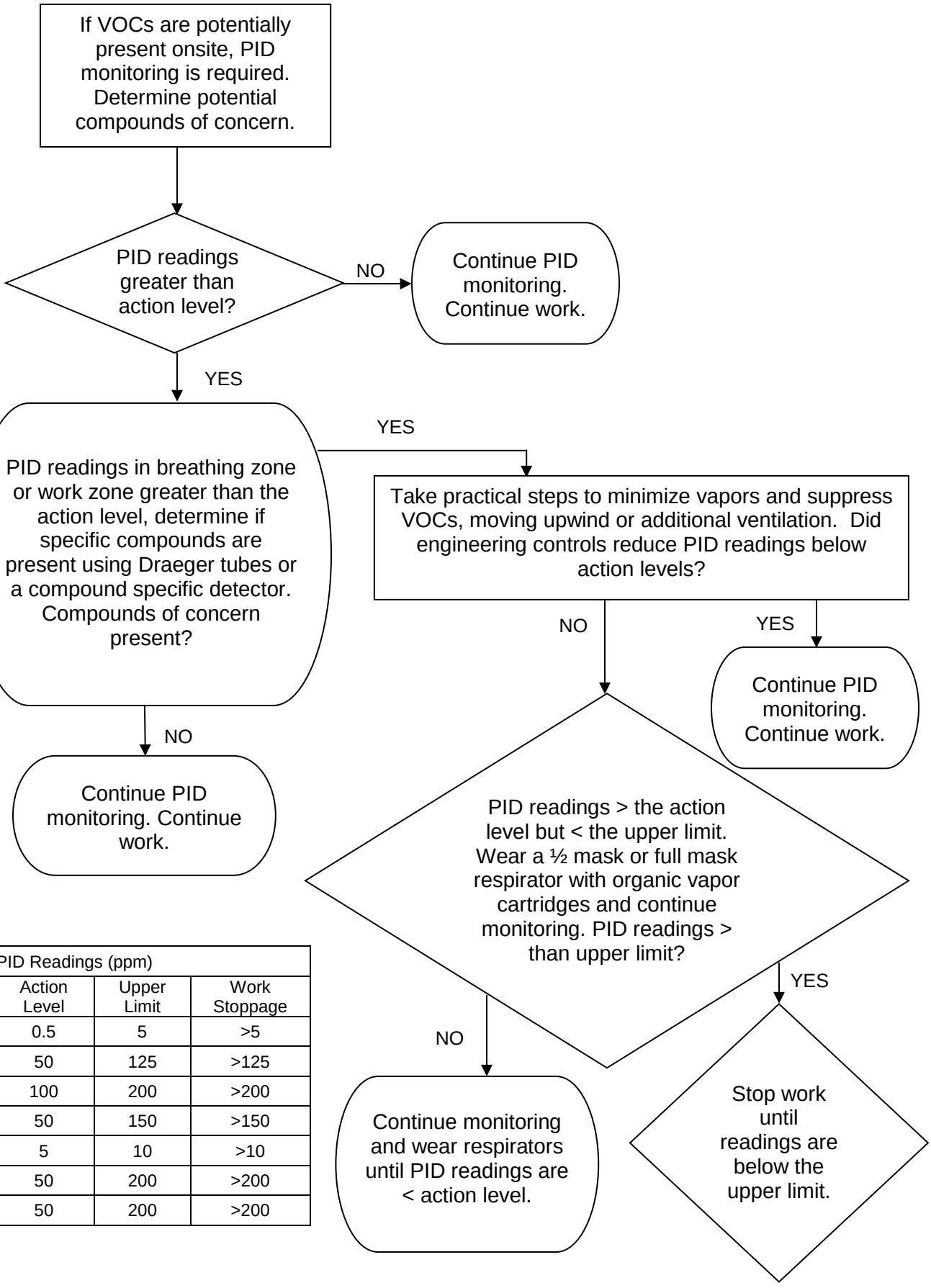
888-449-7787

WorkCare® Making Health Count

Appendix C

Air Monitoring and Respirator Use Flow Chart

Air Monitoring and Respirator Use Flowchart



PID Readings (ppm)			
Compound	Action Level	Upper Limit	Work Stoppage
benzene	0.5	5	>5
ethylbenzene	50	125	>125
toluene	100	200	>200
xylenes	50	150	>150
naphthalene	5	10	>10
tetrachloroethene	50	200	>200
trichloroethene	50	200	>200

Appendix D

Activity Hazard Analysis

ACTIVITY HAZARDS ANALYSIS

Overall Risk Assessment Code (RAC) (Use highest code): L

Date prepared: 9 October 2018

Project location: Waukegan, Illinois

Prepared by: Kyle Schaefer

Job: Air Sampling and Instrument Calibration

Reviewed by: Steve Wiskes

Risk Assessment Code Matrix

E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
Collect SUMMA and PUF air samples	Struck by heavy equipment or trucks	Wear Hi-Vis clothing, make eye contact with drivers and operators, good radio communication	L
Calibrate Instruments	Slip, trip and fall	Watch where you are walking carry only what you can handle easily	L
	Compressed gases	Transport gas cylinders with regulator detached and cap on the cylinder	L
			L
			L

EQUIPMENT	TRAINING	INSPECTION
SUMMA canisters, vacuum gauge and PUF samplers	Read SOP	- Condition of sample containers - Beginning and ending vacuum in SUMMA canisters - Vacuum gauge certified annually
Calibrate instruments	Follow manufacturer's instructions	- Rate of carrier gas usage - Instruments zero - VOC concentrations within 5% or 10% (compund dependant) of true value

Approval Authority: Steve Wiskes

ACTIVITY HAZARDS ANALYSIS

Overall Risk Assessment Code (RAC) (Use highest code): **L**

Date Prepared: 10/9/18

Project Location: Waukegan, IL

Prepared by: Andrea Salus

Job: Former South Plant MGP Site

Reviewed by: Steve Wiskes

RISK ASSESSMENT CODE MATRIX

E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

Severity	Probability: Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

JOB STEPS	HAZARDS	ACTONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
1. Open well vault	- Dropping vault cover - Slips, trips, and falls over vault cover - Fall into vault	1. Stay out of the way of where the cover is dragged to prevent the opportunity for it to land on a foot or hand. 2. Place vault cover out of the way of activities. 3. Stay away from vault edge.	L
2. Remotely monitor the air in the space you will enter	- Low oxygen - Carbon monoxide, hydrogen sulfide present - Explosive atmosphere	1. Do not enter if oxygen is below 19.5 % 2. Do not enter if carbon monoxide, hydrogen sulfide or the lower explosive limit are above the acceptable levels (the meter alarm will sound)	L
1. Inspect area to be entered with extra lighting	- Slip, trip and fall	1. Know the area to be entered. 2. Do not enter the area if obvious hazards exist (standing water, too much debris to move around safely)	L

ACTIVITY HAZARDS ANALYSIS

1. Enter confined space	- Low oxygen - Carbon monoxide, hydrogen sulfide, methane present - Explosive atmosphere - Slip, trip and fall - Hazardous atmospheres - Engulfment hazards - Entrapment hazards	1. Leave confined spacer if oxygen is below 19.5 % 2. Leave confined space if carbon monoxide, hydrogen sulfide or the lower explosive limit are above the acceptable levels (the meter alarm will sound) 3. Leave confined space if hazardous atmosphere 4. Untrained personnel should never enter a confined space or act as an attendant 5. Never enter a confined space without an attendant present 6. Inspect confined space remotely for entrapment and engulfment hazards 7. Inspect confined space for hazardous atmospheres 8. Have sufficient lighting and watch your step	L
1. Pump and or other equipment maintenance	- Contaminants on pump and in the water	1. Wear appropriate PPE, hard hat, gloves, safety glasses, safety boots	L
EQUIPMENT	**TRAINING**	**INSPECTION**	
Tripod and harness	- **Entrant and Attendant must be trained prior to entry into a confined space.** - **Check with Jim Stinnett and Jeff Parsons for confined space training that is required** - **Determine if the confined space is a permit required confined space**	- Inspect body harness for defects - Inspect tripod and retrieval rope for defects -	
MiniRae 3000 (PID)	See manual	- Zero and calibrate to isobutylene 100 ppm - Unit is charged sufficiently	
QRAE II (4 gas meter)	See manual	- Check calibration as necessary - Check ambient air oxygen reading (20.8%)	

Approval Authority: Steve Wiskes

ACTIVITY HAZARDS ANALYSIS

Overall Risk Assessment Code (RAC) (Use highest code): L

Date prepared: 9 October 2018

Project location: Waukegan, Illinois

Prepared by: Kyle Schaefer

Job: Construction Oversight

Reviewed by: Steve Wiskes

Risk Assessment Code Matrix

E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
Document surface and subsurface removal of structures and soil	Exposure to Coal Tar, Cyanide, PAHs material	-Wear proper PPE according to HASP -Conduct air monitoring for VOCs	L
Document clearing, grubbing and fence installation	Struck by or caught between heavy equipment or trucks	-Wear Hi-Vis clothing at all times, -Make eye contact with operators and truck drivers before crossing paths -Maintain communication	L
Document installation of wells and vaults	Fall in excavation	-Stay the proper distance back from excavation, -Be sure excavations are fenced with proper signage	L
	Slip, trip and fall on uneven ground or around excavated materials which may include concrete, rebar and other demolition debris	-Watch where you are walking -Do not use cell phone while walking on 5the site	L
			L

EQUIPMENT	TRAINING	INSPECTION
Hand held photoionization detector	Operation manual	-Calibrate and/or check calibration daily (isobutylene 100 ppm) - Pump working properly -Sufficient charge to last all day

Approval Authority: _____

ACTIVITY HAZARDS ANALYSIS

EQUIPMENT	TRAINING	INSPECTION
Camera	None	Is it charged and is there enough space on memory card

Approval Authority: _____

ACTIVITY HAZARDS ANALYSIS

Overall Risk Assessment Code (RAC) (Use highest code): L

Date prepared: 1 October 2018

Project location: Waukegan, Illinois

Prepared by: Kyle Schaefer

Job: Drill/Install/Develop/Sample Extraction, Injection and GW Wells

Reviewed by: Steve Wiskes

Risk Assessment Code Matrix

E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
Determine location of underground utilities	Shock and explosion to personnel. Damage to underground utilities.	-Contact Julie for utility clearance. -Contact a private utility clearance company.	L
Obtain permits for drilling.	Damage to underground utilities.	-Drill only when permit is present, as applicable to municipality	L
Breakup/cut concrete or asphalt to open up the ground.	Concrete chips and dust, jagged rebar	-Use qualified personnel. -Use of appropriate equipment and tools. -Use appropriate PPE. -Keep unauthorized personnel out of area. -Daily tailgate safety meeting to discuss Site activities and associated hazards.	L
Inspect equipment (machinery, hand tools).	Injuries from defective tools and equipment	-Do not use defective equipment and tools. -Replace defective tools.	L

Approval Authority: Steve Wiskes

ACTIVITY HAZARDS ANALYSIS

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
Drill Soil Well installation	Rotating hazards Noise Atmospheric hazards Struck-by Overhead falling objects	-Use competent and qualified personnel to operate equipment (certifications and licences). -Use of appropriate PPE (reflective vests, hard hats, hearing protection, safety glasses, steel-toed boots). -Hazwoper training (40-hr with up to date 8-hr refresher) -Screen breathing zone with appropriate instruments (i.e. PID). -Keep unnecessary personnel away from drilling area. -Daily Health and Safety Tailgate Meetings to go over activities and associated hazards.	L
Sample soil, water and groundwater	Chemical hazards from contaminants in soil and water Chemical hazards in preservatives	-Use appropriate PPE when handling contaminated soil and water. Use appropriate PPE when handling preservatrives -Use PID to monitor air quality in breathing zone -Use qualified personnel to run equipment. -Daily Health and Safety Tailgate Meetings to go over activities and associated hazards.	L

EQUIPMENT	TRAINING	INSPECTION
Drill rigs	-Documented competent personnel with required certificates and licenses to operate equipment. -40-hr hazwoper training and 8-hr refresher training	-All equipment working properly (daily). -Safety devices working properly (daily).
Hand tools, pump, groundwater quality meter	none	-Operarting correctly and not defective.
PID (10.6 eV)	Must be able to calibrate PID	-Calibrates to within 10% of true isobutylene value (100 ppm). -Battery life sufficient. -Pump operating.

Approval Authority: _____

ACTIVITY HAZARDS ANALYSIS

Overall Risk Assessment Code (RAC) (Use highest code): L

Date prepared: 9 October 2018

Project location: Waukegan, Illinois

Prepared by: Kyle Schaefer

Job: Excavation and Load-out of Soil

Reviewed by: Steve Wiskes

Risk Assessment Code Matrix

E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
Determine location of underground utilities	Shock and explosion to personnel. Damage to underground utilities.	-Excavation contractor to contact Diggers Hotline for utility clearance. -OBG to contact a private utility clearance company.	L
Obtain permits for excavation.	Damage to underground utilities.	-Dig only when permit is present, as applicable to municipality	L
Breakup/cut concrete and cut rebar to open up the ground.	Concrete chips and dust, jagged rebar	-Use qualified personnel. -Use of appropriate equipment and tools. -Use appropriate PPE. -Keep unauthorized personnel out of area. -Daily tailgate safety meeting to discuss Site activities and associated hazards.	L
Inspect equipment (machinery, hand tools).	Injuries from defective tools and equipment	-Do not use defective equipment and tools. -Replace defective tools.	L

Approval Authority: Steve Wiskes

ACTIVITY HAZARDS ANALYSIS

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
Excavate and load-out soil	Cave-in Entrapment Noise Traffic hazards in a small work area Nearby personnel (or public) falling in excavation Atmospheric hazards Struck-by	-Use competent and qualified personnel to operate equipment (certifications and licences). -Use of approved protection systems for excavations over 5 ft. (trench boxes). -Do not enter excavations without proper shoring, air monitoring, and PPE. -Screen breathing air zone with a PID -Use of appropriate PPE (reflective vests, hard hats, hearing protection, safety glasses). -Hazwoper training (40-hr with up to date 8-hr refresher) - Placement of fencing/barricades around the excavation. -Screen breathing zone with appropriate instruments (i.e. PID, dust monitor). -Keep unnecessary personnel away from excavation area. -Daily Health and Safety Tailgate Meetings to go over activities and associated hazards. -Site Control and Security - use sign-in/out sheet to track personnel on site -Make eye contact with operators and drivers before crossing paths	M
Fill-in the excavation and grade site	General construction zone hazards (movement of trucks, backhoes, front-end loaders).	-Use qualified personnel to run equipment. -Use appropriate PPE. -Daily Health and Safety Tailgate Meetings to go over activities and associated hazards. -Make eye contact with operators and drivers before crossing paths	M

EQUIPMENT	TRAINING	INSPECTION
Backhoe, front end loader, dump trucks	-Documented competent personnel with required certificates and licenses to operate equipment. -40-hr hazwoper training and 8-hr refresher training	-All equipment working properly (daily). -Safety devices working properly (daily).

Approval Authority: _____

ACTIVITY HAZARDS ANALYSIS

EQUIPMENT	TRAINING	INSPECTION
Hand tools	None	-Operarting correctly and not defective.
PID	Must be able to calibrate PID	- PID calibrates within 10% of calibration gas standard (isobutylene 100 ppm) - PID zeroes -PID sufficiently charged

Approval Authority: _____

ACTIVITY HAZARDS ANALYSIS

Overall Risk Assessment Code (RAC) (Use highest code): L

Date prepared: 9 October 2018

Project location: Waukegan, Illinois

Prepared by: Kyle Schaefer

Job: O&M

Reviewed by: Steve Wiskes

Risk Assessment Code Matrix

E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
Open and inspect recovery vaults.	Slips, trips, falls, odors	-Wear proper PPE according to HASP -Conduct air monitoring for VOCs, LEL, oxygen, H2S before entering	L
Within vaults maintenance of pumps, conveyance and electrical infrastructure.	High pressure lines.	-Do not stand on or move. -Do not cut. -Wear proper PPE. -De-pressurize lines for any maintenance	L
	Electrical.	-Leave the maintenance to a competent person.	L
Water treatment system maintenance.	High pressure lines Contaminants from water Hazardous atmosphere	-Watch where you are walking. -Have a competent person show working procedure. -De-pressurize lines for any maintenance - Wear appropriate PPE (hard hat, safety glasses, safety boots, , hi vis clothing) -Screen air with a PID for VOCs and 4-gas meter (LEL, O2, CN, H2S). leave area if a hazardous atmosphere is present.	L
			L

Approval Authority: Steve Wiskes

ACTIVITY HAZARDS ANALYSIS

EQUIPMENT	TRAINING	INSPECTION
Hand held photoionization detector	Operation manual	-Calibrate and/or check calibration daily - Pump working properly -Sufficient charge to last all day
Camera	None	Is it charged and is there enough space on memory card
4- gas meter (LEL, H2S, O2, CN)	read manual	- charged sufficiently - Calibrates correctly -Zeroes correctly

Approval Authority: _____

ACTIVITY HAZARDS ANALYSIS

Overall Risk Assessment Code (RAC) (Use highest code): L

Date prepared: 9 October 2018

Project location: Waukegan, Illinois

Prepared by: Kyle Schaefer

Job: Site Control and Security

Reviewed by: Steve Wiskes

Risk Assessment Code Matrix

E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

Severity	Probability: Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
Maintain a secure perimeter at the site and near the excavation	Unauthorized personnel could be injured from equipment, contaminants or falling into the excavation.	- Prevent unauthorized personnel from entering the site by verbal commands, caution tape or other barricades - If the site is fenced keep the gate closed and locked as much as possible.	L
Install signage at the Site including "No Trespassing" and signs indicating hazardous materials are present, and "Do Not Enter" tape should also be used.	Authorized and unauthorized personnel could be injured from equipment, contaminants, or falling into the excavation.	- Use warning tape and signage to alert anyone on-site of the hazards present.	L
Use a "Sign In/Sign Out" log at the Site Office.	Authorized personnel could be unaccounted for during an emergency situation.	- All individuals must sign in and sign out to account for their movements onto and off the Site.	L
Use of a Health and Safety Plan Acknowledgment form.	Site personnel may be unaware of hazards associated with the site activities.	Anyone entering the Site must read and be familiar with the Health and Safety Plan and sign an acknowledgment form which confirms they have read and understand the hazards associated with the Site.	L
			L
			L

Approval Authority: Steve Wiskes

ACTIVITY HAZARDS ANALYSIS

EQUIPMENT	TRAINING	INSPECTION
Signage and warning tape	None	Inspect that they are present and readable.
Locks for site fence gate	None	The locks are present and work properly.

Approval Authority: _____

ACTIVITY HAZARDS ANALYSIS

Overall Risk Assessment Code (RAC) (Use highest code): L

Date prepared: 9 October 2018

Project location: Waukegan, Illinois

Prepared by: Kyle Schaefer

Job: Working Near Vehicular Traffic and Railroad Tracks

Reviewed by: Steve Wiskes

Risk Assessment Code Matrix

E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
Work on site near roadway, right of way or parking lot	struck-by vehicular traffics - cars, haul trucks and heavy equipment	- Wear proper PPE - hard hat, safety glasses, class 2 high visibility vest, safety boots or shoes - Use safety equipment - sign, orange cones and amber strobe light	L
		-Place vehicle between site personnel and oncoming trafiic	L
		- Place "Road Work Ahead" sign at least 75 to 100 ft behind the vehicle. - Place large orange cones between sign and vehicle. - Place amber strobe light on roof of vehicle	L
		- Keep personnel and equipment within the width of the vehicle.	L
Work within 25 ft of the centerline of the railroad track	struck by rail traffic	- Notify railroad 10 days in advance and arrange for a railroad flagger - Do not wear a red hat or red vest. - Wear orange or lime green safety vests	L
		- Move at least 50 ft away from an oncoming train	L

Approval Authority: Steve Wiskes

ACTIVITY HAZARDS ANALYSIS

EQUIPMENT	TRAINING	INSPECTION
Road Work Ahead Equipment	40-hr Hazwoper and 8-hr refresher	- Amber strobe light works - Cones are not damaged - Road Work Ahead sign is readable , in good condition and is self-supporting

Approval Authority: _____

OBG

THERE'S A WAY

Appendix E

Contingency Plan

Contingency Plan

North Shore Gas Company's
Former South Plant Manufactured Gas Plant
Waukegan, Illinois

WEC Business Services, LLC

October 2018

OBG

TABLE OF CONTENTS

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

Akzo	Akzo Aerospace Coatings, Inc
AED	Automated External Defibrillator
ERC	Emergency Response Coordinator
CRP	Cardio-Pulmonary Resuscitation
CQAP	Construction Quality Assurance Plan
HASP	Health and Safety Plan
NSG	North Shore Gas
OBG	O'Brien and Gere Engineers, Inc.
RA	Remedial Action
ROD	Record of Decision
SDS	Safety Data Sheets
SPCC	Spill Prevention, Control, and Countermeasure
SSHO	Site Safety and Health Officer
USEPA	United States Environmental Protection Agency
WEC EIRT	WEC Environmental Incident Response Team

1 INTRODUCTION

O'Brien and Gere Engineers, Inc. (OBG) prepared this Contingency Plan on behalf of North Shore Gas (NSG) for the use by NSG site personnel, NSG contractors, and other authorized parties in the event of an emergency when implementing the remedy selected by the U.S. Environmental Protection Agency (USEPA) in the July 2015 Record of Decision (ROD) for the Former South Plant Manufactured Gas Plant (Site) located in Waukegan, Lake County, Illinois. The purpose of this plan is to:

- Establish an organizational structure and procedures in the event of an emergency.
- Minimize hazards to human health and the environment from emergency events.
- Familiarize response personnel with equipment and procedures.

This Contingency Plan focuses on potential emergencies that may arise during construction and operation of the groundwater treatment plant, installation of injection and recovery wells, and monitoring activities specified in the ROD.

OBG and/or NSG will review this Contingency Plan with Site personnel covered by the plan any time when:

- The Contingency Plan is initially developed or the Site personnel is assigned to the job.
- The Site personnel's responsibilities under the Contingency Plan change.
- The Contingency Plan is changed.

Included as attachments to this Contingency Plan are the following references and additional plans, as required under the ROD:

- Emergency Contacts (Appendix A)
- Emergency Response Equipment (Appendix B)
- Draft Spill Prevention, Control, and Countermeasure Plan (SPCC Plan, Appendix C)

The SPCC Plan was developed in accordance with 40 CFR Parts 109 and 112. Both the Emergency Response Plan and the SPCC Plan will be further refined during the Remedial Design and Remedial Action process.

2 PRE-EMERGENCY PLANNING

To handle emergencies properly and effectively, planning and training are essential. Pre-emergency planning procedures must be in place to facilitate effective immediate response to emergency situations. Site personnel must be knowledgeable of their roles and responsibilities and act within their abilities and training. NSG prohibits employees from responding to emergency situations that would require them to be exposed to hazards beyond their level of training.

Prior to the commencement of remedial activities, and as necessary throughout the project, the Site Safety and Health Officer (SSHO) or other designee will communicate with local emergency personnel (e.g., fire, police, ambulance, and medical) to describe the remedial activities and coordinate emergency response efforts. Contacts within applicable response agencies will be informed of changing Site conditions that may affect emergency response. A list of emergency contacts is provided in Appendix A.

3 ROLES AND RESPONSIBILITIES

The SSHO will be the primary Emergency Response Coordinator (ERC). If an incident occurs, the SSHO, or designated alternate, will contact the appropriate personnel or authorities, as determined by the type and nature of the incident. The personnel identified for this and other emergency response roles will be clarified as part of the Remedial Design and Remedial Action Process. The emergency contact list included in Appendix A will serve as documentation of the site-specific chain-of-command. This chain-of-command is established to minimize confusion and to outline decision-making authority in the event of an emergency.

3.1 EMERGENCY RESPONSE COORDINATOR/INCIDENT COMMANDER ROLE

The ERC's responsibilities during emergency situations include:

- Evaluate emergency and special needs.
- Direct emergency efforts, including evacuation of personnel.
- Notify emergency response agencies.
- Oversee medical and decontamination procedures.
- Serve as the point of contact for local fire department(s), hazardous material team(s) and other emergency response agencies.

The ERC's responsibilities after emergency response activities have been completed include:

- Supervise cleanup efforts; ensure proper recovery, disposal and accounting of hazardous material/waste.
- Ensure all emergency equipment and supplies are inspected, cleaned, and made available for future use.
- Document incident, advise management, and initiate debriefing.

The ERC will delegate, as necessary, specific roles and duties outlined above. An ERC will be established before remedial construction begins.

3.2 ALTERNATE EMERGENCY RESPONSE COORDINATOR ROLE

A Field Technician/Engineer will be designated as the primary backup to the ERC. Additional personnel may be trained as alternate ERCs, as needed.

3.3 PROGRAM HEALTH AND SAFETY MANAGER ROLE

The Program Health and Safety Manager will provide technical assistance and lead post-event investigations. In addition, the Program Health and Safety Manager will receive, review, and track reports from the ERC, provide information to appropriate management, act as a liaison for worker's compensation, and be the focal point for medical return-to-work considerations. The program health and safety manager role will be established before remedial construction commences.

3.4 EMERGENCY RESPONSE TEAMS

Based upon the size and complexity of the Site and/or task activities, Emergency Response Teams will either be jointly comprised of all on-site personnel [cross-trained for necessary actions (e.g., spills, high-angle rescue)], specific individuals and local response agencies, or a combination thereof. A qualified emergency response contractor may be used to provide additional support, as needed, during an emergency. The Emergency Response Team will be defined before remedial construction begins.

4 EMERGENCY RECOGNITION, PREVENTION, AND TRAINING

Immediate recognition of potentially hazardous conditions and swift implementation of the necessary corrective actions can avert an emergency. Emergency response discussions will be incorporated into daily health and safety tailgate meetings and site personnel will be reminded to remain constantly alert for potentially hazardous situations or conditions. The daily tailgate meetings will include such topics as:

- Tasks to be performed that day
- Hazards that may be encountered, how to recognize, and their possible effects
- Emergency procedures

Given that the nature of the remedial action (RA) will involve potentially coming into contact with hazardous materials, training will be consistent with standards for Hazardous Waste Operations (29 CFR 191.120). As such, all Site personnel shall have a minimum of the following safety training:

- 40-hour Hazardous Waste Operations
- 8-hour Annual Refresher Course
- Site-Specific Training

In addition:

- At least one member of the Site team will have First Aid/Cardio-Pulmonary Resuscitation (CPR)/Automated External Defibrillator (AED) training.
- At least one member of the Site team will have 8-hour Site Health and Safety Coordinator Training.

4.1 AIR MONITORING

Air monitoring for potential hazards will be conducted during the RA. Perimeter air monitoring will be conducted as described in the Construction Quality Assurance Plan (CQAP). Personal air monitoring will be conducted, as necessary, as described in the Site Health and Safety Plan (HASP).

5 COMMUNICATION

Daily health and safety tailgate meetings will be used to review personnel roles, responsibilities, and emergency procedures. These briefings may also be used to discuss the day's activities and lessons learned from the previous day. A record of the safety briefings (including attendees and topics) will be completed by the SSHO or their designee, and maintained on Site.

Emergency communications will be conducted by voice, audible horn/alarm, and/or cell phone. Site-specific emergency communication equipment is provided in Appendix B. Telephone or cell phone capability will be a requirement for the Site and Site personnel. Emergency telephone numbers will be kept in Site vehicles and/or Site office. Personnel will be instructed to immediately contact the SSHO or Site Manager if an emergency arises. A backup emergency notification system will also be used (e.g., vehicle horn located at each work location).

In the case of an emergency, the signal for personnel to evacuate the area will be a series of long blasts. Five short blasts will signal "all clear" once the emergency has been mitigated, as determined by the ERC. Only then may workers may return to their designated work areas. In the event of an emergency requiring additional assistance, the ERC or designated alternate will contact outside help using the nearest telephone or other pre-established means. Each type of communication will be tested to ensure that Site personnel can identify the signals above background noise, as well as to check for system efficacy and accuracy.

5.1 COMMUNICATION OUTSIDE THE SITE

In the event an emergency is declared outside of the Site, an emergency alert siren may be activated by the City of Waukegan, Lake County Emergency Management Agency, or other agencies. The emergency alert siren is tested at 10:00 AM on the first Tuesday of the month. No response is required during these testing sessions.

In the event the emergency alert system is activated at other times, Site personnel should use a radio, a smart phone, or a laptop computer to connect to a local media source to obtain information on the emergency. This information should be conveyed to the Site Manager and SSHO.

6 SUPPORT AREAS, EVACUATION PROCUDURES, AND PERSONNEL ACCOUNTING

Evacuation routes and assembly areas will be determined in pre-job briefings and posted at the Site. Means of accounting for Site personnel and visitors will be based upon Site size and complexity (typical methods include sign-in/out logs). In the event of an evacuation, these logs will be brought to the assembly area(s) to verify safe evacuation by all Site personnel. After a head count has been taken at the assembly area(s), further evacuation may be required based on wind direction and other weather conditions.

Alternate routes and assembly areas will be determined and utilized based upon wind speed and direction as well as emergency requirements. A Site plan and hospital evacuation route are included in the HASP. The hospital route map will be posted at the Site and the hospital route will be driven by Site personnel.

7 EMERGENCY PROCEDURES

7.1 GENERAL

The following actions will be taken during an emergency, with some actions conducted concurrently. No individual will attempt an emergency response/rescue until the situation has been assessed and the appropriate response outlined.

It will be determined prior to work initiation, whether any tasks on Site are critical operations requiring one or more persons to shut down sensitive equipment in a time-critical manner. If critical operations are evident, specific procedures will be outlined in an addendum to this report.

7.2 SECURITY ISSUES

Both routine and emergency response actions dictate the need for prevention of unauthorized access and for the protection of the public, vital documents, samples, and equipment. Evaluation of the Site size, location, political or social environment, and equipment needs are necessary to evaluate whether security personnel (private or public) is needed. As needed, NSG will coordinate Site security procedures with the City of Waukegan. The Akzo Nobel Aerospace Coatings, Inc (Akzo) property, located east/southeast of the former MGP, has a separate security perimeter with 24-hour security personnel. Site personnel will need to complete Akzo emergency training comply with their security procedures while working on the Akzo property.

In the event of unauthorized access, Site personnel should avoid confrontation (verbal or physical). Attempts must be made to explain Site hazards, as well as corporate and client expectations for a safe worksite. Continued presence by unauthorized persons will require a team member to notify the local police. Site activities may need to be halted in the event unauthorized persons create an adverse risk to themselves, to Site personnel, or to subcontractors.

7.3 SEVERE WEATHER/NATURAL DISASTERS

In the event of adverse weather conditions occurring at or near the Site, such as lightning, high winds, tornado, flooding, or extreme heat/cold, the SSHO will instruct Site personnel to discontinue or modify field operations. These natural phenomena complicate work activities, often adding or increasing risk to Site personnel. The following actions should be taken in the event of severe weather:

- Stop work.
- Secure loose materials, toolboxes, plywood, trash cans, etc., if it is safe to do so.
- Bring all Site workers to safe areas indoors or in vehicles when lightning or severe weather is in the immediate area (within 8 miles as determined by a lightning detector). Do not resume work until at least 30 minutes have passed since the last lightning strike was observed.
- Verify that all buildings and trailer doors are secured and windows closed.
- Shut down and disconnect all non-critical electrical equipment to protect the equipment from electrical surges and abrupt power loss.
- Notify Program Health and Safety Manager and Site Manager.

7.4 INJURY OR ILLNESS

In the event of injury or illness, qualified Site personnel will take the following action:

- Evaluate the scene for safe entry.
- Notify SSHO and Site Manager.
- Assess the type and extent of injury or illness.
- Provide initial first aid to the injured person.

- If the injury or illness is not potentially life-threatening, transport to local medical facility.
- If injury or illness is potentially life-threatening, notify emergency medical services.
- Notify Program Health and Safety Manager and Site Manager.

Appropriate responses to injuries or illnesses, including first aid application, is described in the HASP.

7.5 EXTRICATION

In the event a person becomes trapped and requires extrication, qualified Site personnel will take the following action:

- Notify SSHO and Site Manager.
- Evaluate the scene for safe entry.
- Contact the local Fire Department or Rescue Service.
- Provide initial first aid, as necessary.
- Notify Program Health and Safety Manager and NSG Project Manager.

7.6 CHEMICAL EXPOSURE

In the event of chemical exposure, qualified Site personnel will take the following action:

- Evaluate the scene for safe entry.
- Notify SSHO and Site Manager.
- Provide assistance with emergency shower, eyewash, or other initial first aid, as required [see Safety Data Sheets (SDS) for chemical information, if known].
- Decontaminate exposed personnel.
- Notify emergency medical services of need for transportation, as necessary.
- Notify Program Health and Safety Manager and NSG Project Manager.

7.7 SMALL FIRE

A small fire is defined as a fire that can be extinguished with a 4A:20BC type fire extinguisher or incipient stage fires, which can safely be extinguished with materials readily at hand. Fire extinguishers will be kept in on-site vehicles and in the Site field office, as described in Appendix B. In the event of a small fire, Site personnel will take the following actions:

- Evacuate all unnecessary personnel from the area, moving to an upwind location, if possible;
- Notify SSHO and Site Manager;
- If properly trained and authorized, attempt to extinguish fire using portable fire extinguishers or by smothering from an upwind location;
- Request emergency response assistance as appropriate; and
- Notify Program Health and Safety Manager and NSG Project Manager.

7.8 LARGE FIRE

In the event of a large fire, or a small fire that cannot be extinguished, the following actions will be taken:

- Sound alarm;
- Evacuate all unnecessary personnel from the area, moving to an upwind location, if possible;

- Notify local fire department and request other emergency response services (police, ambulance, and hospital), as needed; and
- Notify Program Health and Safety Manager and NSG Project Manager.

7.9 SMALL SPILL

In the event of a small spill, appropriate actions will be taken to prevent the spill from reaching groundwater, surface water, or drains. Actions include:

- Assess and verify, if possible, the spilled material, volume, and hazards (see SDS);
- Determine appropriate response procedures and necessary personal protection equipment;
- Determine the level of response necessary to contain and clean up the spill, using the appropriate materials and methods;
- Confine or contain spill with booms, pads, or berm;
- Neutralize spill with appropriate agents (if safe/possible);
- Notify Program Health and Safety Manager, Site Manager, and NSG Project Manager; and
- Collect spilled material including absorbent material and place in appropriate containers. All hazardous materials shall be disposed of in accordance with all applicable hazardous waste regulations and NSG requirements.

7.10 LARGE SPILL

A large spill is defined as a volume equal to or greater than state or federal reportable quantities and/or those beyond the capabilities and resources of on-site personnel. Appropriate RAs will be conducted according to state and federal regulations. General procedures are as follows:

- Assess and verify, if possible, the spilled material, volume, and hazards (see SDS);
- As safe to do so, confine the spill to the smallest area possible using booms, pads, berms or any other effective material;
- Assess type and extent of damages and injuries to personnel; take appropriate first aid steps if necessary;
- Notify Program Health and Safety Manager, Site Manager, and NSG Project Manager;
- If additional emergency clean-up assistance is needed, NSG will request assistance from qualified emergency response contractors;
- Collect hazardous waste, including contaminated booms and absorbent material. All hazardous clean-up residuals shall be disposed of as hazardous waste in accordance with all applicable hazardous waste regulations; and
- All emergency equipment will be decontaminated prior to being put back into service. Expendable or damaged supplies will be isolated and replaced.

7.11 CRITIQUES AND CORRECTIVE ACTIONS

Post-emergency response activities include documentation, investigation and appropriate corrective actions to avoid future problems. The Program Health and Safety Manager will lead the post-incident critique to assure Site personnel are knowledgeable about the actions taken and will propose changes, as necessary. The SSHO, with direction and assistance from the Program Health and Safety Manager, is responsible for documenting incident reports and providing communication to management. Before resumption of work any necessary corrective actions, determined by an appropriate review and investigation of the incident, must be implemented. In the event corrective action(s) cannot be made on an immediate timeframe, documented plans and schedules will be formulated for implementation.

8 NOTIFICATION OF RELEASE

In the event of a release of Waste Materials from the Site constituting an emergency situation or presenting an immediate threat to public health or welfare of the environment, the Program Health Safety Manager, or their designee, must submit a written report to the USEPA within seven days of the release. "Waste Materials" for this Site include dense non-aqueous phase liquid (DNAPL), soil, groundwater, surface water, and sediment containing MGP-derived contaminants such as coal tar, polynuclear aromatic hydrocarbons (PAHs), metals, and phenolic compounds. "Release" is defined as any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment This includes the abandonment or discarding of barrels, containers, and other closed receptacles containing any hazardous substance, pollutant, or contaminant.

This written report will include:

- Name and location of the Site;
- Name of person submitting the report;
- Date, approximate time, and specific location of the release;
- Corrective action and countermeasures taken, including a description of equipment repairs and replacements;
- Description of the Site, including maps, flow diagrams, and topographical maps;
- Detailed cause of the release, including the series of events that occurred prior to, during, and following the release;
- A failure analysis of the system or subsystem in which the failure occurred; and
- Additional preventative measures taken or planned to minimize the possibility of recurrence.

This reporting requirement is in addition to, not in lieu of, reporting under Section 103(c) of CERCLA, 42 USC §9603(c), and Section 304 of the Emergency Planning and Community Right-to-Know Act of 1986, 42 USC §11004, *et seq*. This reporting requirement is also in addition to written notification to the USEPA, as required by 40 CFR 112.4(a) and described in the SPCC Plan (Appendix C).

APPENDIX A – EMERGENCY CONTACTS

Emergency Contact	Phone Number
General Emergency	911
Ambulance	911
Hospital – Vista Medical Center Emergency Department, Waukegan, IL	(847) 360-3000
Illinois Department of Public Health	(312) 814-2793
Lake County Emergency Management Agency (EMA)	(847) 377-7100
Illinois Department of Natural Resources (IL DNR), Region II Office	(847) 608-3100
Illinois Emergency Management Agency (IEMA/State Emergency Response Commission (SERC)	(800) 782-7860
Lake County Emergency Management Agency (EMA), Local Emergency Planning Committee (LEPC)	(847) 377-7100
Illinois Environmental Protection Agency	(217) 782-3637
Illinois Poison Control Center	(800) 222-1222
USEPA Region 5 – Emergency Planning and Response	(312) 353-2318
National Response Center	(800) 424-8802
Illinois State Police – District 2 (Lake County), Non-Emergency	(847) 931-2405
Waukegan Port District	To Be Determined (TBD)
Akzo Nobel Aerospace Coatings, Inc.	TBD
Elgin, Joliet, and Eastern Railroad	TBD
Site Manager: TBD	TBD
Site Specific Health and Safety Officer: TBD	TBD
Program Health and Safety Manager: TBD	TBD
NSG Project Manager: Naren Prasad	(312) 240-4569
WEC EIRT	414-430-3478
Site Field Office	TBD

APPENDIX B – EMERGENCY RESPONSE EQUIPMENT

Emergency response equipment will be kept well-maintained by the ERC, SSHO, and Site personnel. Fire extinguishers are to be inspected monthly with annual testing by a qualified contractor. First aid supplies are to be inspected weekly. Individuals will inspect PPE before donning. It is the responsibility of the ERC to periodically test communications and fire control equipment, and to ensure that all spill response/control, PPE, first aid supplies, and rescue equipment are available and usable.

The following emergency response equipment will be maintained on site in the event of an emergency:

- **Communications Equipment and Alarms:** Cell phone.
- **Fire Control Equipment:** Fire extinguishers will be stored in the field vehicles and in the Site field office.
- **Spill Control Equipment:** A spill kit will be stored in the Site field office for use in responding to small spills. The local fire department and qualified spill response contractor will be contacted to address large spills
- **Personal Floatation Devices:** Required for work near or on water
- **Personal Protective Equipment:** Level D PPE (hard hat, safety glasses, traffic vest, safety boots and hearing protection), or as required based on the HASP.
- **First Aid Equipment:** A first aid kit will be located in company vehicles and/or the Site field office. The contents and application of the first aid kit will be described in the HASP.
- **Rescue Equipment:** When working near or over water, at least one skiff or power boat shall be required for life-saving operations.
- **Laptop computer:** A computer with internet connection and/or a smartphone can be used to obtain weather alerts, critical emergency notifications, and other critical information.

APPENDIX C – SPILL PREVENTION, CONTROL, AND COUNTERMEASURE PLAN

Spill Prevention, Control, and Countermeasure Plan

North Shore Gas Company's
Former South Plant Manufactured Gas Plant
Waukegan, Illinois

WEC Business Services, LLC

October 2018

OBG

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ACRONYMS AND ABBREVIATIONS

Akzo	Akzo Nobel Aerospace Coatings, Inc
AST	Aboveground Storage Tank
COW	City of Waukegan
DNAPL	Dense Non-Aqueous Phase Liquid
EJ&E	Elgin, Joliet, and Eastern
LEPC	Local Emergency Planning Committee
MGP	Manufactured Gas Plan
NSG	North Shore Gas
OBG	O'Brien and Gere Engineers, Inc
ROD	Record of Decision
ROW	Right of Way
SERC	State Emergency Response Commission
SPCC	Spill Prevention, Control, and Countermeasure
USEPA	United States Environmental Protection Agency
UST	Underground storage tank
WPD	Waukegan Port District

1 INTRODUCTION

O'Brien and Gere Engineers, Inc. (OBG) prepared this Spill Prevention, Control, and Countermeasure (SPCC) Plan outline on behalf of North Shore Gas (NSG) as a part of the Emergency Response Plan written for the Preliminary Design of the remedy selected by the U.S. Environmental Protection Agency (USEPA) in the July 2015 Record of Decision for Interim Action (ROD) for the Former South Plant Manufactured Gas Plant (MGP), located in Waukegan, Lake County, Illinois (Site or facility).

1.1 REGULATORY BACKGROUND

The USEPA developed the requirements for SPCC Plans as part of the initiatives for Oil Pollution Prevention mandated by Section 311(j)(1)(C) of the Clean Water Act as amended by the Oil Pollution Act of 1990. Chapter 40 of the Code of Federal Regulations, Part 112 (40 CFR 112 or the SPCC Rule) discusses SPCC planning and contains requirements for SPCC Plans (Appendix A). According to the regulations, 40 CFR 112 applies to "non-transportation related on-shore and off-shore facilities engaged in drilling, producing, gathering, storing, processing, refining, transferring, distributing, using or consuming oil and oil products, and, which due to their location, could reasonably be expected to discharge oil in harmful quantities…into or upon navigable waters." If the facility can reasonably discharge oil into or upon navigable waters, the facility will be subject to the jurisdiction of the USEPA and will be required to prepare an SPCC Plan if one of the following conditions is met:

- The underground buried storage capacity is greater than 42,000 gallons of oil (The capacities of underground storage tanks that are subject to all the technical requirements of 40 CFR Part 280 or 281 are not included when evaluating if this threshold is exceeded).
- The aboveground storage capacity is greater than 1,320 gallons of oil. The oil storage capacities of equipment, containers, and tanks must be included when evaluating if this threshold has been exceeded. The capacities of containers or tanks with capacities of less than 55 gallons are not included when evaluating whether this threshold is exceeded.

"Oil," as defined in the regulations, means "oil of any kind or in any form, including, but not limited to: fats, oils, or greases of animal, fish, or marine mammal origin; vegetable oils, including oils from seeds, nuts, fruits, or kernels; and, other oils and greases, including petroleum, fuel oil, sludge, synthetic oils, mineral oils, oil refuse, or oil mixed with wastes other than dredged.

2 CERTIFICATION – 40 CFR 112.3(D)

I hereby certify that the Former South Plant Manufactured Gas Plant Site located in Waukegan, Lake County, Illinois, has been examined and being familiar with the provisions of 40 CFR 112, attest that this SPCC Plan has been prepared in accordance with good engineering practices and industry standards, the required inspections and testing schedules have been established, and that the SPCC Plan is adequate for the facility.

_____, PE

_____
Registration Number

_____
State

_____
Date

3 PLAN AVAILABILITY – 40 CFR 112.3(E)

A complete copy of this SPCC Plan must be available on Site. This SPCC Plan must be available to the Regional Administrator (USEPA Region V for this facility) upon request during normal working hours. A complete copy of this SPCC Plan will be maintained in the Site field office.

4 SPCC PLAN CHANGES AND REVIEW – 40 CFR 112.5

4.1 SPCC PLAN AMENDMENTS [40 CFR 112.5(A)]

As required by 40 CFR Part 112.5(a), this SPCC Plan will be revised whenever there is a change in facility design, construction, operation, or maintenance which materially affects the facility's potential for the discharge of oil into or upon the navigable water of the United States or adjoining shorelines. The SPCC Plan shall be amended within 6 months of such a change. Such amendments shall be fully implemented as soon as possible, but no later than 6 months after the amendment to the plan. Examples of changes requiring plan amendment include:

- Commissioning or decommissioning containers
- Replacement, reconstruction, or movement of containers
- Reconstruction, replacement, or installation of piping systems
- Construction or demolition that might alter secondary containment structures
- Changes of product or service
- Revision of standard operation or maintenance procedures at the facility

4.2 SPCC PLAN REVIEW [40 CFR 112.5(B)]

As required by 40 CFR Part 112.5(b), this SPCC Plan should be reviewed and evaluated by the owner or operator at least once every 5 years. Documentation of these reviews is kept in Appendix B of this SPCC Plan.

The SPCC Plan must be amended within 6 months of the review to include more effective prevention and control technology if the technology has been field-proven at the time of the review and will significantly reduce the likelihood of a discharge. The amendments shall be implemented as soon as possible, but no later than 6 months after amending the SPCC Plan.

4.3 CERTIFICATION OF TECHNICAL AMENDMENTS [40 CFR 112.5(C)]

A registered Professional Engineer shall re-certify the SPCC Plan when technical amendments are made to the SPCC Plan. Examples of amended information that would require re-certification include, but are not limited to, the following:

- Increase in oil storage capacity
- Additional oil types
- Changes in the handling/storage areas for oil
- Changes in the handling/storage equipment for oil
- Modifications in the handling/storage procedures for oil
- Changes to the inspection, security, and training program

Administrative changes can be made to the SPCC Plan such as updating emergency telephone contacts without a Professional Engineer's re-certification.

5 MANAGEMENT APPROVAL – 40 CFR 112.7

This SPCC Plan is fully approved by the management of the Site and the necessary resources have been committed to fully implement the SPCC Plan as described.

Name	Signature
Title	Date

6 SITE FACILITY INFORMATION – [40 CFR 112.7(A)(1) AND (2)]

6.1 GENERAL [40 CFR 112.7(A)(1) AND (2)]

This SPCC Plan has been prepared to comply with the requirements of 40 CFR 112.7 and 112.8. Any deviations from the requirements of 40 CFR 112, as well as any alternate measures that provide equivalent environmental protection (except for the secondary containment requirements of the 40 CFR 112), are discussed in the respective section(s) of this SPCC Plan.

6.2 FACILITY INFORMATION [40 CFR 112.7(A)(3)]

Facility Name: Former South Plant Manufactured Gas Plant located in Waukegan, Lake County, Illinois.

Site Location: T45N, R12E, Section 22
2 North Pershing Road and 1 South Pershing Road
City of Waukegan, Lake County, Illinois

Owner Name: North Shore Gas Company
Contact: Mr. Naren Prasad (NSG Project Manager)
200 E. Randolph St., 24th Floor
Chicago, IL 60601
312.240.4569

Facility Description: The former South Plant MGP property is located at 2 North Pershing Road and 1 South Pershing Road in City of Waukegan, Illinois. The former MGP is in an industrial/commercial area; it is currently vacant and covered with grass. The property is approximately 1.9 acres in area with North and South Pershing Road bisecting the property. The Site includes the former MGP and adjacent properties where MGP residuals have been identified through site investigation activities.

Fixed and Portable Oil Storage: See Table 1 for a preliminary list of oil storage containers

Total Aboveground Oil Storage Subject To SPCC Planning: To be determined. See Table 1 for a preliminary list of oil storage containers

Total Underground Oil Storage Subject to SPCC Planning: None

6.3 PHYSICAL LAYOUT OF THE FACILITY [40 CFR 112.7(A)(3)]

The former South Plant MGP property is located at 2 North Pershing Road and 1 South Pershing Road in City of Waukegan, Illinois. The former MGP is in an industrial/commercial area; it is currently vacant, and covered with grass. The property is approximately 1.9 acres and is generally rectangular in shape, tapering to the south. North and South Pershing Road is an asphalt-paved right-of-way maintained by the City of Waukegan that was constructed through the middle of the former MGP property in 1970. The portion of the former MGP currently owned by the Waukegan Port District is landscaped.

The Site includes the former MGP and adjacent properties where MGP residuals have been identified through site investigation activities. These properties include:

- Waukegan Port District (WPD) – located east of the former MGP. Includes a marina, a visitor center/administration building, a maintenance building, and asphalt-paved parking lots adjacent to the marina and Lake Michigan
- Akzo Nobel Aerospace Coatings, Inc. (Akzo) – located east/southeast of the former MGP and adjacent to Lake Michigan. The property is approximately 6.2 acres and consists of buildings used for manufacturing paints and coatings and asphalt-paved parking lots.
- Elgin, Joliet, and Eastern (EJ&E) – refers to the railroad tracks and right-of-way (ROW) located east of and at the south end of the former MGP. This parcel is approximately 0.7 acres and the tracks extend diagonally across the south end of the former MGP.
- City of Waukegan (COW) – located southeast of the former MGP between the EJ&E, Akzo, and WPD properties. This property is a vegetated and vacated former city street ROW. This parcel abuts a ComEd substation (not included as part of the investigation and remediation) and together these parcels are approximately 0.5 acres. Other COW properties investigated includes nearby roads and associated ROWs.

The former MGP property is also bounded to the north by a City-owned Metra train parking lot and to the west by a Union Pacific railroad yard. Waukegan Harbor and Lake Michigan are located approximately 600 feet east of the former MGP. A break wall, extending east-northeast into Lake Michigan separates North Waukegan Harbor from South Waukegan harbor. North Waukegan Harbor was constructed in the 1890s and contains a USACE navigation channel that exits east to Lake Michigan. South Waukegan Harbor was constructed in the mid-1980s as a marina for recreational boats and has a southern exit to Lake Michigan. The Waukegan River is located approximately 1,000 feet south of the former MGP and flows east into Lake Michigan.

6.4 PREVENTION MEASURES [40 CFR 112.7(A)(3)(II)]

Sections 11 and 19 of this SPCC Plan discuss the discharge prevention measures that are in place and oil spill prevention procedures that will be followed at the facility, as required by 40 CFR 112.7(a)(3)(ii) and (iii).

6.5 DRAINAGE CONTROLS [40 CFR 112.7(A)(3)(III)]

Sections 11 and 19 of this SPCC Plan discuss the discharge prevention measures that are in place and oil spill prevention procedures that will be followed at the facility, as required by 40 CFR 112.7(a)(3)(ii) and (iii).

6.6 COUNTERMEASURES FOR DISCHARGE DISCOVERY, RESPONSE, AND CLEANUP [40 CFR 112.7(A)(3)(IV)]

Section 9 of this SPCC Plan includes spill clean-up procedures that the facility will follow, as required by 40 CFR 112.7(a)(3)(iv) and (v).

6.7 METHODS OF DISPOSAL [40 CFR 112.7(A)(3)(V)]

Section 9 of this SPCC Plan includes spill clean-up procedures that the facility will follow, as required by 40 CFR 112.7(a)(3)(iv) and (v).

6.8 FACILITY SITE RESPONSE COORDINATOR [40 CFR 112.7(A)(3)(VI)]

Section 7 of this SPCC Plan lists contacts and telephone numbers, as required by 40 CFR 112.7(a)(3)(vi).

7 SPILL CONTACTS

7.1 INTERNAL: SITE OPERATIONS AND PERSONNEL

Contact	Telephone Number
To be determined	To be determined

7.2 EXTERNAL: GOVERNMENT AGENCIES AND SPILL RESPONSE CONTRACTORS

Contact	Telephone Number
National Response Center	(800) 424-8802
Illinois Emergency Management Agency	(800) 782-7860
Spill Response Subcontractor: To be determined	To be determined

8 SPILL REPORTING – 40 CFR 112.7(A)(4)

All releases of oil shall be immediately reported to the Site Manager (as listed in order in Section 7.1). The Site Manager will determine which regulatory agencies need to be contacted and will ensure that these agencies are contacted, if necessary. Agency contacts are listed in Section 7.2.

Release reporting requirements are codified under various state and federal regulations (*e.g.*, SARA 304, CERCLA, RCRA, etc.). Generally, these requirements are dependent on: 1) the type of material; 2) the amount released; and 3) where the material was discharged. For this SPCC Plan, the type of material is limited to oils, as defined under 40 CFR 112.2 (see also Section 1 of this SPCC Plan). Therefore, in the event of a discharge **that is not entirely contained on site** (*e.g.*, discharge runs off the property or enters storm or sanitary sewer systems), the procedures outlined in this section will be implemented.

It is important to note that additional state and federal release reporting requirements may be applicable to each discharge. A discussion of such requirements is beyond the scope of this SPCC Plan; therefore, the Site Manager is responsible for identifying and complying with all applicable release reporting and notification requirements.

8.1 VERBAL NOTIFICATION

Spills requiring verbal notification are listed below. If there is any doubt regarding whether to report, it is recommended to file a report. There are significant penalties for not reporting a reportable spill.

8.1.1 National Response Center

If a spill occurs that results in a discharge of a "reportable quantity" of oil to navigable waters, immediate verbal notification to the National Response Center (NRC) is required. A "reportable quantity" of oil is defined as the discharge of oil into navigable water that causes a visible film or sheen upon the surface of the water. Note that a storm or combined sewer drain is considered a conduit to navigable water.

8.1.2 Illinois Emergency Management Agency

Immediate telephone notification must be made by the owner or operator when a release equal to or exceeding the reportable quantity of an extremely hazardous substance or CERCLA hazardous substance occurs at the Site.

Immediate telephone notification is also required if an incident or accident involving a hazardous material (49 CFR 172.101) occurs which results in:

- A member of the general public is killed.
- A member of the general public receives injuries requiring hospitalization.
- An authorized official of an emergency agency recommends an evacuation of an area by the general public.
- A motor vehicle has overturned on a public highway.
- Fire, breakage, release or suspected contamination occurs involving an etiologic agent.
- Any release of petroleum (or oil) that produces a sheen on nearby surface water and/or threatens navigable waters.
- Any spill or overfill of petroleum that results in a release to the environment that exceeds 25 gallons (25-gallon reporting threshold for underground storage tanks (USTs) only). Aboveground storage tanks (AST) are not subject to the 25-gallon spill reporting threshold in 41 IAC 176.340 but are subject to 29 IAC 430.

The information to be reported in the verbal notification of a release includes the following.

- The chemical name or identity of any substance involved in the release.
- An indication of whether the substance is an extremely hazardous substance.

- An estimate of the quantity in pounds of any such substance that was released into the environment.
- The time and duration of the release.
- The specific location of the release.
- The medium or media (air, land, water) into which the release occurred.
- Any known or anticipated acute or chronic health risks associated with the emergency and, where appropriate, advice regarding medical attention necessary for exposed individuals.
- Proper precautions to take as a result of the release, including evacuations.
- The name and telephone number of the person or persons to be contacted for further information

8.2 WRITTEN NOTIFICATION

8.2.1 USEPA REGION V

As required by 40 CFR 112.4(a), if Site operations spill more than 1,000 gallons of oil in a single spill or more than 42 gallons in two separate spills within any 12-month period, the facility must provide the following information to the USEPA Region V within 60 days of the incident:

- Name of the Site.
- Name of person submitting the report.
- Location of the Site.
- Maximum storage or handling capacity of the facility and normal daily throughput.
- Corrective action and countermeasures taken, including a description of equipment repairs and replacements.
- Description of the facility, including maps, flow diagrams, and topographical maps.
- Cause of such discharge, including a failure analysis of the system or subsystem in which the failure occurred.
- Additional preventative measures you have taken or contemplated to minimize the possibility of recurrence.
- Any other information as the Regional Administrator may reasonably require pertinent to this SPCC Plan or discharge.

The report is to be submitted to the following USEPA address:

USEPA Region V
Mail Code: SE-5J
77 West Jackson Blvd.
Chicago, IL 60604
Attn: SPCC Inspector

8.2.2 Illinois Emergency Management Agency and Local Emergency Planning Agency

As soon as practicable after such release (within 30 days), the owner or operator shall provide a written follow-up emergency notice (or notices, as more information becomes available) to the State Environmental Response Commission (SERC) and the Local Emergency Planning Agency (LEPC), updating the information provided in the immediate notification and including additional information with respect to:

- Actions taken to respond to and contain the release
- Any known or anticipated acute or chronic health risks associated with the release
- Where appropriate, advice regarding medical attention necessary for exposed individuals

9 SPILL CLEAN-UP PROCEDURES – 40 CFR 112.7(A)(5)

Site personnel will follow these procedures in the event of an oil release. When necessary, the procedures may be modified if circumstances require. The requirements of 40 CFR 112.7(a)(3)(iv) (which pertains to countermeasures for discharge discovery, response and clean-up) and 40 CFR 112.7(a)(3)(v) (which pertains to methods of disposal for recovered materials) are also covered in this section.

1. *Notify the Site Manager* - The first person on the scene will immediately notify the Site Manager. The spill notification contact information is provided in Section 7 of this SPCC Plan and will be posted at appropriate locations at the Site.
2. *Stay Clear of the Area* – Personnel not directly involved with the spill need to stay away from the area of the spill.
3. *Assess the Spill* – The Site Manager will determine the exact source and the amount of released oil. The Site Manager will determine the need for notification of authorities and regulatory agencies and decide the steps required to safeguard personnel (*i.e.*, evacuation, personal protection, etc.).
4. *Stop the Flow* – In accordance with Site Manager training, after implementing the required safety-related measures, steps will be implemented to prevent further releases to the extent possible by cutting off the flow at the source. This may require shutting off a pump or setting a drum right side up.
5. *Contain the Spill* – In accordance with Site Manager training, immediately after implementing required safety precautions, containment procedures will be implemented. Absorbent pads or diversionary items will be used to prevent oil from discharging from the site.
6. *Clean-Up Spill* – At the direction of the Site Manager, spilled material will be retrieved and transferred to containers, such as drums, to the extent practicable.
7. *Disposal of Contaminated Material* – At the direction of the Site Manager, contaminated material will be disposed of in accordance with federal, state, and local regulations. The exact means of disposal will depend upon the nature and volume of the contaminated material.
8. *Record the Spill Event Information* – The Site Manager will ensure that a record of any oil spill is made as soon as practicable after the event to recall as much detail as possible. Blank spill forms for recording spill information are kept in Appendix C of this SPCC Plan. Completed oil spill documentation forms shall be kept in the Site field office.
9. *Update the SPCC Plan* – The Site Manager will ensure that an evaluation is conducted to determine measures that can be implemented to prevent a repeat of the incident. The Site Manager will ensure that the SPCC Plan is revised in accordance with Section 4.
10. *Replace Used Spill Equipment* – Following each spill event, the Site Manager will ensure that the inventory of response equipment is assessed and restocked as necessary.
11. Submit Required Reports – The Site Manager will prepare and submit required follow-up written reports as described in Section 8).

10 POTENTIAL EQUIPMENT FAILURES – 40 CFR 112.7(B)

Table 1 summarizes sources that have a reasonable potential for equipment failure (*e.g.*, tank overflow, rupture, leakage, etc.) which could result in an oil release that could reasonably be expected to impact navigable waters.

11 CONTAINMENT AND DIVERSIONARY STRUCTURES – 40 CFR 112.7(C)(1)

Appropriate secondary containment and diversionary structures are currently provided or are planned to be provided (see Section 21 – Implementation Plan) for all SPCC Sources listed in Table 1. Table 1 also summarizes existing containment and diversionary structures (*e.g.,* building floor and walls, dikes, curbing, engineered surface drainage, sorbent materials, etc.) which serve to minimize the risk of impacts to navigable waters from specific potential sources of oil releases. Table 1 will be updated when oil, oil-containing equipment, and secondary containment are determined.

12 DEMONSTRATION OF PRACTICABILITY – 40 CFR 112.7(D)

Site management has determined that the use of containment and diversionary structures, as described in Section 11 and Table 1 and proposed in Section 21, to prevent discharged oil from reaching navigable waters is practical and effective for this Site.

13 INSPECTIONS, TESTS, AND RECORDS – 40 CFR 112.7(E)

Formal SPCC Site inspections will be conducted at least monthly. During the monthly inspections, the aboveground storage tanks and piping, oil storage containers and oil-containing equipment, valves, and pipelines will be visually inspected for leakage or damage. The inspections are documented using the checklist that is contained in Appendix D. The inspections are conducted in accordance with good engineering practice and are signed and dated by the inspector. Results of integrity testing (see Section 19) are kept in Appendix E.

The liquid level sensing devices that currently exist for the bulk oil ASTs must be tested regularly to ensure proper operation, as applicable.

Completed and signed inspection forms and testing records (*e.g.,* liquid level instrument test results, leak detection system test results, integrity testing results, etc.) will be maintained in the Site field office.

14 PERSONNEL TRAINING – 40 CFR 112.7(F)

14.1 INITIAL TRAINING [40 CFR 112.7(F)(1)]

Site personnel who will handle oil or provide spill response will receive initial training. The training will consist of classroom and/or hands-on training. The initial training will include the following topics:

- The operation and maintenance of equipment to prevent discharges
- Discharge procedure protocols
- Applicable pollution control laws, rules, and regulations
- General facility operations
- The contents of this SPCC Plan

14.2 DESIGNATED PERSON [40 CFR 112.7(F)(2)]

This section will be updated with the designated person who is accountable for spill prevention at the Site.

14.3 ANNUAL TRAINING [40 CFR 112.7(F)(3)]

The Site Manager will ensure that annual refresher training is conducted for oil-handling personnel. The refresher training will ensure that personnel have an adequate understanding of the SPCC Plan. Any known discharges that occurred during the prior year will be discussed. The discussion will include the mode of failure, malfunctioning components, and the corrective actions taken (*e.g.,* the placement of absorbent socks or seals over sewer catch basins in the event of a nearby oil spill). In addition, the training will include a discussion of any recently developed precautionary measures.

14.4 CONTRACTOR ORIENTATION

Contractors are advised of spill concerns via instructional signs and contractor orientation prior to the start of work at the Site.

15 SITE SECURITY – 40 CFR 112.7(G)

The following summarizes secured access issues associated with the facility relative to oil spill prevention.

15.1 SECURE AND CONTROL ACCESS

This section will be updated to describe security including Site access. This section will describe perimeter fencing, security personnel, lighting, and security procedures.

15.2 DRAIN VALVES

This section will be updated to describe drain valves on oil storage containers and secondary containment structures, as applicable.

15.3 OIL PUMPS

This section will be updated to describe oil pumps, as applicable.

15.4 LOADING/UNLOADING CONNECTIONS

This section will be updated to describe loading and unloading connections, as applicable.

15.5 FACILITY LIGHTING

This section will be updated to describe Site lighting. Site lighting will be provided with respect to areas associated with oil storage and transfer. Site lighting may be installed to assist in discovery of discharges occurring during hours of darkness and to limit the likelihood of discharges occurring through acts of vandalism.

16 TANK CAR AND TANK TRUCK – 40 CFR 112.7(H)

Periodically, oil containers are filled or pumped out via tanker truck. To minimize the likelihood of an oil release occurring during tank loading and unloading operations, the following additional precautions may be utilized:

- The use of chock blocks is required during loading operations to prevent vehicles from departing before complete disconnection of transfer lines.
- Prior to filling and departure of any tank truck, close inspections for discharges into the lower-most drain and all outlets of such vehicles are required, and if necessary, ensure that they are tightened, adjusted, or replaced to prevent liquid discharge while in transit.
- The tank truck driver or a qualified Site employee is required to be present at all times during tank loading activities so as to quickly respond in the event of an oil spill.
- Unloading procedures are posted with the above requirements in the loading and unloading areas.

17 FIELD-CONSTRUCTED ABOVEGROUND CONTAINERS – 40 CFR 112.7(I)

There are no field-constructed aboveground oil storage containers at the Site.

18 ADDITIONAL PREVENTION STANDARDS – 40 CFR 112.7(J)

Additional prevention standards are not necessary at the time of the original SPCC Plan development. As necessary, additional prevention standards developed in the future will be added to this section.

19 ADDITIONAL REQUIREMENTS FOR ON-SHORE FACILITIES – 40 CFR 112.7(J)

In addition to meeting the requirements of 40 CFR 112.7, owners and operators of on-shore facilities, excluding production facilities, that store petroleum oils must meet the requirements of this section.

19.1 FACILITY DRAINAGE [40 CFR 112.8(B)]

This section will be updated to describe Site drainage.

19.2 BULK STORAGE CONTAINERS [40 CFR 112.8(C)]

19.2.1 Materials of Construction

In general, bulk oil storage containers will be constructed of materials that are compatible with the oil stored and the conditions of storage (*i.e.,* pressure and temperature). The coal tar dense non-aqueous phase liquid (DNAPL) and light non-aqueous phase liquid (LNAPL) ASTs will be constructed with double-walled stainless steel.

19.2.2 Secondary Containment

The coal tar DNAPL and LNAPL ASTs will be constructed with double-walled stainless steel to provide secondary containment.

19.2.3 Storm Water Treatment Bypass

There is no storm water treatment at the Site.

19.2.4 Completely Buried Metallic Storage Tanks

There are no completely buried metallic storage tanks at the Site.

19.2.5 Partially Buried or Bunkered Tanks

There are no partially buried metallic or bunkered storage tanks at the Site.

19.2.6 Integrity Testing

The bulk storage containers listed in Table 1 are required to undergo integrity testing on a regular schedule and whenever material repairs are made, in accordance with good engineering practices as well as appropriate applicable industry standards. Since electrical, manufacturing, and operating oil-filled equipment are not bulk storage containers (per definition of a bulk storage container in 40 CFR Part 112.2), the following are bulk storage containers subject to periodic integrity testing at the Site:

- Coal tar DNAPL double-walled AST
- Coal tar LNAPL double-walled AST
- Diesel fuel AST (tentative)

Portable containers. Portable containers (*i.e.,* 55-gallon drums, totes) are only temporarily stored on Site (*i.e.*, disposed/returned to manufacturer when empty, etc.). These portable containers will undergo US DOT testing. Therefore, inspection of these bulk storage containers, and the portable lube tanks, is limited to visual integrity inspections. Portable containers are addressed as follows:

- Site employees are in the areas where these containers are located and will observe them daily.
- Site employees are trained to notify the Site Manager in the event that a container is not in good condition or is leaking.
- The Site Manager formally inspects these containers at least monthly.

These inspections follow the Steel Tank Institute's (STI) SP001 "Standard for the Inspection of Aboveground Storage Tanks" (5th Edition, September 2011), an industry standard, for portable containers.

ASTs that can be viewed from all sides. The ASTs that can be viewed from all sides at the Site will be describe here. Inspections on these ASTs will be performed and documented as part of the monthly facility inspections, discussed in Section 13. These inspections meet the suggested inspection requirements of the STI's SP001 "Standard for the Inspection of Aboveground Storage Tanks" (5th Edition, September 2011), an industry standard, for shop-fabricated tanks with capacities less than 5,000 gallons. Blank inspection checklists are included in Appendix D.

19.2.7 Internal Heating Coils

There are no internal heating coils associated with the AST at the Site.

19.2.8 Overfill Prevention

40 CFR 112.8(c) requires that bulk storage containers have at least one of the following devices:

- High liquid level alarms with an audible or visual signal at a constantly attended operation or surveillance station.
- High liquid level pump cutoff devices set to stop flow at a predetermined container content level.
- Direct audible or code signal communication between the container gauger and the pumping station.
- A fast response system for determining the liquid level of each bulk storage container such as digital computers, telepulse, or direct vision gauges. If this alternative is used, a person must be present to monitor gauges and the overall filling of bulk storage containers.
- Liquid level sensing devices must be tested regularly to ensure proper operation.

The following overfill prevention measures are currently in place at the Site:

- This section will be updated to address overfill prevention.

19.2.9 Effluent Treatment Facilities

There are no effluent treatment facilities at the Site.

19.2.10 Visible Discharges

Visible discharges from an oil storage container, including discharges from seams, gaskets, piping, pumps, valves, rivets, and bolts will be promptly corrected.

19.2.11 Mobile or Portable Oil Storage Containers

This section will be updated to describe mobile or portable oil storage containers, as applicable.

19.3 FACILITY TRANSFER OPERATIONS [40 CFR 112.8(D)]

Above and belowground oil transfer piping is indicated on Figure 2. The following applies to oil transfer operations:

- Any new buried piping installed at the facility will have a protective wrap or coating and will have a cathodic protection (or other means, such as fiberglass construction) to minimize corrosion of such piping.
- If oil pipelines are taken out of service, they will be capped or blank flanged and marked as to the origin.
- Oil pipe supports will be designed to minimize abrasion and corrosion and to allow for expansion and contraction. Oil pipe supports are periodically viewed for signs of abrasion and/or corrosion.
- Aboveground oil transfer piping is observed during daily operations or during maintenance activities and is inspected at least monthly. Necessary repairs will be conducted if any sign of pipe, valve, or flange wear or failure is observed.
- Warning signs are required in areas where vehicular traffic is present in the same vicinity as oil piping (indicated on Figure 2).

20 RESPONSE REQUIREMENTS – 49 CFR 112 SUBPART D

As required by 40 CFR Part 112.20, an evaluation will be conducted on whether the oil storage at the Site could reasonably be expected to cause substantial harm to the environment by discharging oil into or on the navigable waters or adjoining shorelines. This evaluation will determine if a Facility Response Plan is required.

21 IMPLEMENTATION PLAN

The following serves to identify the planned elements of this SPCC Plan, along with the associated implementation schedule. These dates reflect the current information and incorporate the most recent facility improvement programs. This table will be updated as part of the Pre-Final Design.

Planned Element	SPCC Source No.	Implementation Schedule	Completion Date
To be determined			

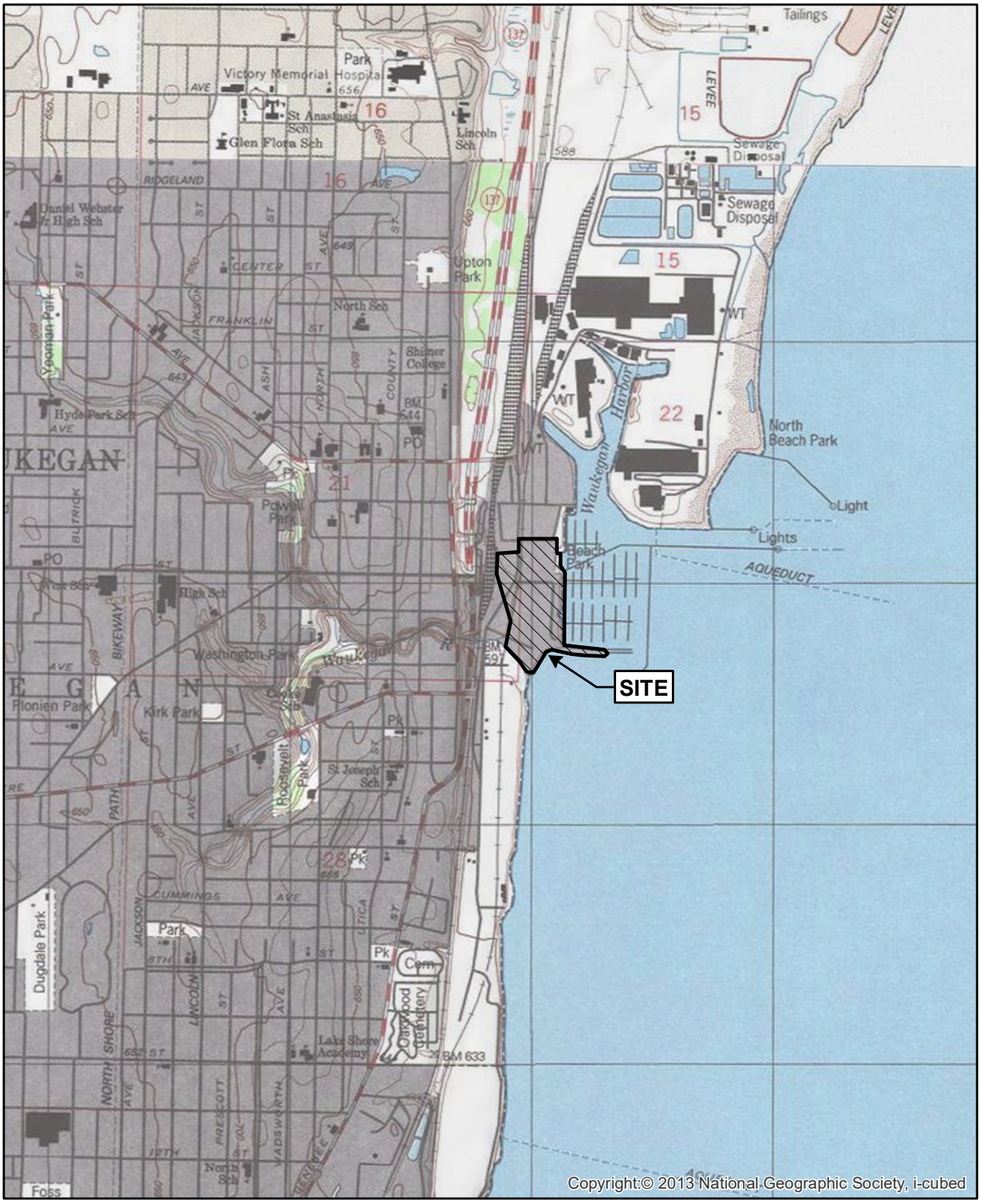
Tables

Table 1
Potential Release Events and Containment and Diversionary Structures
Former South Plant MGP Site

SPCC Source ID	Potential Source	Potential Event	Release Volume	Release Rate	Spill and Containment/Diversionary Structures Description
Site					
1	Coal tar DNAPL Aboveground Storage Tank (AST)	Complete failure of AST	Up to 1,000 gallons	Instantaneous	The AST is double-walled. A release from the initial container will be contained by the secondary containment wall. A release outside of the tank (leaking valve, fittings, spill during material transfer, etc.) will be contained by the Treatment Plant floor and walls. In addition, absorbent materials will be available on Site in the event of a leak or spill.
	Capacity: 1,000 gallons (est.)	Partial failure of AST	1 to 10 gallons	Gradual to instantaneous	
	Location: Treatment Plant	**Release direction:** A release from the AST will flow in a radial direction around the AST and likely pool. A larger release may flow to the east towards Pershing Avenue.			
2	Coal Tar LNAPL	Complete failure of AST	Up to 1,000 gallons	Instantaneous	The AST is double-walled. A release from the initial container will be contained by the secondary containment wall. A release outside of the tank (leaking valve, fittings, spill during material transfer, etc.) will be contained by the Treatment Plant floor and walls. In addition, absorbent materials will be available on Site in the event of a leak or spill.
	Capacity: 1,000 gallons (est.)	Partial failure of AST	1 to 10 gallons	Gradual to instantaneous	
	Location: Treatment Plant area	**Release direction:** A release from the AST will flow in a radial direction around the AST and likely pool. A larger release may flow to the east towards Pershing Avenue.			
3	Diesel fuel AST (Tentative)	Complete failure of AST	Up to 500 gallons	Instantaneous	The AST is tentatively double-walled. A release from the initial container will be contained by the secondary containment wall. A release outside of the tank (leaking valve, fittings, spill during material transfer, etc.) will be contained by the Treatment Plant floor and walls. In addition, absorbent materials will be available on Site in the event of a leak or spill.
	Capacity: 500 gallons (est.)	Partial failure of AST	1 to 10 gallons	Gradual to instantaneous	
	Location: Treatment Plant area	**Release direction:** A release from the AST will flow in a radial direction around the AST and likely pool. A larger release may flow to the east towards Pershing Avenue.			

Notes:
1. Periodic inspections of the above oil storage containers are required as discussed in Sections 13 and 19 of this SPCC Plan.
2. The USEPA issued amendments to the SPCC Rule stating that motive power containers (*e.g.,* tractor fuel tanks) are not subject to SPCC Planning requirements

Figures



SITE LOCATION MAP

PRE-FINAL DESIGN REPORT
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

N

0 1,000 2,000 4,000
Feet

O'BRIEN & GERE ENGINEERS, INC.

SAVED: 10/2/18 5:00 PM

JACK & BORE
24" STEEL CASING
ASTM 53

3/4" DR-17 HDPE DNAPL FORCEMAIN WITHIN 8" DR-17 HDPE AND 1" DR-17 GROUNDWATER FORCEMAIN. SEE TYPICAL TRENCH DETAIL 'X', SHEET C-502.

UTILIZE EXISTING RECOVERY WELL. SEE DETAIL 'X', SHEET C-503.

UTILIZE EXISTING RECOVERY WELL

SEE RECOVERY WELL DETAIL 'X', SHEET C-503.

UTILIZE EXISTING RECOVERY WELL. SEE DETAIL 'X', SHEET C-503.

N. PERSHING RD.

RAILROAD

GRAVEL

CITY OF WAUKEGAN

NORTH SHORE GAS

WAUKEGAN PORT DISTRICT

EJ & E RAILROAD

CONC.

TREES

SHED

EW01
RIM=590.9

EW02
RIM=591.0

EW03
RIM=591.5

EW04
RIM=591.8

EW05
RIM=592.1

EW06
RIM=592.1

JV01
RIM=591.0

JV02
RIM=591.8

JV03
RIM=591.8

JV04
RIM=593.0

JV05
RIM=591.7

DMH
RIM: 590.10
INV: 587.00 W

DMH
RIM: 590.15
INV: 588.65 S

DMH
RIM: 590.46
INV: 589.46 N

DMH
RIM: 590.71
CANT OPEN

DMH
RIM: 591.60
INV: 589.20 NE&S

DMH
RIM: 592.00
CANT OPEN

DMH
RIM: 591.65
INV: 588.88 E

DMH
RIM: 591.43
INV: 588.73 N&E

SANITARY PIT
RIM: 592.02
T/P: 588.17

SMH
RIM: 593.00
INV: 583.45

SMH
RIM: 592.97
INV: 581.82

SMH
RIM: 592.72
INV: 572.57

INV: 584.10

12' WIDE GRAVEL ACCESS ROAD

SPCC #3 - DIESEL FUEL AST

SPCC #2 - COAL TAR LNAPL AST

50'X75' GRAVEL PAD FOR TREATMENT CONTAINERS. SEE TREATMENT AREA PAD DETAIL 'X', SHEET C-502.

SPCC #1 - COAL TAR DNAPL AST

SPILL RESPONSE KIT

40'x15' LAUNCH PIT
(TYP.x2)

10'x10' RECEIVING PIT
(TYP.x2)

SEE HORIZ. INJECTION WELL DETAIL 'X', SHEET C-503.

JACK & BORE
24" STEEL CASING
ASTM 53

TRUE NORTH

PLAN
SCALE: 1"=30'

30' 0 30'

SURFACE RUNOFF

PRELIMINARY
NOT FOR
CONSTRUCTION
DATE: 05/22/2018

IN CHARGE OF
DESIGNED BY
CHECKED BY
DRAWN BY

NO.	DATE	REVISION	INT.

O'BRIEN & GERE ENGINEERS, INC

FORMER NORTH SHORE GAS SOUTH PLANT
MANUFACTURED GAS PLANT REMEDIAL DESIGN

WAUKEGAN, ILLINOIS

SPCC SITE PLAN
PHASE 1
WELL FIELD DESIGN

FILE NO. 31060.67860 -105

DATE JULY 2018

FIG 2

\\SERVER27-01\PROJECTS\WBS.31060\67860.1903-WBS - NSG\DOCS\DWG\PILOT STUDY\67860.C105.DWG

Appendix A

SPCC Planning Regulation

SPCC PLANNING REGULATION

U.S. Environmental Protection Agency – Overview of the Spill Prevention, Control, and Countermeasure Regulation: **https://www.epa.gov/oil-spills-prevention-and-preparedness-regulations/overview-spill-prevention-control-and**

Appendix B

SPCC Plan Review Documentation

SPCC PLAN REVIEW DOCUMENTATION

"I have completed review and evaluation of the SPCC Plan for the North Shore Gas Former South Plant Manufactured Gas Plant in Waukegan, Illinois on _____, 20__, and will/will not (circle one) amend the SPCC Plan as a result."

_____ _____

Signature Date

_____ _____

Printed Name Title

For technical amendments to the SPCC Plan, the following certification from a Professional Engineer is required.

"I hereby certify that the North Shore Gas Former South Plant Manufactured Gas Plant in Waukegan, Illinois, has been examined and being familiar with the provisions of 40 CFR 112, attest that this Spill Prevention, Control, and Countermeasure (SPCC) Plan has been prepared in accordance with good engineering practices and industry standards, the required inspections and testing schedules have been established, and that the SPCC Plan is adequate for the facility."

_____

Name of Professional Engineer

_____

Registration Number

_____

State

_____

Date

Appendix C

Spill Documentation

ENVIRONMENTAL INCIDENT FORM

Observed By:_____

Date and Time of Spill:_____

Location of Spill:_____

Weather Conditions:_____

Duration of Incident (Hours):_____

Type and Amount of Material Spilled:_____

Amount Recovered:_____

Was Spill of Reportable Quantity? Yes_____ No_____

Cause of the Spill:_____

_____

Environmental Damage:_____

_____

Response:_____

_____

Parties Notified:_____

_____

EVALUATION OF SPCC PLAN EFFECTIVENESS IN DIRECTING SPILL RESPONSE

Procedures:_____

Spill Response Equipment:_____

_____

Preventive Measure to be Implemented:_____

_____

Does the SPCC Plan Need to be Revised to Prevent This Type of Spill From Reoccurring? _____

Signature: _____ Date:_____

Appendix D

Monthly Inspection Log

Monthly & Bi-Monthly Oil Spill Prevention, Control and Countermeasures (SPCC) Inspection Log Sheet
Former South Plant MGP Site

Inspector(s): _____ **Inspection Date:** _____

Inspect Monthly (M) or Bi-Monthly	SPCC #	Equipment # or Area	Potential Source	1. Any Signs that a Release has Occurred from this Equipment, Container or Associated Piping?	2. Any Indications that a Release may Occur in the Future?	3. Any Cracks in Containment Structure (*e.g.,* tray, floor, etc.)?	4. Is there Appropriate Spill Response Equipment in Appropriate Quantities in this Area?	5. Comments (e.g., on Housekeeping in the Area)(add longer comments below)
M	1	Treatment Plant	Coal tar DNAPL AST					
	2	Treatment Plant	Coal tar LNAPL AST					
	3	Treatment Plant Yard	Diesel fuel AST					

Additional Comments:

Appendix E

Documentation of Inspections by Certified Tank Inspector

(To be provided)

Appendix F

Annual Tank Inspection Form

(To be provided)

Appendix G

Certification of Substantial Harm

CERTIFICATION OF THE APPLICABILITY OF THE SUBSTANTIAL HARM CRITERIA

Facility Name: North Shore Gas Former South Plant Manufactured Gas Plant

Facility Address: Waukegan, Illinois

1. Does the facility transfer oil over water to or from vessels and does the facility have a total oil storage capacity greater than or equal to 42,000 gallons? Yes ___ No _X_
2. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and does the facility lack secondary containment that is sufficiently large to contain the capacity of the largest above-ground oil storage tank plus sufficient freeboard to allow for precipitation within any aboveground oil storage tank area? Yes ___ No _X_
3. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and is the facility located at a distance (as calculated using the appropriate formula in Attachment C–III of 40 CFR Part 112) such that a discharge from the facility could cause in-jury to fish and wildlife and sensitive environments? For further description of fish and wildlife and sensitive environments, see Appendices I, II, and III to DOC/NOAA's "Guidance for facility and Vessel Response Plans: Fish and Wildlife and Sensitive Environments" and the applicable Area Contingency Plan. Yes ___ No _X_
4. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and is the facility located at a distance (as calculated using the appropriate formula in Attachment C-III of 40 CFR Part 112) such that a discharge from the facility would shut down a public drinking water intake (for the purposes of 40 CFR part 112, public drinking water intakes are analogous to public water systems as described at 40 CFR 143.2(c)).
   Yes ___ No _X_
5. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and has the facility experienced a re-portable oil spill in an amount greater than or equal to 10,000 gallons within the last 5 years? Yes ___ No _X_

Certification - I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document, and that based on my inquiry of those individuals responsible for obtaining this information, I believe that the submitted information is true, accurate, and complete.

Signature	Title
Name (please type or print)	Date

OBG

THERE'S A WAY

OBG

THERE'S A WAY

Appendix F

Field Sampling Plan

Refer to Multi-Site Field Sampling and Analysis Plan Former Manufactured Gas Plant Sites - Integrys Business Support, September 2008

Appendix G

Construction Quality Assurance Plan

Construction Quality Assurance Plan

North Shore Gas Company's
Former South Plant Manufactured Gas Plant
Waukegan, Illinois

WEC Business Services, LLC

October 2018

OBG

TABLE OF CONTENTS

LIST OF TABLES

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LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

AAC	Acceptable Ambient Concentrations
Akzo	Akzo Nobel Aerospace Coatings, Inc.
AMS	Air Monitoring Station
AOC	Administrative Order on Consent
BMPs	Best Management Practices
BTEX	Benzene, Ethylbenzene, Toluene, and Xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act ("Superfund")
COW	City of Waukegan
CQAP	Construction Quality Assurance Plan
CQA	Construction Quality Assurance
CQC	Construction Quality Control
CQCP	Construction Quality Control Plan
DNAPL	Dense Non-Aqueous Phase Liquid
EJ&E	Elgin, Joliet and Eastern
FS	Feasibility Study
FSP	Field Sampling Plan
HASP	Health and Safety Plan
IDOH	Illinois Department of Health
IEPA	Illinois Environmental Protection Agency
MGP	Manufactured Gas Plant
NRT	Natural Resource Technology, Inc
NSG	North Shore Gas
OBG	O'Brien & Gere Engineers, Inc.
O&M	Operation and Maintenance
PID	Photoionization detector
PDI	Pre-design Investigation
PDIWP	Pre-design Investigation Work Plan
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RA	Remedial Action
ROD	Record of Decision
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RD AOC	Administrative Order on Consent for Remedial Design
RI	Remedial Investigation
ROW	Right-of-Way
SAS	Superfund Alternative Site
SOP	Standard Operating Procedure

SPCC	Spill Prevention, Control, and Countermeasure
USACOE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
WPD	Waukegan Port District

1 INTRODUCTION

This Construction Quality Assurance Plan (CQAP) was prepared as part of an Administrative Order on Consent (AOC), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Docket No. V-W-15-C-027 effective October 4, 2015, to perform the remedial design (RD) of the United States Environmental Protection Agency (USEPA)-selected remedy for the North Shore Gas Company (NSG) Former South Plant, Manufactured Gas Plant (MGP) Superfund Alternative Site (SAS, Site). The Site is listed as USEPA Site ID No. ILD984809228 and under the Illinois Environmental Protection Agency (IEPA) as site ID No. 0971900058.

1.1 PURPOSE

This CQAP is a supplemental document to the Pre-Final RD Report. The purpose of the CQAP is to outline quality assurance procedures necessary to successfully implement the interim dense non-aqueous phase liquid (DNAPL) recovery system as outlined in the Record of Decision (ROD), dated July 30, 2015. The CQAP describes the Site-specific components of the construction quality assurance program which will verify the completed project meets or exceeds design criteria, plans, and specifications. Specifically, the CQAP establishes the requirements for the following:

- Personnel responsibilities and authority
- Procedures, guidelines, checklists, and forms for inspection, sampling, testing, and documentation of construction activities
- Deficiencies, noncompliance, and corrective actions
- Identification of proposed sampling activities

Consistent the September 17, 2018 email from NSG summarizing action items agreed upon during the September 12, 2018 meeting between USEPA, NSG, and their representative consultants, the focus of the CQAP is on Phase 1. Following implementation and operation of the Phase 1, modifications to this CQAP will be completed, as necessary, to reflect the future full-scale design.

1.2 SCOPE

Remedial work activities addressed in this CQAP include:

- Erosion control
- Site security
- Roadway/parking lot/sidewalk condition documentation
- Groundwater injection well installation
- DNAPL recovery/groundwater extraction well installation
- Control vault installation
- Horizontal piping installation
- Air monitoring
- Fugitive emissions management
- Site restoration

The scope of this CQAP is limited to construction of the various components of the remedy. This CQAP is not intended to identify quality control procedures associated with startup or operations and maintenance of the DNAPL recovery system and corresponding groundwater treatment plant. Quality control and operational considerations associated with startup, operations, and maintenance are provided in the Operations and Maintenance (O&M) Plan.

1.3 SITE DESCRIPTION

Owner/Operator: North Shore Gas Company
Contact: Mr. Naren Prasad, P.E. (NSG Project Manager)
200 E. Randolph St., 21st Floor
Chicago, IL 60601
312.240.4569

Site Location: T45N, R12E, Section 22
2 North Pershing Road and 1 South Pershing Road
City of Waukegan, Lake County, Illinois

USEPA ID
Illinois EPA # ILD984809228, 0971900058

The former South Plant MGP is generally located at 2 North Pershing Road and 1 South Pershing Road in an industrial/commercial area of the City of Waukegan, Illinois (Figure 1). The former MGP was constructed in 1897 and operated until 1946, prior to being demolished in 1951. NSG retained ownership of much of the property on which former MGP operations were conducted. The remaining portion of the former MGP is located beneath North and South Pershing Road on property which was transacted to the City of Waukegan in 1970.

The Site includes the former MGP and adjacent properties where MGP affected media have been identified through site investigation activities. The properties that comprise the Site are shown on Figure 2 and are summarized below. The property sizes included in the summary below are estimated based on limits identified on Figure 2 and are not intended to convey the extent of MGP-affected media delineated on each property.

- **NSG –** The NSG property comprises three distinct parcels totaling 1.9 acres, separated by Pershing Road and/or South Harbor Place. The NSG property is where the former South Plant MGP resided and is currently vacant and covered with grass.
- **Elgin, Joliet, and Eastern (EJ&E)** – The EJ&E property is located immediately east of the NSG Property. This 0.7-acre property includes the railroad tracks and right-of-way (ROW) located east of and at the south end of the NSG Property.
- **City of Waukegan (COW)** – The COW property is located southeast of the NSG Property between the EJ&E, Akzo Nobel, and Waukegan Port District properties. This 0.5-acre property is a vegetated and vacated former city street ROW. This parcel abuts a ComEd substation (not included as part of the investigation and remediation). Other COW properties investigated include nearby roads and associated ROWs.
- **Akzo Nobel Aerospace Coatings, Inc. (Akzo)** – The Akzo property is located east/southeast of the NSG Property and adjacent to Lake Michigan. This 6.2-acre property consists of asphalt parking lots and buildings used for manufacturing paints and aerospace coatings.
- **Waukegan Port District (WPD)** – The WPD property is located east of the NSG Property. This 12.3-acre property includes a marina, a visitor center/administration building, a maintenance building, a boat storage building (constructed in 2017), and asphalt parking lots adjacent to the marina and Lake Michigan.

The NSG Property is also bounded to the north by a City-owned Metra train parking lot and to the west by a Union Pacific railroad yard. There are no known MGP-residuals on these properties and both are upgradient, based on groundwater flow.

Waukegan Harbor and Lake Michigan are located approximately 600 feet east of the NSG Property. A break wall, extending east-northeast into Lake Michigan separates North Waukegan Harbor from South Waukegan harbor. North Waukegan Harbor was constructed in the 1890s and contains a United States Army Corps of Engineers (USACOE) navigation channel that exits east to Lake Michigan. South Waukegan Harbor was constructed in the mid-1980s, as a marina for recreational boats, and has a southern exit to Lake Michigan. The Waukegan River is located approximately 1,000 feet south of the NSG Property and flows east into Lake Michigan (Figure 2).

2 PERSONNEL RESPONSIBILITY AND AUTHORITY

2.1 OVERVIEW

This section describes and documents the roles and responsibilities of the project personnel responsible for developing, approving, and implementing the CQAP during the remedial action (RA). The duties, responsibilities, and authorities of project personnel are described in the following subsections. The team organization chart, included as Figure 3, indicates direct and indirect lines of correspondence. During remedy implementation, it is possible that a qualified staff personal will fulfill more than one role, provided that combined roles do not present opposing objectives.

2.2 PROJECT MANAGER

The Project Manager will be responsible for overall execution and progress of the RA. The Project Manager's duties include:

- Coordinating with NSG, USEPA, IEPA, and other project personnel, as necessary.
- Coordinating with property owners affected by the construction activities.
- Maintaining daily contact with the Project Engineer during progress of work.
- Evaluating the progress and performance of the RA construction with respect to planned requirements and authorizations and the construction schedule.
- Reviewing and assessing Site-specific documents, including the Remedial Contractor's scope of work, contract terms, and CQAP.
- Monitoring budgetary expenditures and developing budgetary projections throughout the duration of the project.
- Providing technical support to Project Engineer, as needed, to address potential modifications or changes to the Technical Specifications and Contract Drawings.
- Acquiring and applying technical and corporate resources, as needed, to ensure performance within budget and schedule constraints.
- Developing and meeting ongoing project and/or task staffing requirements.
- Reviewing the work performed on each task to ensure its quality, responsiveness, and timeliness.
- Reviewing and/or approving the review and approval of project deliverables from contractors.

2.3 PROJECT ENGINEER

The Project Engineer is responsible for ensuring implementation of the approved Technical Specifications and Contract Drawings. The Project Engineer will report directly to the Project Manager. Duties of the Project Engineer include:

- Reviewing the Construction Quality Control Plan (CQCP) and quality procedures for each definable feature of work.
- Providing daily coordination and communication with the Field Engineer and Construction Quality Assurance (CQA) Engineer.
- Reviewing and approving Contractor Construction Quality Control (CQC) data for conformance with the Technical Specifications and Contract Drawings.
- Reviewing material certifications and related test results for compliance with the Technical Specifications.
- Monitoring budgetary expenditures and developing budgetary projections throughout the duration of the project.

- Reviewing Contractor draft applications for payment with respect to quantities claimed and conformance with approved change orders or field directives.
- Reviewing daily field reports.
- Overseeing daily on-site field office administration with regard to tracking and filing project submittals and documents.
- Communicating daily with the CQA Engineer on the status of the sampling activities and geotechnical and chemical laboratory data.
- Providing daily oversight of the CQA operations.
- Leading weekly progress meetings with the Remedial Contractor, NSG, USEPA, and IEPA.
- Preparing and distributing weekly electronic progress reports and updates to the overall construction schedule.
- Coordinating with the Contractor and relevant subcontractors to eliminate redundancy in quality assurance/ quality control (QA/QC) testing, where possible.
- Reviewing field directives and/or requests for change orders in cases where construction deviates from the intended design and/or Technical Specifications and Contract Drawings with the Project Manager.

The Project Engineer will be determined before the RA begins.

2.4 CORPORATE HEALTH AND SAFETY OFFICER

The Corporate Health and Safety Officer is responsible for reviewing, approving, and auditing the implementation of Site health and safety program elements and has direct access to corporate executive staff, as necessary, to resolve health and safety issues. The Corporate Health and Safety Officer, as well as project personnel, has sufficient authority to stop work on the project as deemed necessary in the event of serious health and safety issues. The Corporate Safety Officer will report directly to the off-site Project Manager. Duties of the Corporate Health and Safety Officer include:

- Reviewing and approving health and safety plans and procedures.
- Providing health and safety consultation to project staff.

Complete details of the Site health and safety program will be presented in the Site-Specific Health and Safety Plan (HASP). The Corporate Safety Officer for this Site is Jim Stinnett.

2.5 ON-SITE HEALTH AND SAFETY OFFICER

The On-Site Health and Safety Officer is responsible for daily implementation of the approved HASP. The On-Site Health and Safety Officer has direct access to corporate executive staff, as necessary, to resolve any health and safety issues. The On-Site Health and Safety Officer, as well as any project personnel, has sufficient authority to stop work on the project as deemed necessary in the event of serious health and safety issues. The On-Site Health and Safety Officer will report directly to the Corporate Health and Safety Officer. The On-Site Health and Safety Officer for this Site will be determined before RA begins.

2.6 FIELD ENGINEER

The Field Engineer will report directly to the Project Engineer and have the responsibility for general project and technical implementation of the project. The Field Engineer, or designee, will be present on Site whenever work is in progress to ensure implementation of the approved Technical Specifications and Contract Drawings. The Field Engineer's duties include:

- Maintaining daily contact with the Project Engineer during progress of work.

- Evaluating the progress and performance of the construction with respect to planned requirements, authorizations, and construction schedule.
- Reviewing and assessing Site-specific documents, including the Remedial Contractor's scope of work, contract terms, and the CQAP.
- Tracking various material quantities such as piping and backfill material delivered to the site, piping installed, injection and extraction well components, installation of injection and extraction wells, and installation of the groundwater treatment plant.
- Developing and meeting ongoing project and/or task staffing requirements.
- Reviewing the work performed on each task to ensure its quality, responsiveness, and timeliness.
- Reviewing and/or approving, or designating the review and approval of, project deliverables before their submission to the Project Engineer.
- Preparing and submitting, or designating such for, the reports listed in Section 4.
- Representing the Project Team at meetings, as needed.
- Providing daily coordination and communication with the field staff during construction.
- Managing a submittal register and reviewing and approving subcontractor CQC data for conformance with the Technical Specifications and Contract Drawings.
- Preparing or reviewing daily field reports.
- Overseeing daily on-Site field office administration regarding tracking and filing project submittals and documents.
- Communicating daily with the on-Site CQC staff on the status of the RA activities.
- Reviewing field directives and/or requests for change orders in cases where construction deviates from the intended design and/or Technical Specifications and Contract Drawings with the off-Site Project Manager.

The Field Engineer for this Site will be determined before RA begins.

2.7 CQA ENGINEER

The CQA Engineer will be on Site during remedial activities requiring CQC or CQA testing by the Technical Specifications, Contract Drawings, and the CQAP. The CQA Engineer will report directly to the Project Engineer. The CQA Engineer's duties include:

- Reviewing the CQCP and quality procedures for each definable feature of work.
- Coordinating collection and testing of CQA samples, as necessary, and shipping of test samples to off-site laboratories, as needed.
- Conducting perimeter ambient air concentration sampling and monitoring.
- Preparing samples for shipment and documenting delivery to the laboratories.
- Communicating and coordinating with the geotechnical and chemical laboratories on the status of sample shipments.
- Reviewing material certifications and related test results for compliance with the Technical Specifications, and reporting deficiencies to the Quality Manager.
- Receiving and reviewing geotechnical and chemical data for completeness and that the results meet the CQA performance criteria.
- Filing and transmitting analytical data into the project database.

- Reviewing geotechnical and chemical laboratory analytical data with the Quality Manager.
- Collecting photographs to document construction progress and CQC/CQA monitoring/testing.
- Preparing CQA sampling reports for review, including:
  - Descriptions of CQA/CQC tests, measurements performed, and any relevant observations.
  - Results of CQA/CQC laboratory testing.
  - Testing results that do not meet the applicable CQA criteria.

The CQA Engineer for this Site will be determined before RA begins.

2.8 QUALITY MANAGER

The Quality Manager will report directly to the Project Manager and be responsible for ensuring that quality processes are implemented correctly and that quality objectives are being met for the project. The Quality Manager has authority to stop any work that is not in compliance with the Technical Specifications and Contract Drawings and has direct access to corporate executive staff, as necessary, to resolve CQA disputes. The Quality Manager, or a designated alternate, will be available during active construction. The Quality Manager is responsible for overall management of CQA and is responsible for auditing the implementation of the CQC program for each definable feature of work. The Quality Manager is also responsible for determining conformance with project requirements. Duties of the Quality Manager, or designee, include:

- Performing CQA/CQC audits on various phases of the field operations.
- Reviewing and approving CQA plans and procedures.
- Providing CQA technical assistance to the Project Manager and other project staff.
- Regularly reporting on the adequacy, status, and effectiveness of the CQA program to the off-Site Project Manager.

The Quality Manager for this Site will be determined before RA begins.

2.9 REMEDIAL CONTRACTOR

Remedial Contractors will be retained to construct the RA components defined for the project. The Remedial Contractors are responsible for completing the construction work in accordance with the Technical Specifications and Contract Drawings, and approved changes to these documents, as well as conducting appropriate CQC tests and inspections to check that the work meets the design requirements. The Remedial Contractors for this Site will be determined during the procurement process.

2.10 REMEDIAL CONTRACTOR PROJECT SUPERINTENDENT

The Remedial Contractor's Project Superintendent will report directly to the Project Manager and have responsibility for work progress and construction quality. The Remedial Contractor's Project Superintendent, or designee, will be present on Site whenever work is in progress to ensure implementation of the approved Technical Specifications and Contract Drawings. The Remedial Contractor's Project Superintendent's duties include:

- Developing and meeting ongoing task staffing requirements and schedule.
- Leading the Remedial Contractor's team at meetings, as needed.
- Coordinating daily with the Field Engineer.
- Managing the subcontractors utilized to complete project tasks, including the water treatment, trucking, materials, and surveys.

The Remedial Contractor's Project Superintendent for this Site will be determined during the procurement process.

2.11 LABORATORY

GESTRA Engineering, Inc. (GESTRA) in Milwaukee, WI was previously approved by the USEPA during the pre-design investigation (PDI) work, and will conduct geotechnical analysis during the RA. STAT Analysis Corporation (STAT) in Chicago, Illinois is tentatively identified to analyze air samples to assess ambient air during the RA. Final laboratory selections are to be determined and will be reported to USEPA prior to sending samples. Generic laboratory roles and responsibilities are defined in the Multi-Site Quality Assurance Project Plan (QAPP) – Revision 2 (September 4, 2007).

3 QUALITY PROGRAM

This section discusses the methodology that will be used to confirm the RA is being implemented to meet the performance criteria, as specified in the Technical Specifications and Contract Drawings. This section includes specific performance criteria, measurements, and inspections that will be performed to verify compliance with the objectives of the RA. This section also discusses contingency or other response actions if the objectives or criteria are not met.

Table 1 provides a summary of the quality program and includes the following:

- Design element
- Specific performance objective and criteria
- Monitoring or inspections to verify compliance
- Frequency of monitoring/inspection
- Contingency or response actions, if necessary

In addition to these individual monitoring and performance criteria, a submittal registry will be managed by the Field Engineer, documenting all materials and equipment brought on Site for installation in the DNAPL recovery system. When a new material is brought on Site, the CQA Engineer will be in charge of verifying that the material is accompanied by a submittal and is in compliance with the Technical Specifications and Contract Drawings before it is installed.

The Sampling and Analysis Plan is summarized in Table 2. This includes more detailed information regarding collection of samples including:

- Sample type
- Number of samples
- Any QA/QC samples
- Type of analysis
- Sampling containers

Sampling and inspection activities will be performed in accordance with the HASP, the Multi-site QAPP, applicable permits requirements, and referenced Standard Operating Procedures (SOPs). Sampling and inspection activities for the RA will be carried out by O'Brien & Gere Engineers, Inc. (OBG).

3.1 EROSION CONTROL MEASURES

Erosion control measures will be installed in accordance with the Illinois Urban Manual – Field Manual for Inspection of Erosion and Sediment Control Best Management Practices (BMPs, Association of Illinois Soil & Water Conservation Districts, 2013) and Illinois Department of Transportation's (IDOT) Erosion and Sediment Control Field Guide for Construction Inspection (IDOT, 2010) at the locations shown on the Contract Drawings. The Remedial Contractor will maintain erosion control measures to minimize, to the extent practicable, the amount of soil/sediment and other pollutants carried by runoff or discharged from land disturbing activities into the storm sewer system. Erosion and sediment control BMPs will include silt fences, gravel tracking pads, specified on-Site truck routes, and material storage procedures. Any material brought in as part of the erosion control will require the proper submittals, as indicated on Tables 1 and 2, received and reviewed by the CQA Engineer before use on Site.

Erosion control measures will be maintained for the duration of the project and will be visually inspected every seven days or following a 0.5-inch rain event, and as necessary per the requirements of acquired permits (e.g., watershed development permit). If inspection activities indicate erosion control measures are damaged or inadequate, the Field Engineer will notify the Remedial Contractor's Site Superintendent so that the erosion

control measures are repaired in timely and orderly fashion. The Remedial Contractor will also be responsible for modifying erosion control measures, as necessary, to accommodate adjustments during RA activities, or means and methods of Site operation with the Field Engineer's approval.

3.2 SITE SECURITY

A temporary Site security fence will be installed around the perimeter of the NSG Property parcels, as shown on the Contract Drawings. The security fence will protect the public from the work zone areas, and provide security for staged materials. Vehicle gates and man gates will be installed, as needed, along the fence perimeter to serve as entrances and exits for authorized vehicles and project personnel. The gates will be locked during non-working hours.

The Site security fence will be maintained for the duration of the project and will be visually inspected daily. If damage to fence is observed, the Field Engineer will notify the Remedial Contractor's Site Superintendent so that the fence or gates are repaired in a timely and orderly fashion.

3.3 ROADWAY/PARKING LOT/SIDEWALK CONDITION DOCUMENTATION

At the beginning of the project, access routes will be visually surveyed to document the existing conditions to identify incremental damage that may result from RA activities. The survey will consist of the CQA Engineer driving or walking the access route to record the location of existing pot holes, excessive settling, and other stressed conditions. The CQA Engineer will take notes, photos and/or video recordings, and measurements of the features to document pre-construction conditions. The CQA Engineer will also walk the locations where RA activities will take place on Site.

On a weekly basis, the CQA Engineer will drive/walk the access routes and the Site to observe for potential project-related damage that may require temporary repair. At the end of the project, a final visual survey will be performed on the pavement, access route, and Site features that were accessed during the construction activities. If incremental damage is identified, these areas will be repaired to the extent practical to achieve pre-construction conditions following completion of the project. Depending on the area and extent of damage, if any, an alternate arrangement may also be discussed with the affected owner of property.

3.4 WELL INSTALLATION

Proper well installation and construction techniques will be critical to remedy success. All wells (e.g., monitoring wells, vertical and horizontal injection wells, DNAPL/groundwater extraction wells) to be installed during RA activities will be installed in accordance with the Illinois Department of Health (IDOH) Administrative Code Section 920.170 - Water Well Construction Code and in accordance with SOP SAS-05-03. All materials associated with the installation of the wells will be installed per the manufacturer's recommendations.

The well sump will be sealed in accordance with the Contract Drawings and Technical Specifications to prevent downward migration of DNAPL. The screen interval of each well will be verified with the Project Engineer (or designee) to ensure the appropriate lithology is screened. The well screen, filter pack, sealant, well vault, pump, and associated piping and control infrastructure will be compared against Contract Drawings and Technical Specifications to ensure material compatibility and consistency with project requirements. Following installation, the well vault will be evaluated for water tightness and that the surrounding ground surface affected by well installation has been restored. Specific details related to CQA for both vertical and horizontal well installation is included in Table 1.

3.5 CONTROL VAULT AND CONVEYANCE PIPING INSTALLATION

Control vaults and conveyance piping will be installed to facilitate control of the well network and conveyance of recovered DNAPL, extracted groundwater, and injected groundwater between the well network and the groundwater treatment plant. Control vaults will be installed in accordance with the Technical Specifications at the locations shown on the Contract Drawings. Stone and soil materials brought on site as part of vault and

conveyance installation will require the proper testing and documentation, as indicated on Table 2. The material documents will be reviewed by the CQA Engineer before the materials are brought on site.

Conveyance piping will be installed in the locations and uniformly sloped between elevations as shown on the Contract Drawings. Corresponding fluid piping, power, and control lines will be installed within the conveyance piping as detailed on the Contract Drawings. Leak testing on the fluid piping will be conducted in accordance with the Technical Specifications prior to commencing system operations. Identified leaks during testing will be properly addressed. All fluid control equipment (valves, transducers, backflow preventers, etc.) will be tested to ensure proper functionality. Additionally, testing to ensure continuity, ground, bond, and/or overcurrent protection will be performed on power and control lines, as required in the Technical Specifications.

3.6 GROUNDWATER TREATMENT SYSTEM

The groundwater treatment system is anticipated to be constructed in modular containers at the vendor's facility. The Project Engineer will be engaged in a series of shop drawing reviews throughout the manufacturing process to ensure compliance with project requirements, Contract Drawings, and Technical Specifications. The Project Engineer and/or CQA Engineer will conduct a quality control review of the groundwater treatment system at the manufacturer's facility prior to shipment to the Site. The quality control review will be focused the following:

- Verifying the system is constructed in accordance with approved Contract Drawings and Technical Specification, and any corresponding submittals (i.e. shop drawings)
- Ensuring piping, pumps, and treatment components are free of deficiencies.
- Testing the functionality of the programmable logic control system to ensure that pressure switches, level control switches, and other control elements can achieve desired system operations.

Deficiencies noted in this inspection will be corrected prior to shipment of the system to the Site. Once on Site, additional QC inspections will be conducted to ensure that the various modular elements are properly connected. The functionality of the system will be evaluated and documented on Site and compared to functionality at the manufacturer's facility.

3.7 AIR MONITORING PLAN

3.7.1 Overview

Potential emissions to be managed and controlled during the RA include odor, fugitive respirable particulate matter, and vapor phase contaminants of concern. Potential sources of emissions include:

- Fugitive dust as part of Site conditions
- MGP-related vapor/odor from staging or loading of MGP-affected soils during well and conveyance piping installation activities

Perimeter air monitoring activities will be conducted by the CQA Engineer under direction of the Field Engineer. The air monitoring activities will include the following:

- An on-Site or remote weather station will be established to monitor meteorological conditions during the RA. Parameters to be monitored include wind speed, wind direction, relative humidity, ambient air temperature, and barometric pressure.
- Prior to initiating intrusive activities, background air monitoring will be performed to establish baseline ambient air concentrations. Background air monitoring will include real-time monitoring and 24-hour time-weighted sampling of MGP-related constituents.
- During well and conveyance piping installation (intrusive activities) both real-time air monitoring and 24-hour time-weighted sampling will be conducted at the Site perimeter.

- The real-time air monitoring for total volatile organic compounds (TVOCs) and respirable particulates will be performed at regular intervals in the vicinity of the intrusive activities at the five air monitoring locations around the perimeter of the work area. Proposed locations of air monitoring stations (AMS), AMS-1 through AMS-5 are indicated on Figure 4.
- The 24-hour time-weighted MGP constituent-specific sampling will be performed by collecting Summa canister samples for benzene, ethylbenzene, toluene, and xylenes (BTEX) and naphthalene analysis. Results will be compared with risk-based acceptable ambient concentrations (AACs), which will be developed before construction begins. Samples will be collected at the five AMS locations shown on Figure 4 but may be supplemented with other locations, if needed.

Examples of air monitoring reports and sample collection logs are provided in Appendix A.

3.7.2 Real-Time Air Monitoring with Handheld Equipment

Real-time monitoring at the fence line will be conducted with handheld devices prior to and during intrusive remedial work. Real-time air monitoring will occur, at a minimum, during on-Site work hours. Key requirements of the program include the following:

- Monitoring for TVOCs using a photoionization detector (PID).
- Monitoring for benzene using a PID calibrated for benzene when TVOCs are detected above the Action Level
- Monitoring for respirable particulates with an aerodynamic diameter of less than 10 microns (PM_{10}), using handheld aerosol monitoring equipment.
- Assessing odor that could indicate a concern for a public nuisance.
- Assessing the presence of off-site dust due to on-site operations.

3.7.3 Time-Weighted Average (24-Hour) Perimeter Air Monitoring

The proposed plan for 24-hour Summa canister sample collection is divided into two phases – background and intrusive RA. Sampling frequencies and quantity requirements for Summa sample collection differ between the phases. Frequencies and quantities may be revised during the RA depending on the conditions encountered. Summa samples will be analyzed for BTEX and naphthalene. Sampling requirements are summarized below:

- Background: Prior to the beginning of intrusive work, background air sampling and monitoring will be conducted to establish baseline concentrations. Three sets of Summa samples will be collected. Each set will include collection of three samples—one from an upwind location and two from downwind air monitoring locations.
- Intrusive RA: During intrusive RA activities (i.e. well and conveyance infrastructure installation), Summa samples will be collected from one upwind and two downwind locations twice per week.
- Standard turnaround (10 days) of analytical results will be requested, unless real-time monitoring or past analytical results indicate that sample analysis should be expedited to evaluate potential on-Site exceedances of AACs.
- Field duplicates for Summa canister samples will be collected at a frequency of one per 20 samples. Duplicates will be obtained by collected two concurrent samples from a single location.
- Field blank Summa samples will be collected at a frequency of once per week.
- Upwind and downwind samples will be located along the Site perimeter based on RA activities, accessibility, receptors, and weather conditions.

Summa canisters will be collected in accordance with procedures outlined in Appendix B and submitted to a laboratory for analysis of BTEX and naphthalene by USEPA Method TO-15.

A summary of sampling requirements for both phases is provided on Table 2. Examples of air monitoring reports and sample collection logs are included in Appendix A.

3.8 FUGITIVE EMISSIONS MANAGEMENT PLAN

Action Levels will be used in a tiered approach to determine necessary response actions to different Site conditions resulting from fugitive air emissions, based on real-time monitoring as identified in Figure 5. Action Levels for the Site will be developed prior to the start of construction. General types of mitigation measures that may be implemented by the Remedial Contractors are divided into the following:

- Physical Controls: Physical controls represent the primary types of mitigation measures and incorporate a broad range of activities (e.g., good housekeeping practices, maintaining exclusion zones, and covering stockpiles) that will be implemented on a periodic (i.e., daily and/or weekly) basis. Modifications to the physical controls may include more aggressive activities, such as, daily covering of stockpiles, if applicable, and /or use of water for dust suppression.
- Work Sequencing: Sequencing the work will limit emissions from freshly exposed MGP-affected soils and drill cuttings. Other factors to be considered include planning the operations to avoid multiple-handling of impacted materials; scheduling loading and off-site hauling to minimize the duration of impacted materials stored on Site. Modifications to the work sequencing may include reducing and/or modifying the rate of excavation, drilling, or on-site processing to further reduce emissions.
- Site Layout: Requirements for Site layout include locating proposed stockpile and material management areas away from potentially sensitive receptors, to the extent practicable. These requirements will also include reassessment of Site layout requirements as the RA is implemented.

Maintaining fugitive emissions below Action Levels and implementing the above mitigation actions will minimize adjacent receptors exposure to fugitive emissions.

3.9 SITE RESTORATION

Following the conclusion of remedial construction activities, equipment, temporary land improvements, erosion controls, and infrastructure installed to support RA shall be disassembled and appropriately reused or disposed of off-Site. Disturbed vegetation, roadways, parking lots, parking islands, and other items damaged or degraded during RA activities shall be restored to pre-construction conditions, to the extent practicable. Topsoil used as part of the restoration will require the proper submittals documenting soil quality, as indicated on Table 2. This documentation will be reviewed by the CQA Engineer before being approved for use. Any seed and mulch will also require the proper submittals, as indicated in the Technical Specifications, to be reviewed by the CQA Engineer before use on site.

At the conclusion of restoration activities, the CQA Engineer will conduct a Site walk to confirm that the Site has been adequately restored in accordance with access agreements. If deficiencies which resulted from remedial activities are noted during the Site walk, the responsible Remedial Contractor will be required to correct the noted deficiency.

4 REPORTING PROCEDURES

The Project Manager and Quality Manager will establish a document control system to provide measures for issuing, distributing, storing, and maintaining quality-related documents. These documents may be provided from the Remedial Contractors, laboratory suppliers, vendors, disposal facilities, and other entities. Documents that require quality control include:

- Drawings and Technical Specifications
- Calculations
- Laboratory reports
- Submittals related to specifications of installed materials/equipment
- As-built drawings documenting system installation
- Design change notices
- Field change requests

4.7 DOCUMENTATION

Several forms will be developed to assist with documenting the RA. Examples of the following forms are provided in Appendix A:

- **Daily Construction Report –** to document daily remediation activities. Information on this form includes daily work performed, samples collected, staff members present, meteorological conditions, and Site conditions
- **Construction Deficiency Report –** to document deficiencies, non-conformances, and follow-up actions
- **Construction Deficiency Report Log –** to summarize and track deficiencies and follow-up actions
- **Submittal Registry –** to track Remedial Contractor submittals, Engineer review, and submittal status

The example forms may be revised, as necessary, to maximize field utility.

4.8 PROJECT COMPLETION REPORT

A Project Completion Report will be prepared to document the following:

- Project summary
- Specifications and locations of wells installed
- Specifications and locations control vaults installed
- Specifications and locations piping installed
- Specifications of groundwater treatment plan
- Record Drawings of RA and restoration
- Daily Reports and photographs
- Quality assurance
- Environmental monitoring
- Description of restorations
- Deviations from the RD
- Submittals and updated submittal schedule

4.9 STORAGE, MAINTENANCE, AND AVAILABILITY OF DOCUMENTS

The Project Engineer, or designee, will file, store, and maintain record documents, including completed forms, logbooks, and meeting minutes, in an electronic format. Documents will be maintained in good order and protected from loss (e.g., backed up on secure server). Project documents will be stored in a manner to provide access by the Project Manager during normal working hours. Records will be available for inspection and audit by authorized persons.

5 REFERENCES

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2015 March. NRT. Focused Feasibility Study Report – Rev 2, Waukegan South Plant MGP, Waukegan, Illinois. NSG.

Tables

Table 1. Summary of Quality Program

Construction Quality Assurance Plan
Former South Plant Manufactured Gas Plant Site
Waukegan, IL
North Shore Gas, CERCLIS ID - ILD984809228

Design Element	Specific Performance Objective and Criteria	Required Monitoring or Inspections to Verify Compliance	Frequency	Contingency or Response Action
Specification Requirement Tracking	Verify that material and equipment that is brought onsite meets specifications	Developing submittal register, comparing submittals to specification requirements, and confirming that material brought on site matches item approved through submittal process	As necessary as new material brought on site	Obtain engineer approval for non-complient material/equipment or require contractor to meet specification
Erosion Control	Title 35 IAC Subtitle C, Chapter 1 and Lake County Watershed Development Ordinance requirements. To minimize to the extent practical migration so soil/sediment off site or into the stormwater system.	Visual inspection of silt fence, tracking pad, and inlet protection integrity	Daily. Official inspection report should be completed once every seven calendar days or following a storm event with greater than 0.5 inches of rainfall or equivalent precipitation	Repair damage, channelizing, in an orderly fashion
Site Security Fence	Maintain fence to restrict public access	Visual inspection of the integrity of the security fence.	Daily	Repair damage in an orderly fashion
Existing Conditions Survey - Access Routes	Establish pre- and post- construction access route quality	Visual inspection of roads, sidewalks, and other infrastructure along haul route and on/adjacent to staging area	Pre and post construction as well as weekly	If soil quality has been negatively affected, soil may be removed
Roadway/Sidewalk/Parking Lot Condition	Document existing conditions to evaluate potential damages	Travel truck routes, inspect sidewalks, and parking lot that equipment has traversed	Beginning of project and weekly	Repair damage to the extent practical at completion of project
Well Installation	Document that well construction completed per project plans, that well is screened in appropriate lithology, and that the well sump is sealed	Review soil before well is installed. Visually verify that well sump is sealed before installation.	After installation of each well.	Redrill and reinstall well to correct specifications or within correct lithology.
Vault Installation	Document that vault construction is completed per project plans, that vault is watertight and surrounding ground is matches previous surface.	Survey vault covers and apron to verify that covers were installed with correct slope. Visually verify integrity of the cover gasket. Verify vaults covers are installed as per the cut sheet in the Plans	After installation of each vault.	Regrade and refinish apron and reinstall cover at appropriate elevation. If leaking, seal interior of vault or properly fit vault cover for watertightness.
Conveyance Piping	Document that conveyance piping is free of leaks and that pipe invert elevations are installed at depth laid out in the Plans and that the uniformly sloped per the project plans	Perform leak testing per Specification 33-08-01.	After installation of piping.	Seal leaking connections
Fluid Control Equipment	Ensure proper functionality of all valves, transducers, backflow preventers and other fluid control equipment.	Test function after installation	Prior to system start-up	Seal or replace any leaking equipment.
Electrical Infrastructure	Ensure continuity, ground, bond, and/or overcurrent protection on all electrical infrastructure installed.	Verify that all infrastructure was installed per the Plans and Specifications and that everything was tested by a qualified person.	Prior to system start-up	Complete any connections, as necessary. Replace any obsolete wires.
Groundwater Treatment System	Verify modular system is constructed according to approved shop drawings. Ensure piping, pumps, and treatment components are free of leaks	Inspect modular containers compared to shop drawings and perform leak testing on piping, pumps, and other treatment components.	Inspect modular containers upon arrival and prior to assembly. Perform leak testing post-assembly and prior to equipment start-up	Contact manufacturer for any adjustments needed to modular containers. Seal or replace any leaking connections.
Equipment Decontamination	Soil and other visual MGP impacts must be cleaned from equipment that is either changing purpose or leaving the site.	Visual inspection by CQA	Once daily for offsite dump trucks. For all other equipment, whenever equipment leaves site or changes role.	If dry decontamination activities are unable to fully remove MGP-Impacts, implement wet decontamination
Fugitive Emissions	Manage fugitive emissions during the remediation	Refer to Section 3.7.	Refer to Section 3.7.	Implement Control Measures as described in Section 3.8

Table 2. Sampling and Analysis Plan

Construction Quality Assurance Plan
Former South Plant Manufactured Gas Plant Site
Waukegan, IL
North Shore Gas, CERCLIS ID - ILD984809228

Sample Type/Location	Proposed Number of Sampling Locations/ Frequency	Matrix	Parameter	Method	Estimated Sample Quantity[1]	Field Duplicates[2]	Equipment Blanks	MS/MSD	Field Blanks[3]	Total Samples	Container Type	Minimum Volume	Preservation	Holding Time from Sample Date
Imported stone (CA-1) for tracking	prequalification	stone	Particle Size Analysis	ASTM D422	1	NA	NA	NA	NA	1	plastic	1 gallon	None	None
Imported stone (CA-6) for vault	prequalification	stone	Particle Size Analysis	ASTM D422	1	NA	NA	NA	NA	1	plastic	1 gallon	None	None
Imported sand for pipe bedding	prequalification	soil	Particle Size Analysis	ASTM D422	1	NA	NA	NA	NA	1	plastic	1 gallon	None	None
			Illinois Maximum Allowable Concentration Criteria, if from unpermitted source	Various	1	NA	NA	NA	NA	1	Various	Various	Various	Various
Imported topsoil for restoration	prequalification	soil	Organic Matter	ASTM D2974	1	0	0	0	0	1	amber glass	4 oz.	None	28 days
			pH	ASTM D4972	1	NA	NA	NA	NA	1	plastic	NA	None	Immediate
			Total phosphorus	365.4	1	NA	NA	NA	NA	1	plastic	4 oz.	None	None
			Potassium	SW846 6010B or 6020A	1	NA	NA	NA	NA	1	plastic	4 oz.	None	None
			Total Nitrogen (TNK + Nitrate+Nitrite)	EPA 351.2 and 353.2	1	NA	NA	NA	NA	1	plastic	4 oz.	None	None
			Illinois Maximum Allowable Concentration Criteria, if from unpermitted source	Various	1	NA	NA	NA	NA	1	Various	Various	Various	Various
Background Air Monitoring	3 locations 1 week	air	**Time Weighted Average (24-hour) 3 times/week**											
			BTEX and Naphthalene	TO-15	9	1	0	0	1	11	summa	6L		30 days
	5 locations	air	**Real Time Monitoring**											
Standard Turnaround	1 week		TVOC, benzene and PM10	PID for TVOC/benzene and Handheld Aerosol Monitor	N/A	N/A	N/A	N/A	N/A	N/A				
Intrusive Remedial Action	3 locations	air	**Time Weighted Average (24-hour) 2 times/week**											
	Remainder (Assumed at 6 weeks)		BTEX and Naphthalene	TO-15	36	2	0	0	6	44	summa	6L		30 days
	5 locations	air	**Real Time Monitoring**											
Standard Turnaround	Remainder (Assumed at 6 weeks)		TVOC, benzene and PM10	PID for TVOC/benzene and Handheld Aerosol Monitor	N/A	N/A	N/A	N/A	N/A	N/A				

Notes:
1. Sample quantities are per source. Each source will need to provide data for at least one sample.
2. Field duplicates will be collected at a frequency of one per group of twenty or fewer confirmation air samples.
3. Field blank summa samples will be collected at a frequency of one per week.

Figures

FIGURE NO. 1

SITE LOCATION MAP

CONSTRUCTION QUALITY ASSURANCE PLAN
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

N

0 1,000 2,000 4,000
Feet

O'BRIEN & GERE ENGINEERS, INC.

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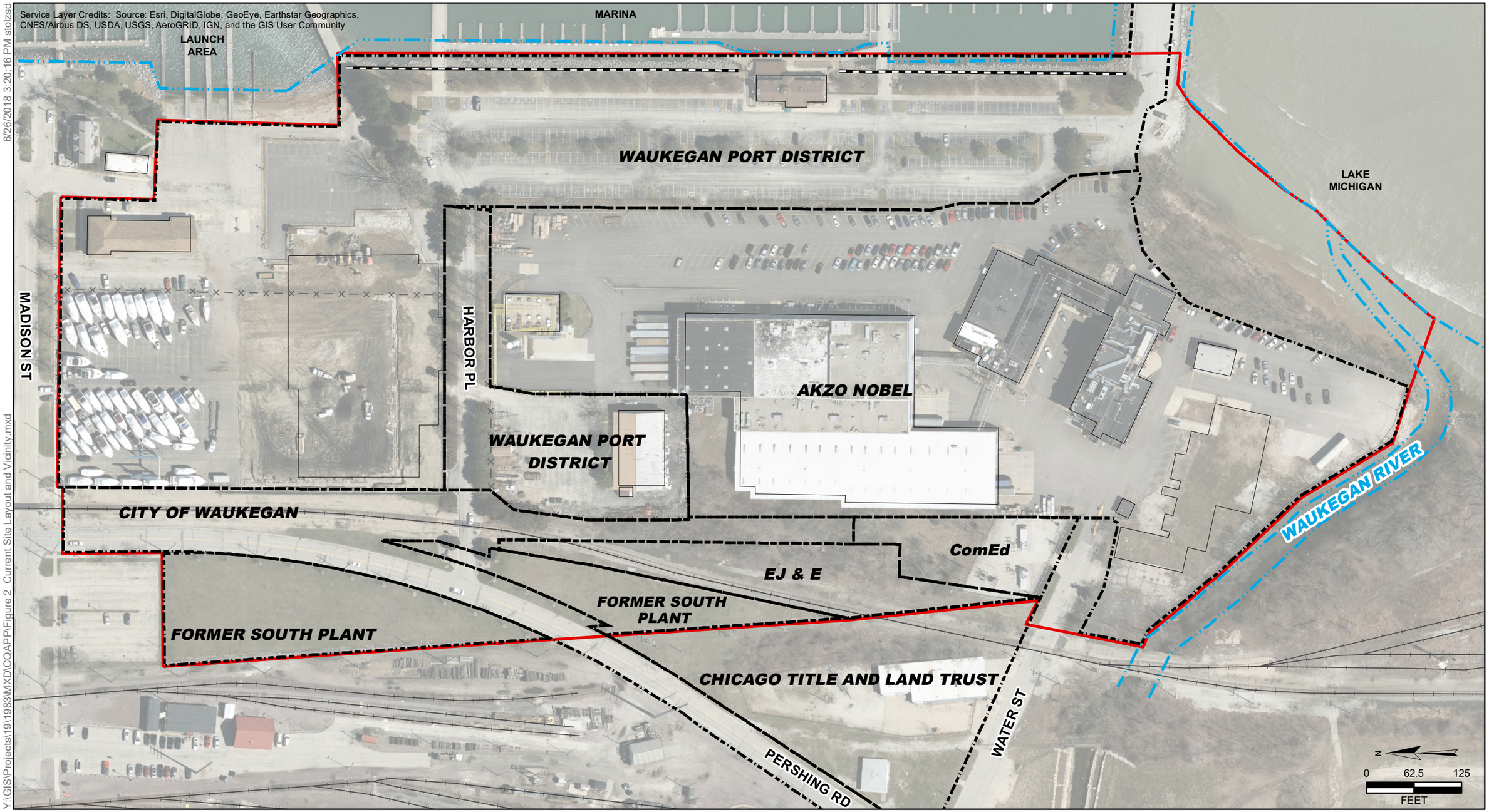
Y:\GIS\Projects\19\1983\MXD\CQAPP\Figure 1_Site Location Map.mxd



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Y:\GIS\Projects\191\1983\MXD\CQAPP\Figure 2_Current Site Layout and Vicinity.mxd

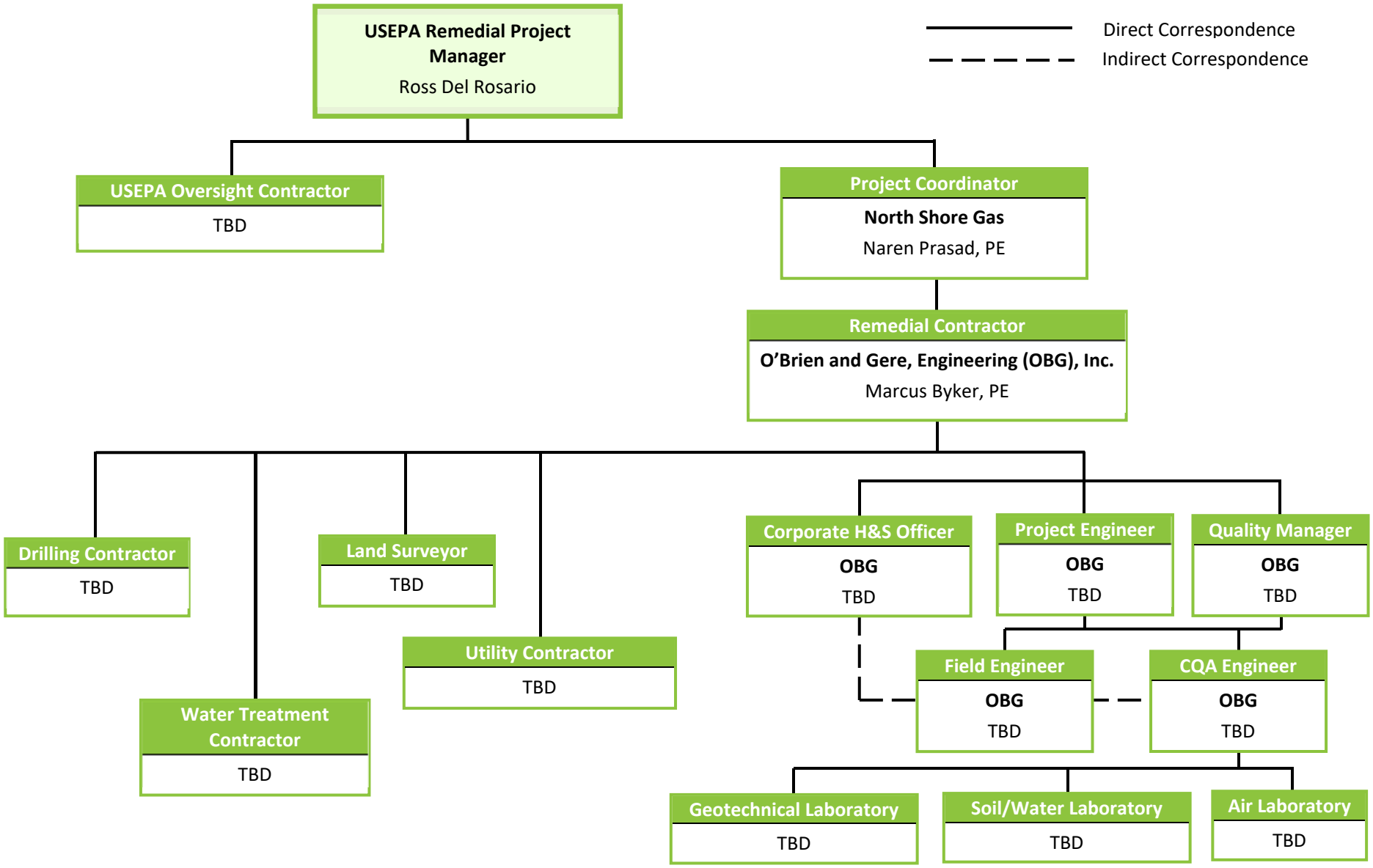
- SHEET PILE WALL
- WATERLINE
- RAILROAD
- FENCE
- OPERATIONAL UNIT BOUNDARY
- BUILDINGS
- APPROXIMATE PROPERTY BOUNDARIES

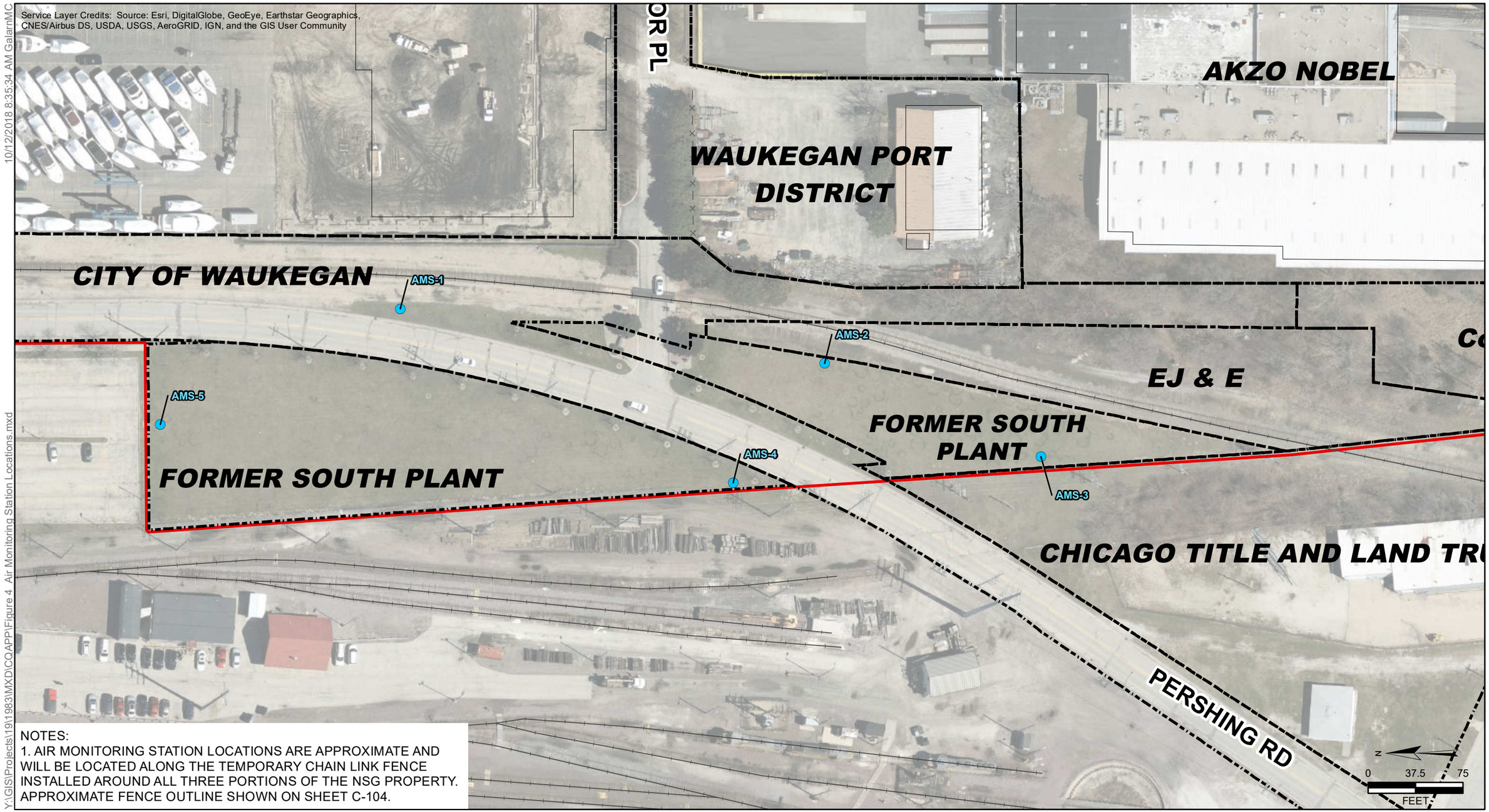
CURRENT SITE LAYOUT AND VICINITY

CONSTRUCTION QUALITY ASSURANCE PLAN
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

O'BRIEN & GERE ENGINEERS, INC.

FIGURE 3 – TEAM ORGANIZATION CHART





NOTES:
1. AIR MONITORING STATION LOCATIONS ARE APPROXIMATE AND WILL BE LOCATED ALONG THE TEMPORARY CHAIN LINK FENCE INSTALLED AROUND ALL THREE PORTIONS OF THE NSG PROPERTY. APPROXIMATE FENCE OUTLINE SHOWN ON SHEET C-104.

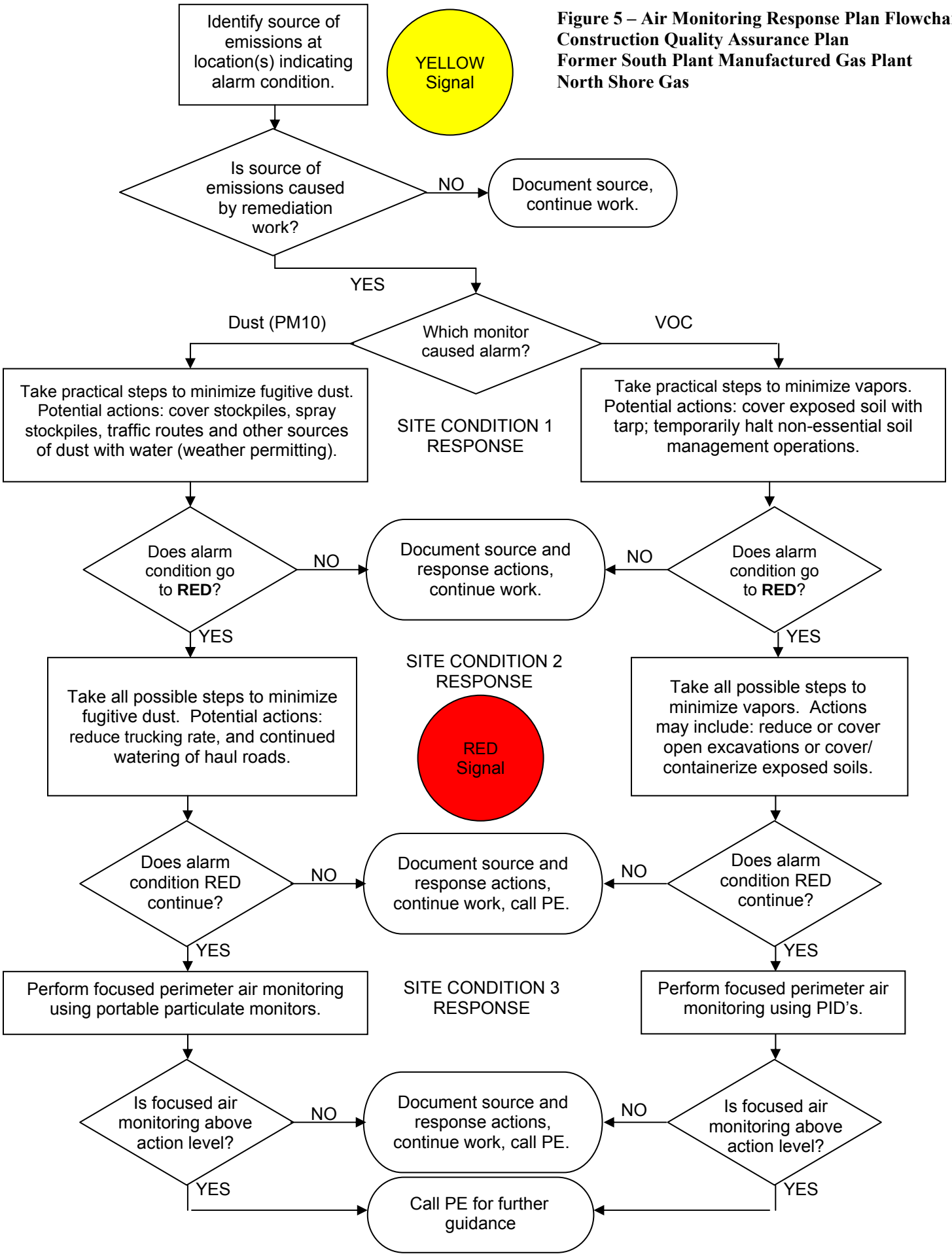
- AIR MONITORING STATION LOCATION
- RAILROAD
- FENCE
- OPERATIONAL UNIT BOUNDARY
- BUILDINGS
- APPROXIMATE PROPERTY BOUNDARIES

AIR MONITORING STATION LOCATIONS

CONSTRUCTION QUALITY ASSURANCE PLAN
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

O'BRIEN & GERE ENGINEERS, INC.

Figure 5 – Air Monitoring Response Plan Flowchart
Construction Quality Assurance Plan
Former South Plant Manufactured Gas Plant
North Shore Gas



Appendix A

Example Documentation Forms

Daily Oversight Report

Date: | **Arrival Time:**

Week: | **Departure Time:**

Project: Former South Plant MGP

Client: North Shore Gas Company

Project Number: 67860

General Information

OBG Project Manager: _____ **Additional OBG Field Staff:** _____

OBG Field Engineer: _____ _____

OBG CQA Engineer: _____ _____

Contractor _____ _____

Contractor _____ _____

Work Performed

Samples Collected

Equipment on Site

General Weather Conditions

Field Notes

Daily Report Staff Signature

Reviewed by:

Detention Basin – Sediment Basin

- Is the basin installed?
- Is the basin adequately stabilized?
- Is there evidence of sufficient coverage of native vegetation?

LAKE COUNTY STORMWATER MANAGEMENT COMMISSION

Field Observation Report

WDO Permit #	Enter Permit #	**USACE Reference #**	Army Corps reference number
Date/Time of Inspection	Date/Time of Inspection	**Observer/DECI:**	Enter name of Inspector
Community	Community Name	**Enforcement Officer**	Enter E.O. Name
Project Name	Project Name		
Field Contact Information	Field contact name and phone/Email		
Address/Location	Address or Location		

In Attendance	Who attended Inspection				
Weather Conditions:	Current weather conditions	**Reason for Inspection**		☐ weekly ☐ rain ☐ other	
Disturbed Area	Estimate area of disturbance	**Stage of Construction**		Pre-Construction	
Floodplain Impacted	☐ Yes ☐ No	**Floodway Impacted**		☐ Yes ☐ No	
Wetland Impacted	☐ Yes ☐ No	**Violation Observed**		☐ Yes ☐ No	
Violation Correction Time	☐1 day ☐10 day ☐30 day	**Violation Rating**		0 - No Violation	
Water Sample Taken	☐ Yes ☐ No ☐ N/A	**Photos Taken**	☐ Yes ☐ No	**Next Site Visit**	Days until next Inspection
Follow up Needed	Note any follow up needed	**Copy To:** Person(s) to receive this report			

Construction Entrance/Pavement	☐ Satisfactory ☐ Unsatisfactory ☐ N/A	**Detention/Sediment Basin Condition**	☐ Satisfactory ☐ Unsatisfactory ☐ N/A
Dewatering Facility	☐ Satisfactory ☐ Unsatisfactory ☐ N/A	**Ditch Checks/Silt Dikes**	☐ Satisfactory ☐ Unsatisfactory ☐ N/A
Dust Control	☐ Satisfactory ☐ Unsatisfactory ☐ N/A	**Inlet Protection**	☐ Satisfactory ☐ Unsatisfactory ☐ N/A
Native Vegetation	☐ Satisfactory ☐ Unsatisfactory ☐ N/A	**Overland Flow/Offsite Drainage Paths**	☐ Satisfactory ☐ Unsatisfactory ☐ N/A
Perforated Riser	☐ Satisfactory ☐ Unsatisfactory ☐ N/A	**Perimeter SE/SC Controls**	☐ Satisfactory ☐ Unsatisfactory ☐ N/A
Restrictor Plate/Structure	☐ Satisfactory ☐ Unsatisfactory ☐ N/A	**Silt Fence**	☐ Satisfactory ☐ Unsatisfactory ☐ N/A
Soil Stockpile Stabilized/Protected	☐ Satisfactory ☐ Unsatisfactory ☐ N/A	**Stabilization Measures**	☐ Satisfactory ☐ Unsatisfactory ☐ N/A
Stormwater System	☐ Satisfactory ☐ Unsatisfactory ☐ N/A	**Wetlands/Waters Protection Measures**	☐ Satisfactory ☐ Unsatisfactory ☐ N/A

Observations:

☐ Yes ☐ No ☐N/A
☐ Yes ☐ No ☐N/A
☐ Yes ☐ No ☐N/A

- Is the emergency overflow constructed with the required materials? ☐ Yes ☐ No ☐N/A

Dewatering

- Is dewatering directly entering a waterway or wetland? ☐ Yes ☐ No ☐N/A
- Are dewatering activities conveying sediment laden water? ☐ Yes ☐ No ☐N/A

Restrictor Plate – Restrictor Structure	
• Is the restrictor plate or restrictor structure installed?	☐ Yes ☐ No ☐ N/A
• Is the opening(s) or pipe size in the restrictor plate or restrictor structure appropriately sized?	☐ Yes ☐ No ☐ N/A
Silt Fence	
• Does the silt fence meet the AASHTO 288-00 Standard?	☐ Yes ☐ No ☐N/A
• Is the silt fence trenched in properly?	☐ Yes ☐ No ☐N/A
• Is the silt fence backfilled and compacted?	☐ Yes ☐ No ☐N/A
• Is the silt fence maintained and in good condition?	☐ Yes ☐ No ☐N/A
• Is silt fence installed in all areas shown on the permitted plans and in all areas necessary?	☐ Yes ☐ No ☐N/A
Site Stabilization	
• Have all disturbed areas been stabilized with temporary or permanent measures within 14 days of the end of active hydrologic disturbance?	☐ Yes ☐ No ☐N/A
• Are stabilization measures effective?	☐ Yes ☐ No ☐N/A
• Are there areas of disturbance that need additional stabilization measures?	☐ Yes ☐ No ☐N/A
Soil Stockpile	
• Is the soil stockpile located in an approved location (ie. not in floodplain or wetland)?	☐ Yes ☐ No ☐N/A
• Is the soil stockpile adequately stabilized?	☐ Yes ☐ No ☐N/A
• Is the soil stockpile properly enclosed with silt fence?	☐ Yes ☐ No ☐N/A
Stormwater Management System	
• Is the stormwater management system installed and functional, prior to building construction?	☐ Yes ☐ No ☐N/A
• Are all points of concentrated discharge appropriately installed for energy dissipation?	☐ Yes ☐ No ☐N/A
• Are all inlets and catch basins adequately protected from sediment conveyance into the system?	☐ Yes ☐ No ☐N/A
• Is hydrocarbon removal technology in place, functional and maintained where needed?	☐ Yes ☐ No ☐N/A
Temporary Construction Entrance	
• Are all ingress and egress points covered by a temporary construction entrance?	☐ Yes ☐ No ☐N/A
• Is the entrance constructed with 3” coarse aggregate?	☐ Yes ☐ No ☐N/A
• Has an appropriate geotextile material been installed underneath the stone?	☐ Yes ☐ No ☐N/A
• Is the entrance appropriately sized, both in width and length?	☐ Yes ☐ No ☐N/A
• Is the entrance adequately preventing tracking of dirt, mud, and sediment onto roadways?	☐ Yes ☐ No ☐N/A
Triangular Silt Dike	
• Are triangular silt dikes installed in all locations shown on the permitted plan set?	☐ Yes ☐ No ☐N/A
• Are the triangular silt dikes pinned or otherwise secured on the upstream side?	☐ Yes ☐ No ☐N/A
• Are the triangular silt dikes spaced appropriately, ie. the top of the downstream unit should be at the same elevation as the bottom of the unit immediately upstream?	☐ Yes ☐ No ☐N/A
Wetlands and Waters Protection	
• Are all delineated wetlands on site protected by 4’ IDOT Standard Construction Fencing?	☐ Yes ☐ No ☐N/A
• Are all adjacent offsite wetlands protected from impact?	☐ Yes ☐ No ☐N/A
• Are illicit discharges into wetlands or bodies of water being prevented?	☐ Yes ☐ No ☐N/A
• Are wetland buffers protected?	☐ Yes ☐ No ☐N/A

Inspector’s Signature _____ **Date of Inspection** _____

Soil Disposal - Special Waste
Former South Plant MGP Site
Waukegan, Illinois

TOTAL DISPOSAL (Tons)

		TOTAL (Project)	***0.00***	
Ticket No.	Date	Material Type	Tons	Comments

Imported Materials
Former South Plant MGP Site
Waukegan, Illinois

IMPORTED MATERIAL							
			CA-1 Stone	CA-6 Stone	Topsoil	General Fill	Description
		TOTAL QUANTITY (Project)	***0.00***	***0.00***	***0.00***	***0.00***	
		TOTAL LOADS (Project)	***0***	***0***	***0***	***0***	
Date	Contractor	Ticket No.	Tons	Tons	Tons	Tons	

NOTES:

Construction Deficiency Report Log

Former South Plant MGP
Waukegan, IL
North Shore Gas

Deficiency	Summary	Follow-Up Action

Submittal Registry

Former South Plant MGP
Waukegan, IL
North Shore Gas

Submittal	Submittal Date	Comments from Engineer	Date Approved

Real-Time Air Monitoring Field Form

Project: Former South Plant MGP

Client North Shore Gas

Project Number: 67860

Date:

Personnel:

Calibration Data

Equipment	*Time*	*Result*
UltraRAE 3000		

Location	Time	Wind Direction	Orientation	VOCs (ppm)	PM_{10} (mg/m^3)	Visual Dust	Comments

Orientation:
UW - upwind
DW - downwind
CW - crosswind

Acronyms:
ppm - parts per million
PM_{10} - particulate matter less than 10 microns in diameter
mg/m^3 - milligrams per cubic meter
NA - Not analyzed

Sampler Signature: _____

Sampler Signature: _____

Summa Field Data Log

Date:
Week:
Project: Former South Plant MGP
Client: North Shore Gas
Project Number: 67860

Summa Sample Summaries

Station ID	AMS-1	AMS-2	AMS-3	AMS-4	AMS-5
Sample ID					
Wind Direction					
Orientation					
Can #					
Flow Valve #					
Start Date					
Start Time					
Start Temp (F)					
Start Barometric Pressure (in Hg)					
Digital Check Start (in Hg)					
Reading Start (in Hg)					
Reading #1 (in Hg)					
Reading #2 (in Hg)					
Reading End (in Hg)					
Digital Check End					
End Time					
Stop Date					
End Temp (F)					
End Barometric Pressure (in Hg)					

Field Comments

Electronic Construction Sample Control Log - South Plant

Unique Sample ID	Sample Date Start	Sample Date End	Sample Time Start	Sample Time End	Sample Media	Sample Type (Grab or Composite)	Sample Location[1]	GPS File Name	Coordinate System	Northing (WCCS) or Latitude (WGS)	Easting (WCCS) or Longitude (WGS)	Sample Top Depth (ft.)	Sample Bottom Depth (ft.)	QC Sample Information (duplicates, blanks, etc...)	Surface Elevation	Pace	Lab Work Order Number	Analytes Requested					Test America (Job #)	Lab Work Order Number	Analytes Requested			T.E.S.T	Analytes Requested		Archived or Sampled?	Notes

Lab Schedule Evaluation

Standard Turn	48hr Turn	24hr Turn	Lab Receipt Date	Due Date	Date Received	Days Late

Meeting Agenda/Minutes

Meeting #1

Weekly Progress Meeting
Remedial Action
Former South Plant Manufactured Gas Plant Site

Date	Start Time	End Time	Next Meeting Date	Next Meeting Time	Prepared By:

GoToMeeting Information			
Call in Number	Access Code	Audio PIN	Meeting ID

Attended By:	Copies To:

Item No.[1]	Item	Action necessary?
1-1		
1-2		
1-3		
1-4		
1-5		
1-6		

	Work Planned for Upcoming Weeks:	
	Meeting Action Items List: **OBG:** **WBS:**	

Notes:

Appendix B

Sampling Procedures

Prepared By:	SGW	Date Prepared:	08-22-2013
Corporate Officer:	REW	Date Approved:	05-22-2014

SUMMA CANISTER AIR SAMPLING PROCEDURES

1.1. Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe a procedure for sampling of volatile organic compounds (VOCs) and naphthalene in ambient air. The samples are collected as whole air samples in passivated stainless steel canisters, commonly known as SUMMA canisters. The analytes are subsequently separated by gas chromatography (GC) and measured by mass-selective detector or multi-detector techniques. This SOP describes procedures for sampling with canisters at final pressures both above atmospheric pressure (referred to as pressurized sampling) and below atmospheric pressure (referred to as sub-atmospheric pressure sampling).

This method is applicable to specific organic compounds that have been tested and determined to be stable when stored in pressurized and sub-atmospheric pressure canisters. These compounds have been measured at the parts-per-billion-by-volume (ppbv) level. Refer to project-specific documents for variances to this SOP.

1.2 Health and Safety Warnings

Follow Natural Resource Technology, Inc. (NRT) Health and Safety SOPs when working with potentially hazardous material or with material of unknown origin. Project Health and Safety Plans will contain additional practices, if necessary, to mitigate site-specific hazards.

2.0 Method Summary

Both pressurized and sub-atmospheric pressure sampling modes use a pre-evacuated canister. Both modes may also use a mass flow controller/sample pump arrangement, fixed orifice, capillary or adjustable micrometering valve to regulate flow. With this configuration, a sample of ambient air is drawn through a sampling train comprised of components that regulate the rate and duration of sampling into a pre-evacuated passivated canister.

3.0 Sample Preservation, Containers, Handling, and Storage

After the air sample is collected, the canister's valve is closed, an identification tag is attached to the canister, and the canister is transported to a laboratory for analysis. Upon receipt at the laboratory, the canister tag data are recorded. Sample holding and expiration times should be determined prior to initiating field activities.

4.0 Interferences and Potential Problems

Contamination may occur in the sampling system if canisters are not properly cleaned before use. Additionally, all other sampling equipment (e.g., pump, tubing, and flow controllers) must be cleaned and/or purged between uses.

5.0 Equipment/Apparatus

The following equipment and apparatuses are used to collect ambient air samples using SUMMA canisters.

5.1 Sub-atmospheric Pressure Sampling Equipment

- VOC canister sampler - whole air sampler capable of filling a pre-evacuated canister by action of the flow controller from near 30 inches of mercury (Hg) vacuum to near atmospheric pressure.
- Sampling inlet line – a stainless steel tubing to connect the sampler to the sample inlet.
- Sample canister (1 or 6 liter volume) – a leak-free stainless steel pressure vessel of desired volume with valve and passivated interior surfaces.
- Particulate matter filter - 2-micron (µm) sintered stainless steel in-line filter.
- Chromatographic-grade stainless steel tubing and fittings are used for interconnections -all materials in contact with sample, analyte, and support gases should be chromatographic-grade stainless steel.
- Fixed orifice, capillary or adjustable micrometering valve – used in lieu of the electronic flow controller/sample pump for grab samples or short duration time-integrated samples.

5.2 Pressurized Sampling Equipment

- VOC canister sampler – whole air sampler capable of filling a pre-evacuated canister by action of the flow controller and pump from near 30 inches of Hg vacuum to 15 to 20 pounds per square inch (psi) atmospheric pressure

- Mass flow meter/controller – leak-free, linearly-proportioned mass flow meter/controller unit at desired flow rate (e.g., 100 mililiters per minute [mL/min])

- Sampling inlet line – stainless steel tubing to connect the sampler to the sample inlet

- Sample canister – leak-free stainless steel pressure vessels of desired volume with valve and passivated interior surfaces

- Particulate matter filter – 2-µm sintered stainless steel in-line filter

- Chromatographic-grade stainless steel tubing and fittings for interconnections – all materials in contact with sample, analyte, and support gases should be chromatographic-grade stainless steel

6.0 Procedures

The following procedures are used for collection of VOCs using SUMMA canisters.

6.1 Sub-atmospheric Pressure Sampling

1. Attach flow controller to the canister.

2. Prior to sample collection, record the 1) canister serial number, 2) flow controller serial number, 3) ambient temperature, 4) ambient pressure, 5) initial vacuum of canister and 6) sample start time on the Air Sampling Data Sheet (Attachment 1).

2. Open a canister, which is pre-evacuated to 28 to 30 inches of Hg at sea level and fitted with a flow-restricting device, to the ambient air to be sampled. The pressure differential causes the sample to flow into the canister. At higher elevations, the vacuum may be less.

3. Immediately after opening the canister, record the initial vacuum reading from the flow controller on the Air Sampling Data Sheet. If the initial pressure is outside of acceptable project-specific limits (e.g., 25 to 30 inches of Hg), replace the canister, and restart the sampling process.

3. This technique may be used to collect grab samples (e.g., duration of 10 to 30 seconds) or time-integrated samples (e.g., duration of 8 to 24 hours). Sampling duration depends on the degree to which the flow is restricted by the flow controller.

4. After sampling is complete, record the 1) ambient temperature, 2) ambient pressure, 3) final canister pressure, and 4) sample stop time on the Air Sampling Data Sheet.

6.2 Pressurized Sampling

1. Prior to sample collection, complete the appropriate information on the Air Sampling Data Sheet (Attachment 1). This data includes: date, time of the start of sample collection, location of sample, regulator identification, canister number, beginning vacuum of canister, temperature, wind direction and speed, relative humidity, and barometric pressure.

2. Use a digital time-programmer to preselect sample duration, and start and stop times.

3. Open a canister, which is pre-evacuated to 28 to 30 inches of Hg at sea level and connected in line with the sampler, to the ambient air to be sampled.

4. Using a direct-drive blower motor assembly, draw a whole air sample into the system through a stainless steel inlet tube. (Some units do not have a blower).

5. Using a specially modified inert sample pump in conjunction with a flow controller, pull a small portion of this whole air sample from the inlet tube. The initially evacuated canister is filled by action of the flow controlled pump to a positive pressure not to exceed 25 pounds per square inch gage (psig).

6. Upon sampling completion at the location, complete the requisite information on the Air Sampling Data Sheet. This data includes ending time of sample, total minutes of sample collection, ending vacuum of canister, sampler name, and any comments pertaining to unusual conditions which occurred during sample collection.

7.0 Quality Assurance/Quality Control

The following general quality assurance procedures apply:

- All data must be documented on standard chain of custody forms, field data sheets, and/or within site logbooks.

- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

- Collect 1 duplicate sample for every 20 parent samples collected.

8.0 References

Ralph M. Riggin, Technical Assistance Document for Sampling and Analysis of Toxic Organic Compounds in Ambient Air, EPA-600/4-83-027 U. S. Environmental Protection Agency, Research Triangle Park, NC, 1983.

OBG

THERE'S A WAY

Appendix H

Operations and Maintenance Plan

Operations and Maintenance Plan

North Shore Gas Company's
Former South Plant Manufactured Gas Plant
Waukegan, Illinois

WEC Business Services, LLC

March 8, 2019

OBG
Part of Ramboll

TABLE OF CONTENTS

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LIST OF FIGURES

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

Akzo	Akzo Nobel Aerospace Coatings, Inc
bgs	Below Ground Surface
COW	City of Waukegan
DNAPL	Dense Non-Aqueous Phase Liquid
DTW	Depth to Water
EJ&E	Elgin, Joliet, and Eastern
GAC	Granular Activated Carbon
MGP	Manufactured Gas Plant
NSG	North Shore Gas
OBG	O'Brien & Gere Engineers, Inc., part of Ramboll
O&M	Operations and Maintenance
OWS	Oil-Water Separator
PAH	Polyaromatic Hydrocarbon
PVOC	Petroleum Volatile Organic Compound
ROD	Record of Decision
ROW	Right of Way
TPH	Total Petroleum Hydrocarbons
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
WPD	Waukegan Port District

1 INTRODUCTION

O'Brien & Gere Engineers, Inc., part of Ramboll (OBG) prepared this Operations and Maintenance Plan (O&M Plan) on behalf of North Shore Gas (NSG). The objective of the O&M Plan is to provide a framework for monitoring, operations, and maintenance to track the long-term effectiveness of the remedy selected by the U.S. Environmental Protection Agency (USEPA) in the July 2015 Record of Decision for Interim Action (ROD) for the Former South Plant Manufactured Gas Plant (MGP), located in Waukegan, Lake County, Illinois.

1.1 SITE DESCRIPTION

The former South Plant MGP is generally located at 2 North Pershing Road and 1 South Pershing Road in an industrial/commercial area of the City of Waukegan, Illinois (Figure 1). The former MGP was constructed in 1897 and operated until 1946, prior to being demolished in 1951. NSG retained ownership of much of the property on which former MGP operations were conducted. The remaining portion of the former MGP is located beneath North and South Pershing Road on property which was transacted to the City of Waukegan in 1970.

The Site includes the former MGP (NSG Property) and adjacent properties where MGP affected media have been identified through site investigation activities, including Waukegan Port District (WPD), Akzo Nobel Aerospace Coatings, Inc (Akzo), Elgin, Joliet, and Eastern (EJ&E), and City of Waukegan (COW). Waukegan Harbor and Lake Michigan are located approximately 600 feet east of the NSG Property. The Site and its surroundings are shown on Figure 2.

Owner/Operator: North Shore Gas Company
Contact: Mr. Naren Prasad, P.E. (NSG Project Manager)
200 E. Randolph St., 21st Floor
Chicago, IL 60601
312.240.4569

Site Location: T45N, R12E, Section 22
2 North Pershing Road and 1 South Pershing Road
City of Waukegan, Lake County, Illinois

USEPA ID
Illinois EPA # ILD984809228, 0971900058

1.2 REMEDIAL ACTION COMPONENTS

The USEPA-selected remedy consists of enhanced recovery of dense non-aqueous phase liquid (DNAPL) using a network of groundwater injection and co-located DNAPL and groundwater recovery wells. Groundwater and DNAPL extracted from the system will be pumped through dedicated conveyance piping to a groundwater treatment plant where DNAPL will be separated from groundwater. The separated DNAPL will be containerized and shipped off-site for treatment and disposal. Extracted groundwater will be treated on site and reinjected into the aquifer, resulting in localized increases in hydraulic gradient and theoretically increasing the migration rate of mobile DNAPL towards the recovery wells.

Monitoring and maintenance will be performed on all aspects of the system, encompassing the extraction wells, pumps, and vaults; conveyance infrastructure; injection wells; and the treatment system. Specific requirements related to each element of the system are discussed in Section 2.

2 GROUNDWATER TREATMENT SYSTEM OPERATIONS AND MAINTENANCE

This section establishes O&M requirements for each element in the recovery and treatment systems. Per the September 12, 2018 meeting between USEPA, NSG, and their consultations, and the September 17, 2018 follow-up email, this Pre-Final Design and associated reports focus on the design aspects of a pilot-scale Phase 1 system. This system includes a scaled version of the full well network that will be installed west of the EJ&E railroad on the NSG Property. As such, this O&M Plan focuses on O&M requirements for the Phase 1 well network and treatment system. Once the system has been constructed, a comprehensive Phase 1 O&M Manual will be written to encompass changes and additional field-based O&M requirements. As part of full-scale design, necessary changes may be made to this O&M Plan and the O&M Manual based on observations of system operation during the Phase 1 O&M period.

The sections below lay out the individual O&M requirements and schedule for each element of the system. Table 1 provides a summary of the information in this section.

2.1 FLUID EXTRACTION

2.1.1 DNAPL Recovery

DNAPL recovery will consist of extraction through vertical wells installed into the DNAPL plume. For the Phase 1 system two pumps will be used to determine which will provide the most efficient extraction. Three extraction wells will be fitted with a non-submersible air-operated double diaphragm pump. This pump will be installed within the recovery vault, attached to a drop pipe inserted into the well and intersecting with the DNAPL plume. The suction lift of the pump will be used to extract DNAPL from the well and pump it into the conveyance system and towards the treatment plant. The remaining three wells will be equipped with submersible pneumatic displacement pumps, which will be inserted directly into the well. The goal of this portion of the system is to recover DNAPL at the optimal rate, as determined by DNAPL flow into the well. The O&M requirements for the DNAPL recovery system to achieve this are discussed below.

2.1.1.1 Operations

To pump at the optimal rate, matching the DNAPL flow through the soil matrix into the well, three main aspects of the system need to be monitored: flow rate, DNAPL thickness, and pump prime (air-operated double diaphragm).

Flow Rate

The recovery rate from each well will be monitored and the flow rate adjusted, as needed, to match as closely as possible to flow of DNAPL into the well. The timers attached to each pump, along with the regulators and cycle counters attached to each air line, will be checked weekly to confirm all the equipment is operating as intended. During the weekly inspections, the pressure of each regulator and the number of cycles on the cycle counter will be documented (Appendix A). The inspection will also involve visually and audibly confirming that the cycle counter is accurate. Following the cycle counter verification step, the length of time between cycles will be counted to manually determine an approximate flow rate. Based on the calculated flow rate and thickness of DNAPL in the well, the flow rate will be adjusted via the cycle timers and regulators, as needed. If observations in the groundwater treatment plant regarding the cumulative flow rate are inconsistent with the sum of the follow rate from each well, a correction factor will be developed to convert the volume estimate from cycle counters to more closely align with the volume measured through intermittent bypass valve pumping and the total volume measured in the treatment plant.

DNAPL Thickness

The DNAPL thickness in each well will be measured frequently to allow for adjustment of the pumping rate. A part of Phase 1 operations, two pressure transducers will be inserted into the well—one in the DNAPL layer and the second in the water column—which will collect real-time pressure readings in each layer. At the beginning of Phase 1, the pressure transducer data will be downloaded daily and DNAPL thicknesses calculated based on the equation described in Section 2.2.2.1 of the Remedial Design Report. The thickness at each well will be validated with a string and sinker test. Once the system has been running consistently and it has been

determined how quickly DNAPL levels change, the data download and manual validation of DNAPL levels will be reduced to one time per week. The data download and manual validation of DNAPL levels will be conducted during the weekly vault inspections (Section 2.2). There is potential that DNAPL thickness estimates developed based on transducers readings may prove inadequate for long-term measurement of DNAPL thickness. Should this inadequacy be observed during Phase 1 operations, NSG, in collaboration with USEPA, may discontinue transducer measurements in favor of traditional string and sinker testing.

Pump Prime and Documentation of Fluids Extracted

In addition to monitoring the flow rate and thickness of DNAPL within the recovery well, it will also be necessary to confirm that the air-operated double diaphragm pump maintains prime between infrequent cycles. It is also useful to visually confirm the percentage of water and DNAPL associated with each pump cycle. It is anticipated that pump prime will be evaluated through a bypass valve to temporarily discharge DNAPL pump into a sample container. If the pump is losing prime, it is unlikely that fluid will be discharged during a pump cycle. If loss of prime is a persistent issue, a foot valve may be installed on the DNAPL suction line. The bypass valve will also allow for inspection of the fluid being discharged by the pump. If discharged fluid contains significant water content, the cycle timer on the affected well will be adjusted to lengthen the time between pump cycles and allow for more DNAPL to enter the well before the next pump cycle.

2.1.1.2 Maintenance

Pump maintenance will be conducted in accordance with the manufacturer's recommendations, and as necessary, as determined by pump performance in the field. In addition to the routine maintenance, pumps and down-well suction lines will need to be removed from service for cleaning or unique maintenance requirements. To keep the system running efficiently while pump maintenance or cleaning occurs, backup pumps and down-well suction lines will be kept on Site. O&M activities may need to be conducted at a higher frequency to maintain system operations shortly after startup until typical operating conditions are established.

During Phase 1, barring any unique maintenance situations, the pumps will be left in place for approximately three months before servicing. At that time, each pump will be switched out with a backup for cleaning and routine maintenance. The pump condition will be inspected, noting if significant sand or DNAPL are found in the system, if there is a noticeable difference in the conditions of pumps from wells with different screen slot sizes, and other details that may help inform the final full-scale system pump selection. After cleaning and observation, the two pumps will be switched out with the next set due for maintenance and the third set will follow. This maintenance schedule will be adjusted once the full-scale system is installed, based on the observations made during Phase 1 and to account for the significant increase in pumps that will need to be serviced.

2.1.2 Groundwater Extraction

A separate dedicated groundwater extraction pump will be co-located with the DNAPL recovery pump in the vertical wells. The same non-submersible, air-operated double diaphragm pump that will be used in three of the DNAPL recovery wells was selected for groundwater extraction. This will allow for some efficiencies and cost savings in maintenance and repair. The pump will be installed in the recovery vault and attached to a drop pipe which will be placed approximately six feet below the water table. The goal of this portion of the system is to continuously extract groundwater, creating a gradient towards the DNAPL sump, without desaturating the DNAPL-bearing material. The O&M requirements for the groundwater extraction system to achieve this are discussed below.

2.1.2.1 Operations

The main operational task for groundwater extraction will be to monitor water table drawdown and adjust the flow rate accordingly. To maintain system efficiency, it will be essential for each well to avoid drawdown of groundwater beyond the target depth to water (DTW). This drawdown limit will be set individually for each well. During Phase 1, the drawdown limit will be monitored both with a pressure transducer set in the water table collecting real-time data and through manual water level measurements. At the beginning of system operation, transducer data will be downloaded and manual water levels will be collected daily. Once consistent water levels and flow rates are reach in each well, the transducer data download and manual water level

measurements will be reduced to weekly, corresponding with the weekly vault inspections. Loss of prime on groundwater extraction pumps is not a significant concern due less required net positive suction head and more frequent pump cycling.

2.1.2.2 Maintenance

Pump maintenance will be conducted in accordance with the manufacturer's recommendations, and as necessary, as determined by pump performance in the field. In addition to the routine maintenance, pumps and down-well suction lines will need to be removed from service for cleaning or unique maintenance requirements. It is anticipated that these pumps will require less regular maintenance and cleaning than the DNAPL recovery pumps; however, actual maintenance requirements will depend on how much emulsified DNAPL is pumped with the groundwater. To keep the system running efficiently while pump maintenance or cleaning occurs, backup pumps and down-well suction lines will be kept on Site.

During Phase 1, barring any unique maintenance situations, the pumps will be left in place for approximately three months before servicing. At that time two pumps will be switched out with backup pumps for cleaning and routine maintenance. The pump condition will be inspected, noting if significant sand or DNAPL are found in the system, if there is a noticeable difference in the conditions of pumps from wells with different screen slot sizes, and other details that may help refine the final full-scale well network system design. After cleaning and observation, the two pumps will be switched out with the next set due for maintenance and the third set will follow. This maintenance schedule will be adjusted once the full-scale system is installed, based on the observations made during Phase 1 and to account for the significant increase in pumps that will need to be serviced.

2.2 RECOVERY VAULTS AND CONVEYANCE SYSTEM

2.2.1 Recovery Vaults

The recovery vaults for each extraction well will consist of a 5-foot by 5-foot square vault with a depth of no more than 3.9 feet. The recovery vault will house both the DNAPL and groundwater recovery pumps; connections to the DNAPL and groundwater conveyance lines; and conduits for air lines and electrical wiring. The vaults are designed to be as water-tight as practical. O&M requirements for the vaults will focus on maintaining vault integrity to minimize water inflow and are discussed below.

2.2.1.1 Operations

A weekly inspection of each vault will be conducted and documented throughout the duration of Phase 1. The weekly inspections will focus on the condition of each vault including proper fitting of the lid; indications of impact from vehicles, plows, or other equipment; and the overall condition of the vault.

Before opening the vault, a portable gas detector will be inserted inside for a headspace measurement before staff can enter, to confirm that the vault is a safe working environment. Following the confirmation of a safe environment, the inside of the vault will be visually inspected for leaks and the vault cover gasket inspected for integrity.

Observations will be documented on the O&M field form (Appendix A) and added to the O&M field binder. The field binder will be scanned monthly and saved on the OBG server for future access. Maintenance will be conducted on an as-needed basis to address unsatisfactory observations.

2.2.1.2 Maintenance

The recovery vaults will require minimal maintenance throughout the life of the system. Maintenance will mostly likely focus on updates or repairs needed to keep the vaults as watertight as practical. This may include repairing or replacing the gaskets attached to the vault lids or repairing leaks within the vault itself, as needed. Decisions regarding maintenance will be based on the weekly visual inspections.

2.2.2 Air Lines and Conveyance System

To connect the recovery vaults to the groundwater treatment plant, the conveyance system will consist of a trench in which the groundwater, DNAPL, electrical, and air lines will be situated at different depths. The water lines will be buried deep enough to be installed without heat tracing or conduit. The DNAPL, air, and electrical lines will be installed within the conduit to facilitate maintenance or repairs. The DNAPL conveyance line will wrapped in heat trace material to keep the DNAPL at a flowing viscosity year-round. O&M for the conveyance system will focus on maintaining the necessary pressure, temperature, and cleanliness of the different fluid lines. The O&M requirements for the conveyance system are discussed below.

2.2.2.1 Operations

The air lines will be monitored to ensure pressure within the fluid lines remains below the maximum pressure and within the operational pressure parameters. Pressure gauges will be installed throughout the air lines network. Alerts that pressure has vacillated outside the desired range will be addressed by adjusting flow rates or shutting down that line for cleaning and maintenance, as discussed in Section 2.2.2.2. As the system is monitored, significant changes in DNAPL delivery from the recovery vaults will be noted; a substantial drop in production or increase in pressure may indicate maintenance is needed.

Inspection of the conduits and valves will be conducted and documented weekly to check for leaking fluids (Appendix A). All valves will be opened and closed to ensure full range of motion.

2.2.2.2 Maintenance

No routine maintenance is anticipated for the conveyance infrastructure. Due to DNAPL buildup, the DNAPL recovery line piping may require periodic cleaning or replacement to reclaim the full pipe cross-sectional area. Cleaning will be conducted on an as-needed basis, usually initiated by an alert of increasing pressure in the line or a substantial drop in production rate. The heat trace wrapping around the DNAPL lines may need repair or replacement, as necessary. Other incidental replacements of infrastructure, including pipes and valves, will be carried out, as necessary.

2.3 GROUNDWATER TREATMENT SYSTEM

The purpose of the groundwater treatment system will be to separate out any DNAPL that is extracted with the influent groundwater and to treat the groundwater for reinjection back into the aquifer. A process flow diagram identifying the Phase 1 groundwater water treatment system is included on Sheet M-601 of the Construction Drawings. Preliminarily, the system will include the following steps:

- Oil-Water Separator (OWS)
- Particle Removal—including pre- and post-particle removal pH adjustment
- Organoclay
- Particle Filtration
- Granular Activated Carbon (GAC) Vessels
- Effluent Holding Tank
- Supporting infrastructure, including pumps, and an air compressor

Sizing and equipment type will be contingent on what is available from equipment providers. Detailed piping, instrumentation, and equipment layout will be developed and evaluated as part of a vendor shop drawing review. The sections below cover O&M requirements for each of the elements in the Phase 1 treatment system. Table 1 provides an O&M summary and schedule for the treatment system and Table 2 summarizes sampling and analysis requirements, as well as frequency, of breakthrough sampling for each section of the system. Testing protocol outlined in Table 2 may be supplemented with field test kits and handheld instruments to provide real-time feedback during system startup.

A significant concern regarding treatment system operations is the potential for fouling. When fouling is suspected in a water treatment process (based on sludge/scale accumulation or pressure increases), field test kits will be utilized or laboratory testing will be completed to determine the type of fouling that is occurring (iron, sulfate, calcium, etc.). If fouling becomes an operational issue, modifications to system operations will be considered, targeting the source of fouling.

2.3.1 Sampling

Sampling ports will be placed to allow for collection of influent and effluent samples from each individual process unit. Sample ports are often locations where stagnant water and solids accumulate. Accordingly, when collecting the inter-process samples described in the following sections, the initial flow of water should be diverted onto a spare container for approximately 5 seconds, until the water discharged is has stabilized in color and solids content. Once stabilized, the sample jars should be filled, stored, and shipped consistent with the following SOPS:

- SAS-08-06 - Potable Water Well Sampling
- SAS-03-01 - Sample Identification, Labeling, Documentation, and Packing for Transport
- SAS-03-02 - Chain of Custody
- SAS-03-03 - Sample Location Identification and Control

2.3.2 Oil-Water Separator

The main role of the OWS will be to separate the DNAPL from the groundwater and send the DNAPL to a storage container for off-site disposal.

2.3.2.1 Operations

The influent coming into the OWS will be sampled for water quality parameters, as indicated on Table 2. The sampling frequency will be one sample every other day for the first week of system startup (with expedited turnaround time), and once per week during the following three weeks operation, with frequency decreasing over time to biweekly for the remainder of Phase 1.

The water effluent from the OWS will be sampled for total petroleum hydrocarbons (TPH) and oil and grease with a sampling frequency during first four weeks of operation as indicated in Table 2. After that scheduled OWS effluent sampling will cease and sampling will be conducted if effluent data or treatment system operations indicate that a closer analysis of water within the treatment process is necessary.

2.3.2.2 Maintenance

The OWS and DNAPL storage tanks must be monitored regularly for DNAPL and sludge accumulation. As necessary, a vendor will be scheduled to extract accumulated DNAPL from the storage tank for off-site disposal/reuse. The OWS tank will be inspected weekly. If the inspections or breakthrough sampling indicates an issue with collection of neutral buoyancy NAPL particles or sludge build-up, a thorough cleaning the of the tank will be conducted.

2.3.3 Particle Removal

Particle removal will be conducted in a clarifier aided by the increasing the pH, emulsion polymer, and flocculant. Solids will be removed on the incline plate clarifier and batch discharged into a containerized geotube where remaining water will be removed before the solids are disposed. Water separated from the solids will be returned to the groundwater treatment plant influent. Following the clarifier, the pH will be lowered, as necessary to slightly below 7 Standard Units.

2.3.3.1 Operations

The clarifier influent will have been sampled upon its exit from the OWS, as indicated on Table 2. Following settling and pH readjustment, clarifier effluent will be sampled for the full water quality parameters listed, as indicated on Table 2. The effluent will be sampled during system startup (the first four weeks of operation).

After that scheduled particle removal effluent sampling will cease and sampling will only be conducted if effluent data or treatment system operations indicate that a closer analysis of water within the treatment process is necessary. The pH readjustment tanks, clarifier, and solids storage container will be inspected weekly for solids build-up and other maintenance issues.

2.3.3.2 Maintenance

When the build-up of solids in the pH readjustment tanks and/or clarifier is observed during the weekly inspections, the tanks will be cleaned and the excess material will be disposed of in the solids container. When the geotube containing settled solids has reached capacity as indicated by differential pressure between the influent and effluent pressure gauges approaching manufactures recommendations, the geotube will be properly disposed of at an approved landfill. Automatic shutdown will occur if or when differential pressures reach approximately 50 psi. The backup roll-off box will be fitted with the geotube and the system will resume normal operations.

2.3.4 Organoclay

The organoclay unit will target removal of polycyclic aromatic hydrocarbons (PAHs), along with remaining emulsified oils.

2.3.4.1 Operations

Sampling will be conducted to determine when the organoclay is no longer effective. The effluent leaving the organoclay unit will be sampled for water quality parameters, as indicated on Table 2. Pressure through the organoclay units will be monitored for spikes, indicating that maintenance is needed.

2.3.4.2 Maintenance

Maintenance for the organoclay will include backwashing or media replacement. When pressure through the unit spikes, backwashing will be completed to remove fines and expand the media bed. The impacted unit will be taken out of service and backwashed before being returned to service. When effluent sampling indicates that the organoclay is no long effective, the organoclay media will be replaced. Automatic shutdown will occur if or when differential pressures approach manufacture's limits, anticipated to be approximately 60 psi in the media filters.

2.3.5 Particle Filtration

Particle filtration will follow the organoclay in the treatment process flow with the primary purpose of assessing breakthrough of DNAPL through the organoclay. The secondary purpose of this unit is to capture remaining DNAPL or suspended solids from the influent.

2.3.5.1 Operations

Pressure through the bag filters will be monitored continuously. An increase in pressure will indicate build-up in the bags and an established pressure trigger point will indicate that maintenance is required.

2.3.5.2 Maintenance

The bag filters will be maintained on an as-needed basis, with spiking pressure readings as the main impetus. Maintenance will include removing the impacted filter from service and replacing the bag before putting it back into service. Carbon steel components will be qualitatively monitored during the pilot system operation and increased maintenance or replacement of carbon steel parts in contact with DNAPL will be noted in O&M logs and considered during the full-scale system design.

2.3.6 Granular Activated Carbon (GAC)

As the last step in the treatment process, the GAC units will act as the predominant mechanism for removing PAHs and VOCs.

2.3.6.1 Operations

Effluent from this element will be sampled and analyzed for key constituents used to monitor groundwater treatment plant performance, as well as parameters necessary to demonstrate compliance with the injection

permit. Sampling will be conducted between each of the units and then at the end of the treatment train. Sample parameters for each location are summarized on Table 2. Sampling of the GAC effluent will also be used to determine when the GAC is no longer effective. Pressure through the GAC units will be monitored for spikes, indicating that maintenance is needed.

2.3.6.2 Maintenance

Maintenance for the GAC will include backwashing or media replacement. When pressure through the unit spikes, backwashing will be completed to remove fines and expand the media bed. The impacted unit will be taken out of service and backwashed before being returned to service. When effluent sampling indicates that the GAC is no long effective, the GAC media will be replaced. Automatic shutdown will occur if or when differential pressures approach manufacture's limits, anticipated to be approximately 60 psi in the media filters.

2.3.7 Equalization Tank

The equalization tank will be used to hold and release treated groundwater, as needed, to balance flow through the system and back into the aquifer. This tank will also provide a place to conduct minor pH adjustments, if necessary, to the treated groundwater.

2.3.7.1 Operations

The equalization tank will be equipped with sensors monitoring the water level in the tank. These sensors will actuate pump cycles as the low or high water set points are reached. The tank will also be equipped with an overflow prevention control switch which, in the event the tank becomes full, will shut down the entire pumping system to prevent tank overflow.

2.3.7.2 Maintenance

The equalization tank will not require regular maintenance. Accumulation of fines in the bottom of the tank will be assessed as part of the routine system monitoring either visually or using a measuring stick. Once buildup of fines has reached a level of significance, the tank will be cleaned. This maintenance is anticipated to be needed every six months.

2.3.8 Treatment System Pumps

Routine maintenance for treatment plant pumps will be conducted in accordance with manufacturer's recommendations. Pumps will be monitored regularly for excessive heat, accumulation of air and solids, or unusual noises. Additional maintenance will be completed, as needed, to manage any unique issues or cleaning needs.

2.3.9 Air Compressor

An air compressor will be installed on the groundwater treatment plant pad and used to operate the DNAPL recovery and groundwater extraction pumps in the well network, as well as select pumps used for DNAPL and sludge transfer within the groundwater treatment plant. The compressor will receive routine maintenance in accordance with manufacturer's recommendations. The compressor will be monitored regularly for unique issues or signs that maintenance is needed to be conducted sooner.

2.3.10 System Monitoring Controls

The groundwater treatment plant will contain a significant number of process monitoring controls which will track the various operations of the treatment system. No regular maintenance will be anticipated for these controls. The accuracy of each control will be monitored and checked on a regular basis, and components of the system will be replaced, as necessary.

2.4 WATER INJECTION

Following treatment, the groundwater will be reinjected through a network of horizontal and vertical wells.

2.4.1 Operations

During operation of the system, two main aspects will require monitoring to ensure the optimal injection efficiency - valves (pressure at the valve and valve position) and water levels.

Pressure and Valve Position

Daily monitoring of pressure and position of valves throughout the system is needed to ensure the effluent is sufficiently balanced throughout the injection well network. Adjustments will be made, as needed, to balance injection. For Phase 1, injection will occur using a horizontal injection well, and intermittently, a vertical injection well. To ensure pressure is balanced throughout the entire length of the horizontal well back pressure from the groundwater treatment plant will need to be monitored.

Water Levels

Water levels within the injection wells and adjacent piezometers will be monitored to ensure that the water table elevation remains 2-3 feet below ground surface (bgs) to prevent daylighting. For Phase 1 these water levels will be measured manually, daily when reinjection first begins and decreasing to once a week once a balanced is reached between injection rates and water levels in the injection wells. For full-scale implementation, it is anticipated that these water level measurements will be automated with transducers and alarmed so that the operator can adjust flow rates, as needed. For Phase 1 the operator will adjust flow rates, as needed, based on the manual measurements, to ensure that the volume discharged from the treatment system is equal to or lesser than the injection well capacity.

2.4.2 Maintenance

Regularly scheduled well maintenance is not anticipated; however, differences in aquifer chemistry between the current groundwater and injection water may make the injection wells susceptible to fouling. Wells will be inspected regularly and fouled wells will be taken out of service and either cleaned or rehabilitated. As necessary, an injection well may be replaced. Flow meters will be maintained, including recalibration, cleaning, or part replacement, as needed, based on regular inspection.

Near the conclusion of the Phase 1 system operations, the injection well will be inspected with a camera to provide insights into well condition the magnitude of fouling. Based on observations, a schedule for additional camera work will be develop for inclusion in the full-scale design and submittal to USEPA in support of an adaptive management approach.

3 GROUNDWATER MONITORING PLAN

Groundwater monitoring will be conducted regularly during operation of the DNAPL recovery and treatment system. The goal of groundwater monitoring will be to document changes in the DNAPL plume and ensure that DNAPL and dissolved-phase compounds remain within the treatment area. Monitoring of the DNAPL plume will be conducted to document changes in plume size and determine if injecting treated groundwater back into the system creates a change in the dissolved-phase components seen in the groundwater.

Protection or containment monitoring will be used to confirm that DNAPL is not migrating further downgradient towards Lake Michigan or outside of the treatment area to unimpacted areas north or south of the plume. This groundwater monitoring approach will also confirm that dissolved-phase components in groundwater outside the treatment area are either remaining at steady state or decreasing.

Water levels taken at the groundwater containment monitoring wells will be combined with water levels from the injection and extraction wells to create potentiometric maps. These maps will illustrate whether groundwater mounding is occurring at the injection points and if a cone of depression is occurring at the extraction locations.

Groundwater monitoring will be carried out with greater frequency at the start of DNAPL recovery and will decrease as containment is assured. Prior to start-up of the system, a baseline monitoring event will be conducted. Once the Phase 1 system is running, groundwater monitoring will be conducted quarterly. As part of the full-scale design, the frequency of groundwater monitoring will be reevaluated. Two of the quarterly events associated with containment monitoring will occur concurrently with semi-annual full well network groundwater monitoring events.

Figure 3 shows the wells which will be used for containment monitoring during Phase 1. The Phase 1 network consists entirely of wells that are part of the current groundwater monitoring network; no new wells will be installed for containment monitoring at this time. Along with the schedule for sampling, the monitoring network for the full-scale system will be reviewed and finalized as part of the full-scale design. If a monitoring location consists of a well nest, the deepest of the group of wells will be sampled.

Groundwater samples will be analyzed for the following constituents:

- Petroleum Volatile Organic Compounds (PVOCs)
- PAHs
- Field parameters

The presence or absence of NAPL will also be observed at each well. If NAPL is present in any significant thickness it will be manually measured using the string and sinker method.

4 REPORTING

An Annual Report will be submitted 60 days following the end of the preceding year to summarize the tasks performed during the previous year and the results of the previous years' sampling, maintenance, and monitoring activities.

At a minimum, the body of the report will include:

- Total volume of water treated over the year
- Total volume of DNAPL pumped that year, where it was pumped from, and the overall total volume of DNAPL removed from the subsurface
- Potentiometric maps and sampling data from the containment monitoring conducted throughout the year
- Summary of O&M highlights
- Other monitoring activities

Additional sections may be added as the O&M of the system progresses and an O&M manual is developed.

5 REFERENCES

United States Environmental Protection Agency (USEPA), 2015. *South Plant Remedial Design Administrative Settlement Agreement and Order on Consent for Remedial Design*, V-W-15-C-027.

Tables

Table 1. Phase 1 Operations and Maintenance Schedule

Operations and Maintenance Plan
Former South Plant Manufactured Gas Plant Site
Waukegan, IL
North Shore Gas, CERCLIS ID - ILD984809228

System Element	O&M Task	Frequency[1]									
		Start-Up (4 weeks)[2]					Long-Term[3]				
		Daily	Weekly	Bi-Monthly	Quarterly	As Needed	Daily	Weekly	Bi-Monthly	Quarterly	As Needed
DNAPL Recovery	**Operations**										
	Document regulator pressure		X					X			
	Document number of cycles on cycle counter		X					X			
	Visually confirm cycle counter working properly		X					X			
	Count cycles and manually determine flow rate		X					X			
	Verify DNAPL pump prime and that mainly pumping DNAPL		X					X			
	Make necessary adjustments to cycle counter and regulator		X					X			
	Download pressure transducer data	X						X			
	Manually validate DNAPL thickness	X						X			
	Maintenance										
	Cleaning, routine maintenance, and condition observations				X					X	
Groundwater Recovery	**Operations**										
	Download pressure transducer data	X						X			
	Manually validate water level	X						X			
	Maintenance										
	Cleaning, routine maintenance, and condition observations				X					X	
Recovery Vaults	**Operations**										
	Document conditions of closed vault		X					X			
	Visually inspect and document conditions inside the vault		X					X			
	Inspect and document integrity of vault lid gasket		X					X			
	Maintenance										
	Repair or replace vault lid gaskets					X					X
	Repair interior vault leaks					X					X
Conveyance System	**Operations**										
	Check pressure gages throughout the system		X					X			
	Inspect conduits and valves for leaks			X					X		
	Open and close valves to ensure full range of motion			X					X		
	Maintenance										
	Clean DNAPL conveyance lines					X					X
	Repair or replace heat trace on DNAPL lines					X					X
	Replace piping, valves, and other conveyance infrastructure					X					X
Oil-Water Separator	**Operations**										
	Influent sampling[4]		X					X			
	Effluent sampling[4]		X								X
	Inspection of sludge in OWS tank		X					X			
	Maintenance										
	Clean OWS tank and coalesing filter					X					X
	Schedule vendor for DNAPL storage pickup					X					X
Particle Removal	**Operations**										
	Water sampling for effluent leaving the tank[4]		X								X
	Inspection of pH readjustment tanks, clarifier, and solids storage		X					X			
	Maintenance										
	Clean out pH readjustment tanks and clarifier					X					X
	Schedule vendor for roll-off and geotube pickup					X					X
Organoclay	**Operations**										
	Water sampling for effluent leaving the tank[4]		X						X		
	Monitor pressure through each unit for spikes	X					X				
	Maintenance										
	Backwash media beds					X					X
	Replace media					X					X
Particle Filtration	**Operations**										
	Monitor pressure through each unit for spikes	X					X				
	Maintenance										
	Replace bag					X					X
Granular Activated Carbon	**Operations**										
	Water sampling for effluent leaving the tank[4]		X						X		
	Monitor pressure through each unit for spikes	X					X				
	Maintenance										
	Backwash media beds					X					X
	Replace media					X					X
Equalization Tank	**Operations**										
	Monitor water level sensors in the tank	X					X				
	Inspect accumulation of fines in the equalization tank	X					X				
	Maintenance										
	Clean out the tank					X					X
Treatment System Pumps	**Operations**										
	Monitor for excessive head buildup, accumulation of air, solids, and unusual noises	X					X				
	Maintenance										
	Cleaning, routine maintenance, and condition observations					X					X
Air Compressor	**Operations**										
	Monitor for unique issues or signs maintenance is needed	X					X				
	Maintenance										
	Cleaning and routine maintenance					X					X
Injection Wells	**Operations**										
	Monitor pressure and position of valves throughout the system	X					X				
	Monitor water levels within injection and adjacent wells	X						X			
	Inspect injection wells and document screen condition		X						X		
	Maintenance										
	Clean, rehabilitate, or replace injection well					X					X
	Maintain flow meters					X					X

Notes:

1. Additional sampling may be performed with greater frequency that indicated here. Any additional sampling would be completed on an "as necessary" basis to optimize the treatment system, based upon effluent data or treatment system observations that indicate a closer analysis of water within the treatment train is necessary.
2. O&M activities may need to be conducted at a higher frequency to maintain system operations shortly after startup until typical operating conditions are established.
3. Long-term encompasses the rest of the operational life of the treatment system, estimated 2-5 months after startup period.
4. See Table 2 for details regarding sampling and analysis.

Table 2. Sampling and Analysis Plan

Operations and Maintenance Plan
Former South Plant Manufactured Gas Plant Site
Waukegan, IL
North Shore Gas, CERCLIS ID - ILD984809228

Sample Type/Location	Phase	Proposed Number of Sampling Locations/ Frequency	Matrix	Parameter	Method	Estimated Sample Quantity	Field Duplicates[1]	Equipment Blanks	MS/MSD	Trip Blanks	Total Number of Samples[2]	Estimated Number of Containers	Container Type	Minimum Volume	Preservation[3]	Holding Time from Sample Date
Oil-Water Separator (Influent)	Startup	3 sample/wk for 1st week 1 sample/wk. for weeks 2-4	Water	VOCs[4]	8260B	6	1	--	--	VOC trip blanks will company each cooler containing VOC samples[1]	7	3	Glass vial	3-40 mL	HCl to pH<2, zero headspace	14 days
				TPH-GRO	8015	6	1	--	--		7	3	Glass vial	3-40 mL	HCl to pH<2, zero headspace	14 days
				TPH-DRO	8015	6	1	--	--		7	1	Amber glass	1 L	--	14/40 days
				Phenolics	420.4	6	1	--	--		7	2	Amber glass	125 mL	HSO_4 to pH<2	28 days
				TOC	415.1/9060A	6	1	--	--		7	1	Glass	250 mL	HSO_4 to pH<2	Various
				PAHs[5]	8270 SIM	6	1	--	--		7	1	Amber glass	1 L	--	7/40 days
				SVOCs[6]	8270D	6	1	--	--		7	1	Amber glass	1 L	--	7/40 days
				PCBs	8082A	6	1	--	--		7	1	Glass	1 L	--	14/40 days
				TSS	SM 2540D	6	1	--	--		7	1	Plastic	1 L	--	7 days
				TDS	160.1	6	1	--	--		7	1	Glass	1 L	--	7 days
				Alkalinity	310.2	6	1	--	--		7	1	Plastic	125 mL	--	14 days
				Hardness	6010C	6	1	--	--		7	1	Plastic	250 mL	HNO_3 to pH<2	6 mo.
				Metals, total[7]	6020/7470A	6	1	--	--		7	1	Plastic	250 mL	HNO_3 to pH<2	6 mo./28 days Hg
				Metals, dissolved[7]	6020/7470A	6	1	--	--		7	1	Plastic	250 mL	HNO_3 to pH<2	6 mo./28 days Hg
				Oil and Grease	1664	6	1	--	--		7	1	Amber glass	1 L	HCl to pH<2	28 days
	Long-term	1 sample biweekly 3-6 months	Water	VOCs[4]	8260B	12	1	--	--		13	3	Glass vial	3-40 mL	HCl to pH<2, zero headspace	14 days
				TPH-GRO	8015	12	1	--	--		13	3	Glass vial	3-40 mL	HCl to pH<2, zero headspace	14 days
				TPH-DRO	8015	12	1	--	--		13	1	Amber glass	1 L	--	14/40 days
				Phenolics	420.4	12	1	--	--		13	2	Amber glass	125 mL	HSO_4 to pH<2	28 days
				TOC	415.1/9060A	12	1	--	--		13	1	Glass	250 mL	HSO_4 to pH<2	Various
				PAHs[5]	8270 SIM	12	1	--	--		13	1	Amber glass	1 L	--	7/40 days
				SVOCs[6]	8270D	12	1	--	--		13	1	Amber glass	1 L	--	7/40 days
				PCBs	8082A	12	1	--	--		13	1	Glass	1 L	--	14/40 days
				TSS	SM 2540D	12	1	--	--		13	1	Plastic	1 L	--	7 days
				TDS	160.1	12	1	--	--		13	1	Glass	1 L	--	7 days
				Alkalinity	310.2	12	1	--	--		13	1	Plastic	125 mL	--	14 days
				Hardness	6010C	12	1	--	--		13	1	Plastic	250 mL	HNO_3 to pH<2	6 mo.
				Metals, total[7]	6020/7470A	12	1	--	--		13	1	Plastic	250 mL	HNO_3 to pH<2	6 mo./28 days Hg
				Metals, dissolved[7]	6020/7470A	12	1	--	--		13	1	Plastic	250 mL	HNO_3 to pH<2	6 mo./28 days Hg
				Oil and Grease	1664	12	1	--	--		13	1	Amber glass	1 L	HCl to pH<2	28 days
Oil-Water Separator (Effluent)	Startup	3 sample/wk for 1st week 1 sample/wk. for weeks 2-4	Water	TPH-GRO	8015	4	1	--	--		5	3	Glass vial	3-40 mL	HCl to pH<2, zero headspace	14 days
				TPH-DRO	8015	4	1	--	--		5	1	Amber glass	1 L	--	14/40 days
				Oil and Grease	1664	4	1	--	--		5	1	Amber glass	1 L	HCl to pH<2	28 days
Particle Removal (Effluent)	Startup	3 sample/wk for 1st week 1 sample/wk. for weeks 2-4	Water	VOCs[4]	8260B	4	1	--	--		5	3	Glass vial	3-40 mL	HCl to pH<2, zero headspace	14 days
				TPH-GRO	8015	4	1	--	--		5	3	Glass vial	3-40 mL	HCl to pH<2, zero headspace	14 days
				TPH-DRO	8015	4	1	--	--		5	1	Amber glass	1 L	--	14/40 days
				Phenolics	420.4	4	1	--	--		5	2	Amber glass	125 mL	HSO_4 to pH<2	28 days
				TOC	415.1/9060A	4	1	--	--		5	1	Glass	250 mL	HSO_4 to pH<2	Various
				PAHs[5]	8270 SIM	4	1	--	--		5	1	Amber glass	1 L	--	7/40 days
				SVOCs[6]	8270D	4	1	--	--		5	1	Amber glass	1 L	--	7/40 days
				PCBs	8082A	4	1	--	--		5	1	Glass	1 L	--	14/40 days
				TSS	SM 2540D	4	1	--	--		5	1	Plastic	1 L	--	7 days
				TDS	160.1	4	1	--	--		5	1	Glass	1 L	--	7 days
				Alkalinity	310.2	4	1	--	--		5	1	Plastic	125 mL	--	14 days
				Hardness	6010C	4	1	--	--		5	1	Plastic	250 mL	HNO_3 to pH<2	6 mo.
				Metals, total[7]	6020/7470A	4	1	--	--		5	1	Plastic	250 mL	HNO_3 to pH<2	6 mo./28 days Hg
				Metals, dissolved[7]	6020/7470A	4	1	--	--		5	1	Plastic	250 mL	HNO_3 to pH<2	6 mo./28 days Hg
				Oil and Grease	1664	4	1	--	--		5	1	Amber glass	1 L	HCl to pH<2	28 days
Organoclay (Effluent)	Startup	3 sample/wk for 1st week 1 sample/wk. for weeks 2-4	Water	VOCs[4]	8260B	4	1	--	--		5	3	Glass vial	3-40 mL	HCl to pH<2, zero headspace	14 days
				TPH-GRO	8015	4	1	--	--		5	3	Glass vial	3-40 mL	HCl to pH<2, zero headspace	14 days
				TPH-DRO	8015	4	1	--	--		5	1	Amber glass	1 L	--	14/40 days
				PAHs[5]	8270 SIM	4	1	--	--		5	1	Amber glass	1 L	--	7/40 days
				Metals, total[7]	6020/7470A	4	1	--	--		5	1	Plastic	250 mL	HNO_3 to pH<2	6 mo./28 days Hg
				Metals, dissolved[7]	6020/7470A	4	1	--	--		5	1	Plastic	250 mL	HNO_3 to pH<2	6 mo./28 days Hg
				Oil and Grease	1664	4	1	--	--		5	1	Amber glass	1 L	HCl to pH<2	28 days
	Long-term	1 sample biweekly 3-6 months	Water	VOCs[4]	8260B	12	1	--	--		13	3	Glass vial	3-40 mL	HCl to pH<2, zero headspace	14 days
				TPH-GRO	8015	12	1	--	--		13	3	Glass vial	3-40 mL	HCl to pH<2, zero headspace	14 days
				TPH-DRO	8015	12	1	--	--		13	1	Amber glass	1 L	--	14/40 days
				PAHs[5]	8270 SIM	12	1	--	--		13	1	Amber glass	1 L	--	7/40 days
				Metals, total[7]	6020/7470A	12	1	--	--		13	1	Plastic	250 mL	HNO_3 to pH<2	6 mo./28 days Hg
				Metals, dissolved[7]	6020/7470A	12	1	--	--		13	1	Plastic	250 mL	HNO_3 to pH<2	6 mo./28 days Hg
				Oil and Grease	1664	12	1	--	--		13	1	Amber glass	1 L	HCl to pH<2	28 days

Table 2. Sampling and Analysis Plan

Operations and Maintenance Plan
Former South Plant Manufactured Gas Plant Site
Waukegan, IL
North Shore Gas, CERCLIS ID - ILD984809228

Sample Type/Location	Phase	Proposed Number of Sampling Locations/ Frequency	Matrix	Parameter	Method	Estimated Sample Quantity	Field Duplicates[1]	Equipment Blanks	MS/MSD	Trip Blanks	Total Number of Samples[2]	Estimated Number of Containers	Container Type	Minimum Volume	Preservation[3]	Holding Time from Sample Date
Granular Activated Carbon (Effluent) *between units (2)	Startup	3 sample/wk for 1st week[8] 1 sample/wk. for weeks 2-4	Water	VOCs[4]	8260B	4	1	--	--	VOC trip blanks will company each cooler containing VOC samples1	5	3	Glass vial	3-40 mL	HCl to pH<2, zero headspace	14 days
				TPH-GRO	8015	4	1	--	--		5	3	Glass vial	3-40 mL	HCl to pH<2, zero headspace	14 days
				TPH-DRO	8015	4	1	--	--		5	1	Amber glass	1 L	--	14/40 days
				PAHs[5]	8270 SIM	4	1	--	--		5	1	Amber glass	1 L	--	7/40 days
				Metals, total[7]	6020/7470A	4	1	--	--		5	1	Plastic	250 mL	HNO_3 to pH<2	6 mo./28 days Hg
				Metals, dissolved[7]	6020/7470A	4	1	--	--		5	1	Plastic	250 mL	HNO_3 to pH<2	6 mo./28 days Hg
				Oil and Grease	1664	4	1	--	--		5	1	Amber glass	1 L	HCl to pH<2	28 days
	Long-term	2 samples biweekly[8] 3-6 months	Water	VOCs[4]	8260B	12	1	--	--		13	3	Glass vial	3-40 mL	HCl to pH<2, zero headspace	14 days
				TPH-GRO	8015	12	1	--	--		13	3	Glass vial	3-40 mL	HCl to pH<2, zero headspace	14 days
				TPH-DRO	8015	12	1	--	--		13	1	Amber glass	1 L	--	14/40 days
				PAHs[5]	8270 SIM	12	1	--	--		13	1	Amber glass	1 L	--	7/40 days
				Metals, total[7]	6020/7470A	12	1	--	--		13	1	Plastic	250 mL	HNO_3 to pH<2	6 mo./28 days Hg
				Metals, dissolved[7]	6020/7470A	12	1	--	--		13	1	Plastic	250 mL	HNO_3 to pH<2	6 mo./28 days Hg
				Oil and Grease	1664	12	1	--	--		13	1	Amber glass	1 L	HCl to pH<2	28 days
Granular Activated Carbon (Effluent) *System Effluent	Startup	3 sample/wk for 1st week 1 sample/wk. for weeks 2-4	Water	VOCs	8260B	4	1	--	--		5	3	Glass vial	3-40 mL	HCl to pH<2, zero headspace	14 days
				TPH-GRO	8015	4	1	--	--		5	3	Glass vial	3-40 mL	HCl to pH<2, zero headspace	14 days
				TPH-DRO	8015	4	1	--	--		5	1	Amber glass	1 L	--	14/40 days
				PAHs[5]	8270 SIM	4	1	--	--		5	1	Amber glass	1 L	--	7/40 days
				Metals, total[7]	6020/7470A	4	1	--	--		5	1	Plastic	250 mL	HNO_3 to pH<2	6 mo./28 days Hg
				Metals, dissolved[7]	6020/7470A	4	1	--	--		5	1	Plastic	250 mL	HNO_3 to pH<2	6 mo./28 days Hg
				Oil and Grease	1664	4	1	--	--		5	1	Amber glass	1 L	HCl to pH<2	28 days
	Long-term	1 sample biweekly 3-6 months	Water	VOCs	8260B	12	1	--	--		13	3	Glass vial	3-40 mL	HCl to pH<2, zero headspace	14 days
				TPH-GRO	8015	12	1	--	--		13	3	Glass vial	3-40 mL	HCl to pH<2, zero headspace	14 days
				TPH-DRO	8015	12	1	--	--		13	1	Amber glass	1 L	--	14/40 days
				PAHs[5]	8270 SIM	12	1	--	--		13	1	Amber glass	1 L	--	7/40 days
				Metals, total[7]	6020/7470A	12	1	--	--		13	1	Plastic	250 mL	HNO_3 to pH<2	6 mo./28 days Hg
				Metals, dissolved[7]	6020/7470A	12	1	--	--		13	1	Plastic	250 mL	HNO_3 to pH<2	6 mo./28 days Hg
				Oil and Grease	1664	12	1	--	--		13	1	Amber glass	1 L	HCl to pH<2	28 days
Containment Groundwater Monitoring (11 wells)	Entire Phase 1	11 samples/event Quarterly events 3-6 months[9]	Water	VOCs[10]	8260B	33	2	--	--		35	3	Glass vial	3-40 mL	HCl to pH<2, zero headspace	14 days
				PAHs[5]	8270 SIM	33	2	--	--		35	1	Amber glass	1 L	--	7/40 days
				Field parameters[11]	Field	33	2	--	--		35	--	Field measured	--	--	--

Notes:

1. Field duplicates will be collected at a frequency of one per group of twenty or fewer samples.
2. Does not include number of trip blanks.
3. Cool all samples to 4° ± 2°C.
4. VOCs include: Benzene, ethylbenzene, toluene, xylenes (total), Bromoform, Carbon Tetrachloride, Chlorobenzene, Chloroform, 1,2-Dichloroethane, 1,1-Dichloroethene, cis-1,2-Dichloroethene, trans-1,2-Dichloroethene, Dichlorobromomethane (0.2 mg/kg), Dichloromethane (methylene chloride), 1,2-Dichloropropane, 1,3-Dichloropropene, Styrene, Tetrachloroethene, 1,1,1-Trichloroethane, 1,1,2- Trichloroethane, Trichloroethene, and Vinyl Chloride.
5. PAHs include: Naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, chrysene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene, and 2-methylnaphthalene.
6. SVOCs include: N-Nitrosodiphenylamine, N-Nitrosodi-n-propylamine, Bis (2-chloroethyl) ether,Bis (2-ethylhexyl) phthalate, 1,2-Dichlorobenzene, 1,4-dichlorobenzene, Hexachlorocyclopetadiene, 1,2,4- Trichlorobenzene.
7. Metals include: Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Lithium, Magnesium, Manganese, Molybdenum, Nickle, Potassium, Selenium, Silver, Sodium, Strontium, Sulfur, Thallium, Tin, Titanium, Tungsten, Vanadium, Zinc.
8. The two samples per week includes one sample collected from between the first and second GAC filters and a second sample collected from between the second and third GAC filters.
9. Sample numbers assumes three sampling events during the estimated 6-month operation period--one baseline monitoring event prior to startup and two quarterly events during Phase I operation.
10. VOCs include: Benzene, ethylbenzene, toluene, xylenes (total), 1,2,4-trimethylbenzene, and 1,3.5-trimethylbenzene.
11. Field parameters for groundwater include: pH, temperature, turbidity, dissolved oxygen, oxidation/reduction potential, and specific conductivity.

Acronyms:

SVOCs = Semi-Volatile Organic Compounds
VOCs = Volatile Organic Compounds
PCBs = Polychlorinated Biphenyls

PAH = Polyaromatic Hydrocarbon

TPH = Total Petroleum Hydrocarbons
DRO = Diesel Range Organics
GRO = Gasoline Range Organics

GAC = Granular Activated Carbon

Figures

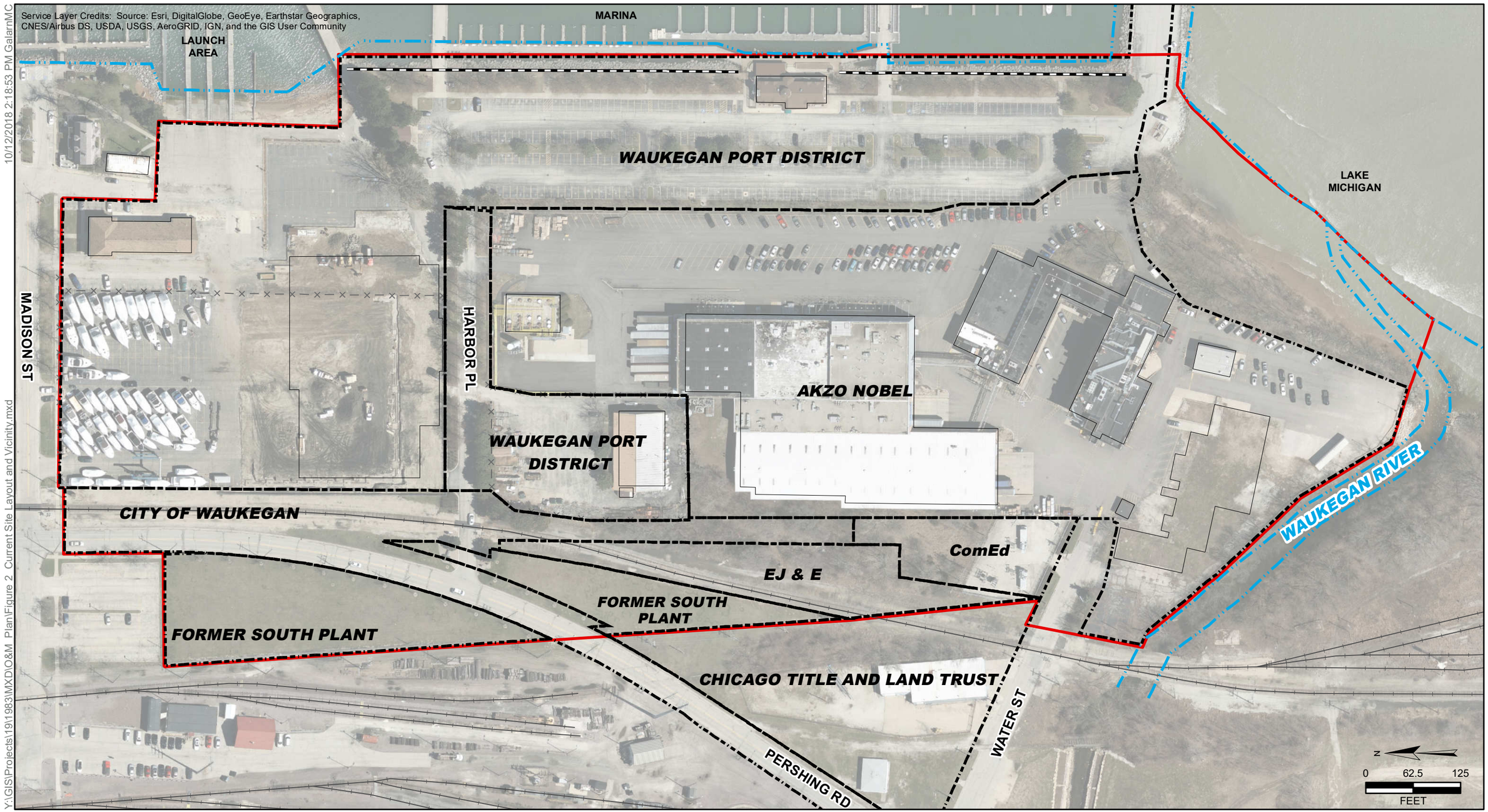
SITE LOCATION MAP

OPERATIONS AND MAINTENANCE PLAN
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

N

0 1,000 2,000 4,000
Feet

O'BRIEN & GERE ENGINEERS, INC.



SHEET PILE WALL
WATERLINE
RAILROAD
FENCE
OPERATIONAL UNIT BOUNDARY
BUILDINGS
APPROXIMATE PROPERTY BOUNDARIES

CURRENT SITE LAYOUT AND VICINITY

OPERATIONS AND MAINTENANCE PLAN
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

O'BRIEN & GERE ENGINEERS, INC.

MARINA

LAUNCH AREA

WAUKEGAN PORT DISTRICT

LAKE MICHIGAN

MADISON ST

HARBOR PL

AKZO NOBEL

WAUKEGAN PORT DISTRICT

WAUKEGAN RIVER

SPPA-MW47D

NSGSP-MW04

COW-MW03D

SPPA-MW52D

CITY OF WAUKEGAN

PZ-03

PZ-04

EW02

NSGSP-MW01

EW01

EW03

ComEd

EJ & E

NSGSP-MW30

EW04

EW06

IW01

HW01

EW05

FORMER SOUTH PLANT

PZ-02

PZ-01

FORMER SOUTH PLANT

NSGSP-MW33D

NSGSP-MW27D

NSGSP-MW28D

NSGSP-MW29D

CHICAGO TITLE AND LAND TRUST

WATER ST

PERSHING RD

N

0 62.5 125

FEET

- SHEET PILE WALL
- WATERLINE
- RAILROAD
- FENCE
- OPERATIONAL UNIT BOUNDARY
- BUILDINGS
- APPROXIMATE PROPERTY BOUNDARIES
- CONTAINMENT MONITORING WELL
- MONITORING WELL
- PROPOSED CONTAINMENT MONITORING WELL
- EXTRACTION WELLS
- VERTICAL INJECTION WELL
- HORIZONTAL INJECTION WELL

CONTAMINANT MONITORING WELL NETWORK

OPERATIONS AND MAINTENANCE PLAN
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

O'BRIEN & GERE ENGINEERS, INC.

Appendix A

Example Documentation Forms

Sample Control Log

Project Name: NSG Former South Plant MGP, Waukegan, IL

Project ID: 67860 / CERCLIS ID - ILD984809228

Task ID:

Analytical Laboratory: Pace/TestAmerica

Geotechnical Laboratory: NA

Field Staff ID(s):

Month (2-digit)	Date (2-digit)	Year (2-digit)	Sample Number (3-digit)	Unique Sample ID	Sample Media	Sample Location	Sample Depth (feet)	QC Sample Information (duplicate, blank, etc…)	COC Number	Notes (turnaround time, handling notes

PROJECT INFORMATION

Site: North Shore Gas, Waukegan South MGP, Waukegan, IL
Client: North Shore Gas
Project Number: 67860
Task #: 553
Start Date:
Time:
Field Personnel:
Finish Date:
Time:

WELL INFORMATION

Well ID: AKZO-MW01D
Casing ID: 2 Inches
Screen Interval: 6.75-16.75
Borehole Diameter: unknown Inches
Filter Pack Interval: unknown

EVENT TYPE

[ ] Well Development
[X] Low-Flow / Low-Stress Sampling
[ ] Well Volume Approach Sampling
[ ] Other (Specify below)

PURGE INFORMATION

Purge Method: [ ] Bailer [X] Pump
Bailer Type: n/a
Pump Type and Serial #: Geopump
Tube/Pump Intake Depth:
Stabilized Pumping Rate:

DEPTH MEASUREMENTS

	INITIAL		FINAL	
	Depth FT BTOC	Time (24-Hour)	Depth FT BTOC	Time (24-Hour)
LNAPL				
Groundwater				
DNAPL				
Casing Base				

VOLUME CALCULATION AND PRODUCTION INFORMATION

Volume Calculation Type: [ ] Well Casing [ ] Borehole
Volume Per Foot:
Standing Water Column: feet
1 Well Volume: Gallons
3 Well Volumes: Gallons
5 Well Volumes: Gallons
10 Well Volumes: Gallons
Total Volumes Produced: Gallons
Well Purged Dry? [ ] Yes [ ] No

Water Level Serial #: Solinst
Water Quality Probe Type and Serial # AquaTroll 600

WATER QUALITY INDICATOR PARAMETERS

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp (°C)	SEC or Cond. (µs/cm)	Dissolved Oxygen (mg/L)	pH (SU)	Turbidity (NTU)	ORP (mV)	Visual Clarity
initial		0									
purge											

NOTES

ABBREVIATIONS

Cond. - Actual Conductivity
FT BTOC - Feet Below Top of Casing
na - Not Applicable
nm - Not Measured
ORP - Oxidation-Reduction Potential
SEC - Specific Electrical Conductance
SU - Standard Units
Temp - Temperature
°C - Degrees Celcius

WELL INFORMATION

Well ID: AKZO-MW01D
Casing ID: 2 inches

EVENT TYPE

[ ] Well Development
[X] Low-Flow / Low Stress Sampling
[ ] Well Volume Approach Sampling
[ ] Other (Specify):

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp (°C)	SEC or Cond. (µs/cm)	Dissolved Oxygen (mg/L)	pH (SU)	Turbidity (NTU)	ORP (mV)	Visual Clarity

NOTES (continued)

ABBREVIATIONS

Cond. - Actual Conductivity
FT BTOC - Feet Below Top of Casing
na - Not Applicable
nm - Not Measured
ORP - Oxidation-Reduction Potential
SEC - Specific Electrical Conductance
SU - Standard Units
Temp - Temperature
°C - Degrees Celcius

WELL LEVEL AND FIELD PARAMETERS FIELD FORM

General Information

Site : NSG South Plant MGP, Waukesgan, IL

Project # : 67860 / CERCLIS ID ILD984809228

Task # :

Date :

Samplers :

Water Level Indicator Serial # : Solinst

Purge Device and Serial # : GeoPump

Quality Probe Type and Serial # : AquaTroll 600

Calibration Check :

Notes: *nm : Not Measured; n/a : Not Applicable; TOC: Top of Well Casing*

Location	Time (military)	Depth to Water (feet below TOC)	Product Top Depth (feet below TOC)	Product Bottom Depth (feet below TOC)	Product Notes	Time (military)	Temper-ature (°C)	Cond-uctivty (µs/cm)	Dissolved Oxygen (DO) (mg/L)	pH (su)	Turbitity (NTU)	Oxidation/ Reduction Potential (ORP) (mV)	Field Comments:
AKZO-MW01D													

WELL LEVEL AND FIELD PARAMETERS FIELD FORM

Solinst

Field Remarks: GeoPump

67860 / CERCLIS ID ILD984809228 AquaTroll 600

METER / FIELD KIT INFORMATION:

Water Quality Probe

Water Level Indicator:

Interface Probe:

	Well Casing Schedule	Inside Diameter of Casing (inches)	Casing Inside Radius (inches)	Casing Inside Radius (feet)	Well Volume Per 1 foot of Water Column	Four Well Volumes per One foot of Water Column
	40	1.05	0.53	0.04	0.04	0.18
	80	0.96	0.48	0.04	0.04	0.15
	40	1.38	0.69	0.06	0.08	0.31
	80	1.28	0.64	0.05	0.07	0.27
	40	1.61	0.81	0.07	0.11	0.42
	80	1.5	0.75	0.06	0.09	0.37
	40	2.07	1.04	0.09	0.17	0.70
	80	1.94	0.97	0.08	0.15	0.61
	40	3.07	1.54	0.13	0.38	1.54
	80	2.9	1.45	0.12	0.34	1.37
	40	4.03	2.02	0.17	0.66	2.65
	80	3.83	1.92	0.16	0.60	2.39
	40	6.065	3.03	0.25	1.50	6.00
	80					
	40	7.981	3.99	0.33	2.60	10.39
	80					
	40	11.938	5.97	0.50	5.81	23.26
	80					

Indicator Parameter Changes		
Three consecutive readings spaced approximately 2 minutes or 0.5 well volumes or more apart within the following ranges:		
Dissolved Oxygen	±	0.2 mg/L
Specific Conductance	±	5.0 µmhos/cm for values <1000
	±	10.0 µmhos/cm for values >1000
pH	±	0.1 pH units
Temperature	±	0.1 °C
Turbidity	±	<5 NTUs (required if metals not filtered)
Eh (optional)	±	30 mV

Sampling Standard 2" Well

CHAIN-OF-CUSTODY COPIES ONLY Original COCs must be filed in accordance with OBG Data Management Policies.	

Manual Data Entry Form

Project # / Task:______________________ Well ID:_________________________

Static Water Level:____________________ Date:___________________________

For Slug Tests:
Measurements should be taken as often as possible (10-15 seconds) for the first 10 minutes.
After 10 minutes, measurements should be taken every minute.
After 1 hour, measurements should be taken every 10 minutes.

Elapsed time (min : sec)	**Depth to Water (feet)**	**Elapsed time (min : sec)**	**Depth to Water (feet)**	**Elapsed time (min : sec)**	**Depth to Water (feet)**
0:00	6.02				
0:10	7.32				
0:20	7.18				

Weekly System Operations and Maintenance Report

Date: _____ Personnel: _____
Well Name: _____

Recovery Vault					
Closed Vault Conditions:					
Inner Vault Conditions: (observe any leaks in vault, air line, DNAPL, or water extraction lines, etc)					
MultiRae Readings	O_2: _____	CO: _____	Benzene: _____	H_2S: _____	
Vault Gasket Intact? Y/N?	_____	Notes:			

DNAPL Recovery			
Regulator Pressure:	_____	Cycle Counter Working? Y/N?	_____
Cycles: _____ cycles per _____ (length of time)		Pump primed? Y/N?	_____
Flow Rate (manual calculation):	_____	Mainly Pumping DNAPL? Y/N?	_____
Manual DNAPL Thickness:	_____	Transducer Data Downloaded?	_____
Notes: (any changes to cycle counter and regulator, etc)			

Groundwater Recovery			
Manual Groundwater Level:	_____	Notes:	
Transducer Data Downloaded?	_____		

OBG
Part of Ramboll

Appendix I

Hydraulic Testing Memorandum

HYDRAULIC TESTING MEMORANDUM

TO:	Marcus Byker, PE Project Manager	cc:	Brian Hennings, PG
FROM:	Katie Moran, PG Andrea Salus, PE		
RE:	2017 RW-5 Pumping Test Former South Plant MGP		
FILE:			
DATE:	June 28, 2018		

INTRODUCTION

A program of hydraulic testing, consisting of a step-drawdown test and a constant-rate pumping test, was conducted at the Former South Plant MGP (Site) as part of the 2017 Pre-Design Investigation (PDI). The objectives of this testing were to characterize the hydraulic properties of the unconfined aquifer and evaluate potential groundwater extraction rates for the proposed dense non-aqueous phase liquid (DNAPL) recovery remedy.

SUMMARY OF TESTING ACTIVITIES

The well network and test specifications outlined in the Pre-Design Investigation Work Plan were modified prior to testing due to logistical and access considerations at the Site. Recovery well RW-5 was selected as the pumping well instead of RW-1 due to the abandonment of RW-1 to facilitate construction of a Boat Storage Building on the Waukegan Port District property. This arrangement also allowed for equipment staging on the larger southeastern portion of the North Shore Gas (NSG) property and minimized infrastructure and personnel movement across the surrounding roadways. Nine nearby monitoring wells were selected to evaluate aquifer response during the constant rate test (Table 1, Figure 1), including one recovery well (RW-11) that was used as an observation well for this test.

A step-drawdown test, of approximately 120 minutes in duration, was conducted at RW-5 on September 26, 2017 to identify an appropriate pumping rate for the subsequent constant-rate test. Stable drawdown was obtained for the rate steps of 1.14 gallons per minute (gpm) and 2.20 gpm; the test was stopped after the next rate increase to 2.64 gpm, which resulted in unsustainable drawdown at the well. A pumping rate of 1.7 gpm was selected for the constant-rate test based upon the step-drawdown test results.

The constant-rate pumping test at RW-5 consisted of pumping at 1.7 gpm for approximately 41 hours, beginning at 7:30pm on September 26, 2017. The test was stopped prior to the planned 48-hour duration when drawdown in the pumping well approached the level of the pump intake. Water levels at RW-5 and the observation wells listed in Table 1 were recorded by pressure transducers deployed in the wells and manual measurements collected periodically during the test. Attachment A presents the groundwater elevation data collected at each well.

During previous monitoring activities, the thickness of DNAPL measured in RW-5 was not sufficient for inclusion in the DNAPL recovery program. Prior to the start of the step-drawdown test, less than a half a foot of DNAPL were detected in the bottom of the well. Measurements of DNAPL thickness were not collected during the constant-rate test due to limited gauging access below the pump. It is likely DNAPL continued to enter the well during pumping based on the presence of DNAPL on equipment upon removal from the well following the test.

TEST ANALYSIS AND RESULTS

Time-drawdown data from six observation wells were analyzed using AQTESOLV for Windows® (Duffield, 2007). The transducer records for several wells exhibited significant noise of unknown origin (Attachment A);

therefore, the manual drawdown measurements were used for analysis. The results of these analyses are presented on Table 2. Data collected at wells with less than 0.1 feet of drawdown were not individually analyzed.

The Cooper-Jacob straight-line approximation of the Theis solution (Cooper and Jacob, 1946; Theis, 1935) yielded aquifer transmissivities (T) between 440 and 600 square feet per day (ft^2/d) for the six observation wells (Attachment B). These estimates are consistent with the results of distance-drawdown analysis of the maximum drawdown recorded at each observation well (Attachment C). Water levels recorded by transducer at observation well MW-36 were suitable for evaluation in AQTESOLV; derivative analysis identified delayed-yield behavior consistent with drawdown response to pumping of an unconfined aquifer. Evaluation of the MW-36 transducer-recorded drawdown with the Moench (1997) solution yielded a good match to the observed drawdown and calculated derivative for a transmissivity of 600 ft^2/d, aquifer storativity (S) of 0.003, and unconfined aquifer specific yield (Sy) of 0.3.

These estimates of aquifer transmissivity, and an assumed aquifer thickness of 10 feet, yield calculated hydraulic conductivities (K) of 44 - 60 feet per day (ft/d) for the unconfined sand aquifer. Review of transducer data collected during the test period suggests a possible background trend of decreasing groundwater elevations during the test. MW-24 was selected for monitoring as a background well during the test. Groundwater elevations at this well decreased during the test by approximately 0.17 feet; however, the decreasing trend was not confirmed in pre- or post-test data at this well, and it remains unclear if these levels were influenced by pumping activities. The existence of a potential decreasing background trend would result in overestimation of transmissivity.

REFERENCES

Cooper, H.H. and C.E. Jacob, 1946. A generalized graphical method for evaluating formation constants and summarizing well field history, Am. Geophys. Union Trans., vol. 27, pp. 526-534.

Duffield, G. 2007. AQTESOLV® Professional Version 4.5. Hydrosolve, Inc.

Moench, A.F., 1997. Flow to a well of finite diameter in a homogeneous, anisotropic water-table aquifer, Water Resources Research, vol. 33, no. 6, pp. 1397-1407.

NRT, 2015. Pre-Design Investigation Work Plan—Rev 1, Former South Plant Manufactured Gas Plant. June 2016.

Theis, C.V., 1935. The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage, Am. Geophys. Union Trans., vol. 16, pp. 519-524.

ATTACHMENTS

TABLES

FIGURES

ATTACHMENTS

Tables

Table 1. Pumping Test Well Summary

2017 RW-5 Pumping Test Memo

Former South Plant MGP

Well Name	Distance From Pumping Well (ft)	TOC Elevation (ft NAVD88)	Ground Surface Elevation (ft NAVD88)	Top of Screen (ft bgs)	Top of Screen Elevation (ft NAVD88)	Bottom of Screen (ft bgs)	Bottom of Screen Elevation (ft NAVD88)	March 2017 Groundwater Sampling		October 2017 Groundwater Sampling		March 2018 Groundwater Sampling	
								DTW (ft)	DNAPL Thickness (ft)	DTW (ft)	DNAPL Thickness (ft)	DTW (ft)	DNAPL Thickness (ft)
Pumping Well													
SPPA-RW-5	--	590.02	591.77	6.75	585.02	16.75	575.02	--	--	--	--	--	--
Observation Wells													
SPPA-RW-11	101.17	588.48	589.84	6.25	583.59	16.75	573.09	--	--	--	--	--	--
NSGSP-MW35	50.23	590.45	591.00	6.25	584.75	16.25	574.75	6.95	0	6.85	0	7.08	0
NSGSP-MW36	4.21	591.35	591.79	6.75	585.04	16.75	575.04	7.79	2	7.8	2.5	7.95	1.71
NSGSP-MW37	16.39	591.20	591.57	6.25	585.32	16.25	575.32	7.6	0	7.48	0	7.85	0
NSGSP-MW23	99.91	591.62	591.87	5.25	586.62	17.25	574.62	7.49	0	7.44	0	7.99	0
NSGSP-MW24	423.24	590.83	591.39	5.25	586.14	15.25	576.14	6.35	0	6.22	0	6.83	0
NSGSP-MW26	59.53	590.88	591.35	6.25	585.10	16.25	575.10	7.15	0	7.09	0	7.46	0
NSGSP-MW29	105.43	592.77	592.99	4.75	588.24	14.75	578.24	8.89	0	8.81	0	9.28	0
NSGSP-MW38	36.66	591.13	591.53	5.25	586.28	15.25	576.28	7.4	0	7.32	0	7.66	0

[O: ANS 6/19/18, C: JQW 6/21/18]

Notes

1. ft = feet
2. bgs = below ground surface
3. All elevations surveyed based upon theNorth American Vertical Datum of 1988 (NAVD88)

Table 2. Aquifer Testing Results

2017 RW-5 Pumping Test Memo

Former South Plant MGP

Well ID	Distance from Pumping Well (ft)	Maximum Drawdown (ft)	Individual Well Analysis - Cooper-Jacob Method		
			Transmissivity (T) (ft^2/d)	Storativity (S)	Hydraulic Conductivity (K) (ft/d)
RW-5 (Pumping Well)	nm	7.93	--	--	--
MW-36	4.2	0.25	580	0.52*	58
MW-37	16.4	0.22	440	0.16	44
MW-38	36.7	0.2	510	0.027	51
MW-35	50.2	0.11	600	0.07	60
MW-26	59.5	0.14	480	0.05	48
MW-23	99.9	0.11	540	0.025	54
RW-11	101.2	0.09	--	--	--
MW-29	105.4	0.09	--	--	--
MW-24	423.2	ND	--	--	--
Distance-Drawdown Evaluation	--	--	497	0.003	49.7

Unconfined Analysis - MW-36 Transducer Data

Analysis Method	Analysis Timeframe	Anisotropy Ratio (Kz/Kr)	Transmissivity (T) (ft^2/d)	Storativity (S)	Specific Yield (Sy)
Cooper-Jacob	Early Time	--	640	0.06	--
	Late Time	--	570	--	0.37
Moench (unconfined)		0.1	600	0.003	0.3

Notes

1. Hydraulic Conductivity (K) was calculated by dividing transmissivity (T) by an aquifer thickness of 10 feet.
2. -- Indicates that a parameter was not analyzed in AQTESOLV
3. * indicates that the estimated Storativity value at MW-36 is out of range

ft = feet

d = day

nm = not measured

ND = no value detected

Figures

WAUKEGAN PORT DISTRICT

MADISON ST

HARBOR PL

AKZO NOBEL

WAUKEGAN PORT DISTRICT

SPPA-RW11

CITY OF WAUKEGAN

NSGSP-MW36

NSGSP-RW5

NSGSP-MW35

NSGSP-MW26

NSGSP-MW37

NSGSP-MW38

ComEd

EJ & E

FORMER SOUTH PLANT

NSGSP-MW23

FORMER SOUTH PLANT

NSGSP-MW29

NSGSP-MW24

CHICAGO TITLE AND LAND TRUST

WATER ST

PERSHING RD

WAUKEGAN RIVER

N

0 62.5 125

FEET

RECOVERY WELL LOCATION

MONITORING WELL LOCATION

RAILROAD

BUILDINGS

APPROXIMATE PROPERTY BOUNDARIES

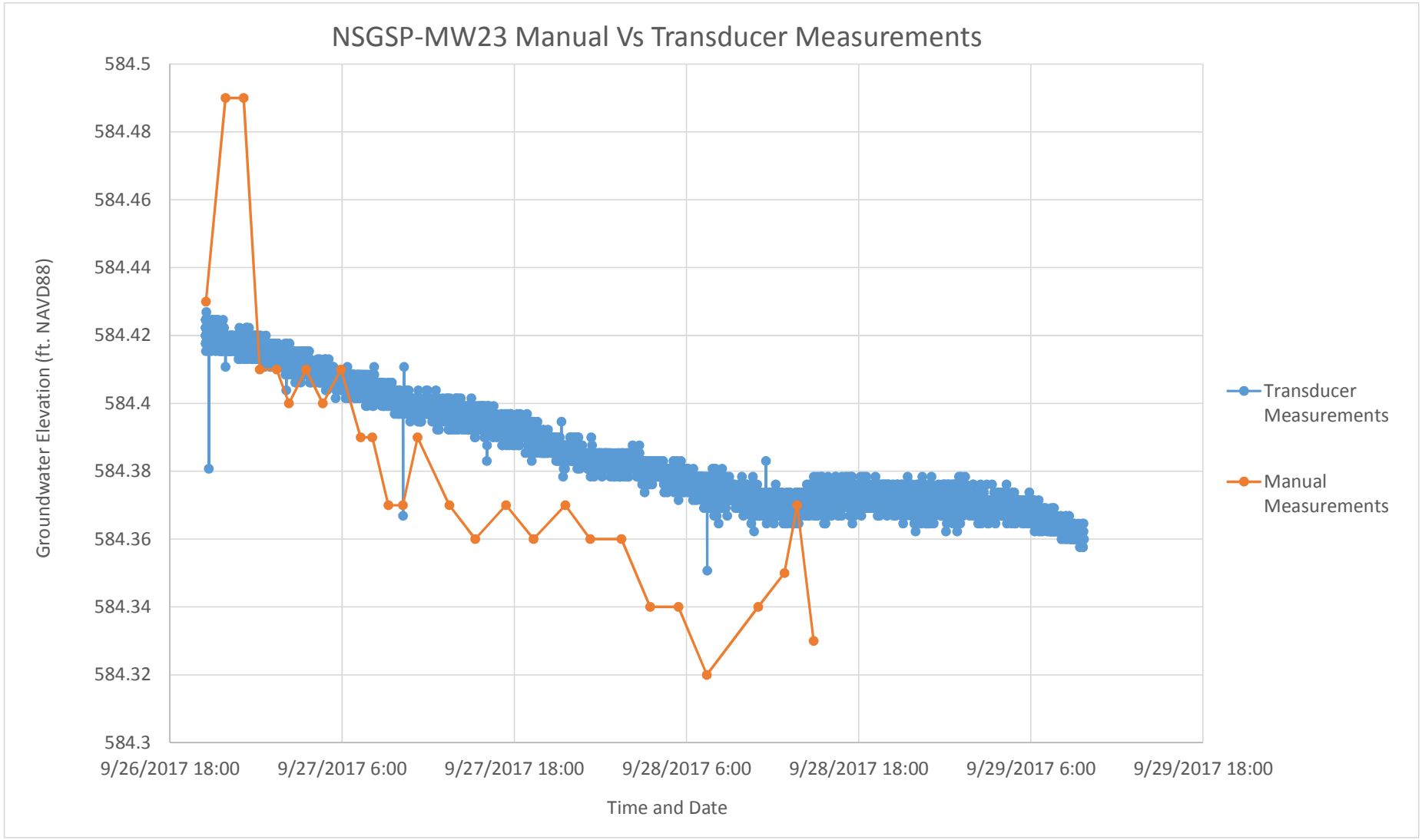
PUMPING TEST WELL LOCATIONS

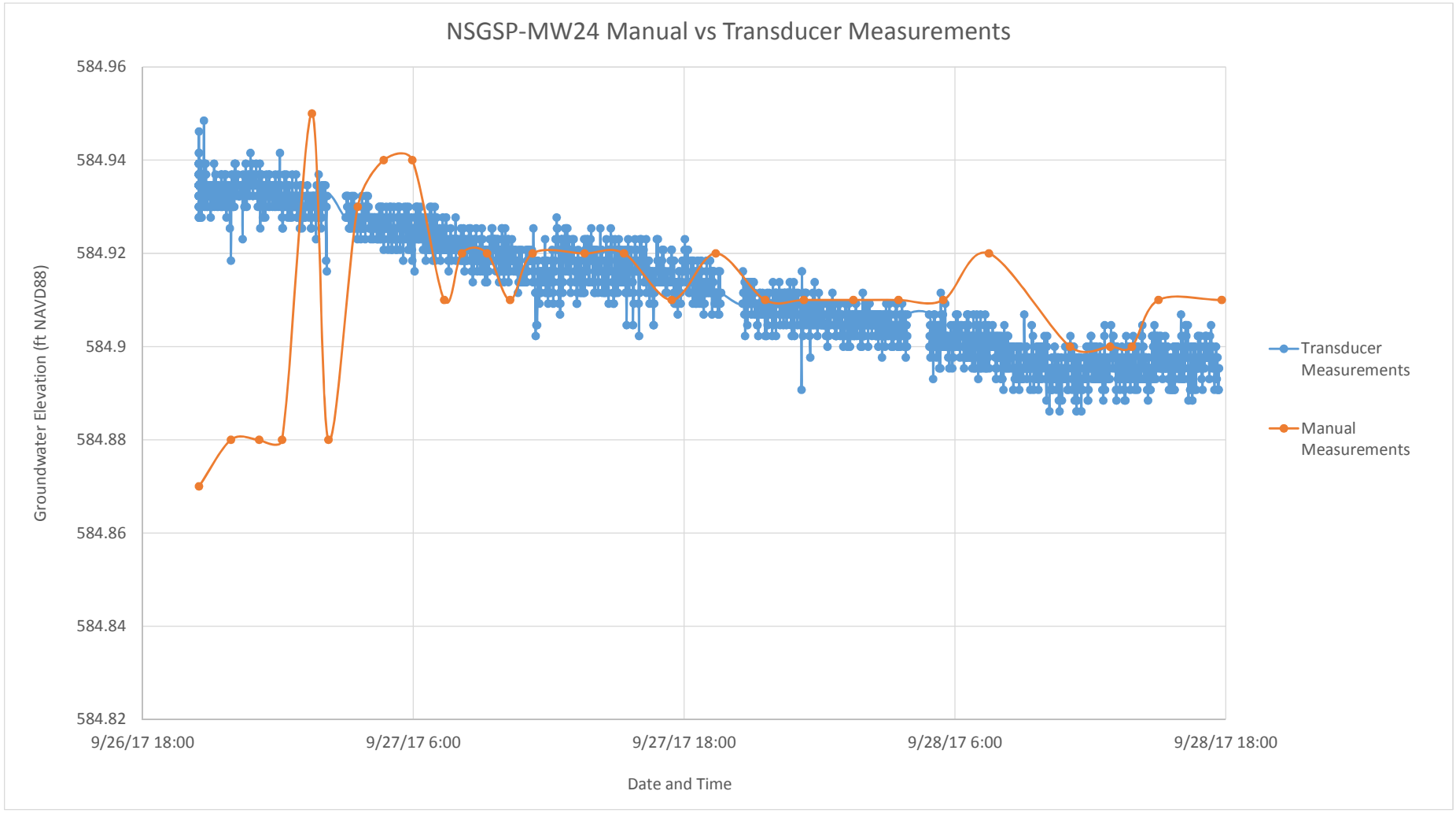
2017 RW-5 PUMPING TEST MEMO
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

O'BRIEN & GERE ENGINEERS, INC.

Attachment A

Water Level Charts


NSGSP-MW23 Manual Vs Transducer Measurements
Groundwater Elevation (ft. NAVD88)
584.5
584.48
584.46
584.44
584.42
584.4
584.38
584.36
584.34
584.32
584.3
9/26/2017 18:00
9/27/2017 6:00
9/27/2017 18:00
9/28/2017 6:00
9/28/2017 18:00
9/29/2017 6:00
9/29/2017 18:00
Time and Date
Transducer Measurements
Manual Measurements


NSGSP-MW24 Manual vs Transducer Measurements
Groundwater Elevation (ft NAVD88)
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584.82
9/26/17 18:00
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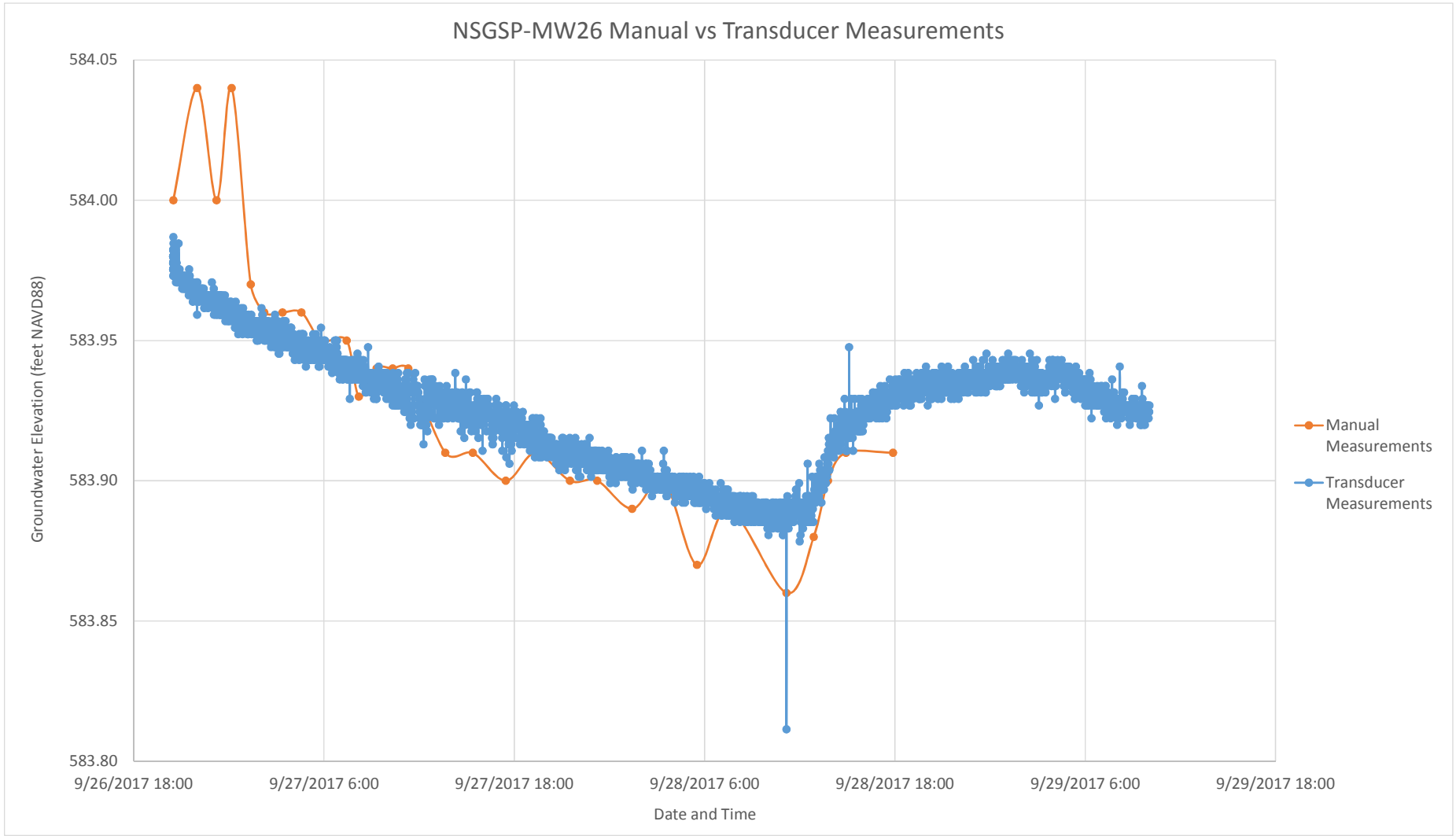
9/27/17 18:00
9/28/17 6:00
9/28/17 18:00
Date and Time
Transducer Measurements
Manual Measurements


NSGSP-MW26 Manual vs Transducer Measurements
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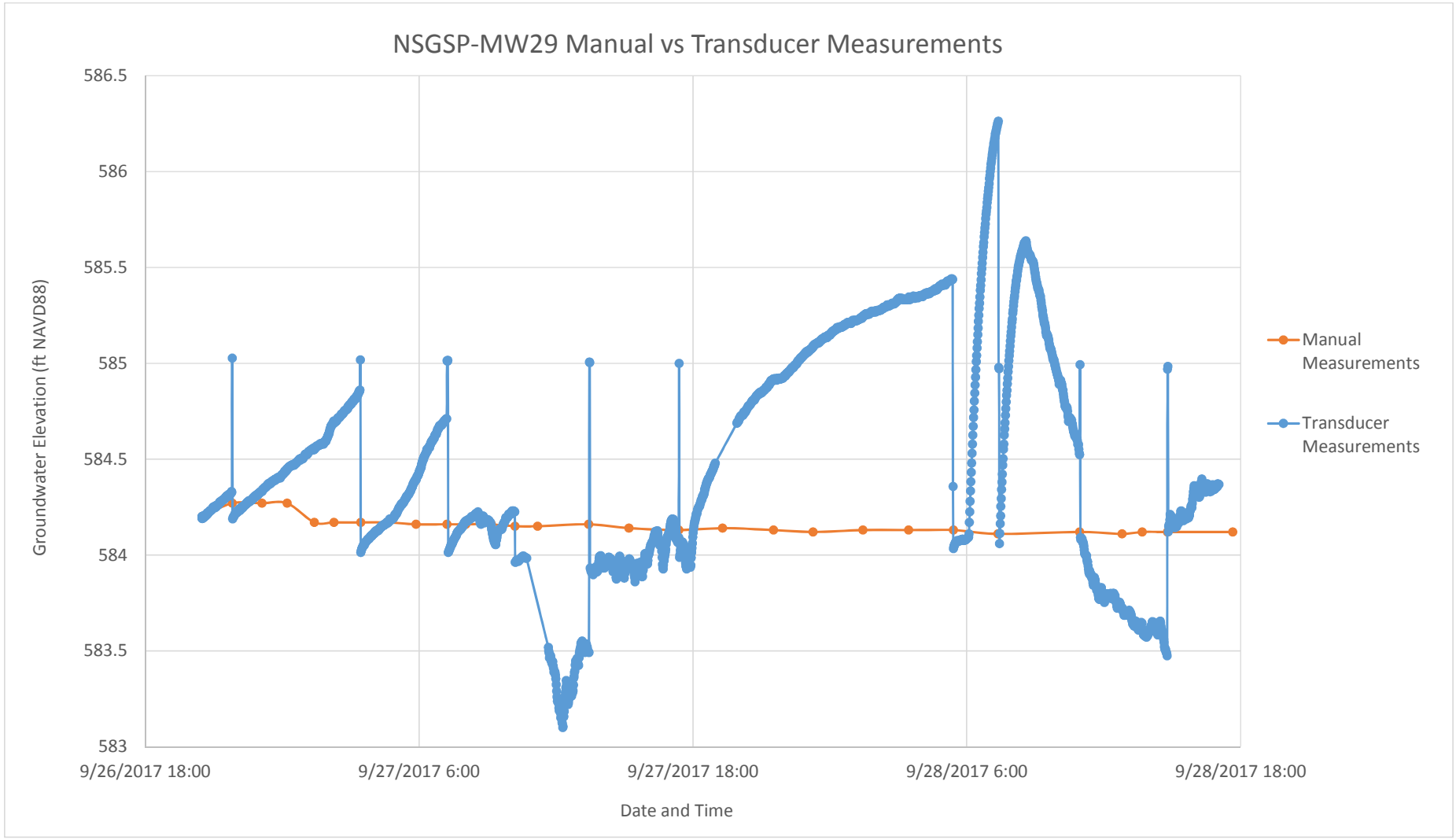
584.00
583.95
583.90
583.85
583.80
Groundwater Elevation (feet NAVD88)
9/26/2017 18:00
9/27/2017 6:00
9/27/2017 18:00
9/28/2017 6:00
9/28/2017 18:00
9/29/2017 6:00
9/29/2017 18:00
Date and Time
Manual Measurements
Transducer Measurements


NSGSP-MW29 Manual vs Transducer Measurements
Groundwater Elevation (ft NAVD88)
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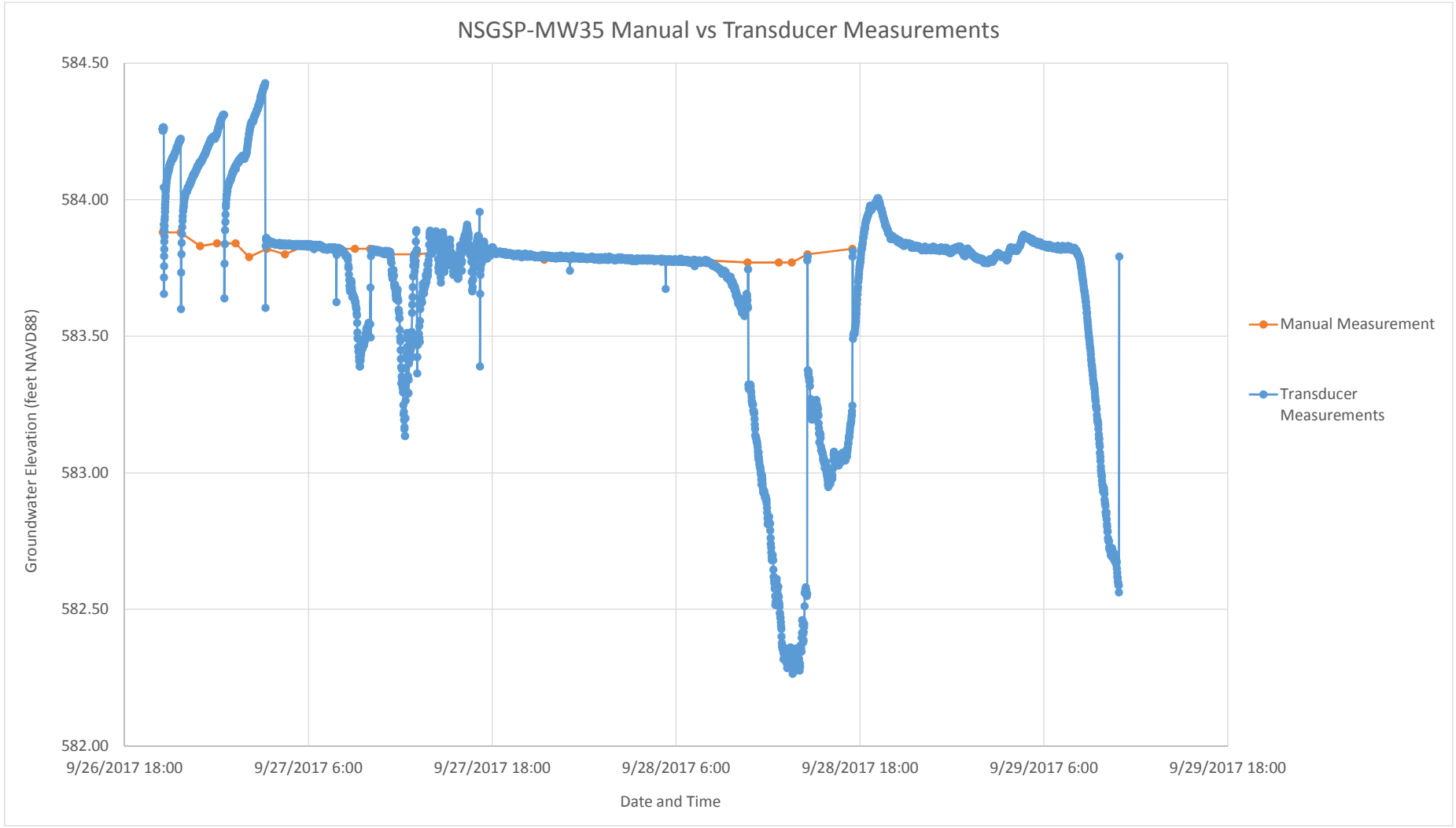
586
585.5
585
584.5
584
583.5
583
9/26/2017 18:00
9/27/2017 6:00
9/27/2017 18:00
9/28/2017 6:00
9/28/2017 18:00
Date and Time
Manual Measurements
Transducer Measurements


NSGSP-MW35 Manual vs Transducer Measurements
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583.50
583.00
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582.00
Groundwater Elevation (feet NAVD88)
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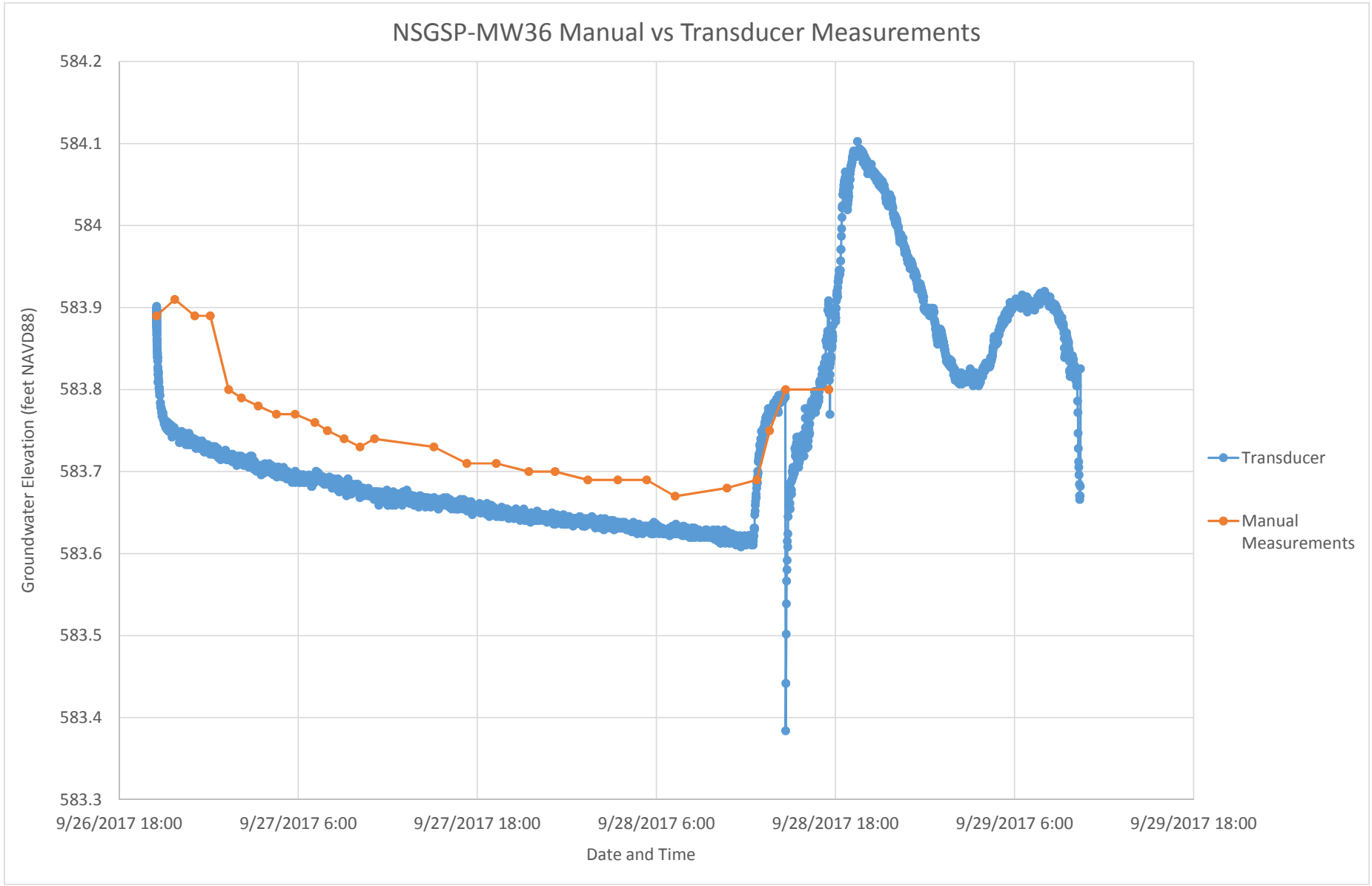
9/27/2017 6:00
9/27/2017 18:00
9/28/2017 6:00
9/28/2017 18:00
9/29/2017 6:00
9/29/2017 18:00
Date and Time
Manual Measurement
Transducer Measurements


NSGSP-MW36 Manual vs Transducer Measurements
Groundwater Elevation (feet NAVD88)
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584
583.9
583.8
583.7
583.6
583.5
583.4
583.3
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9/27/2017 18:00
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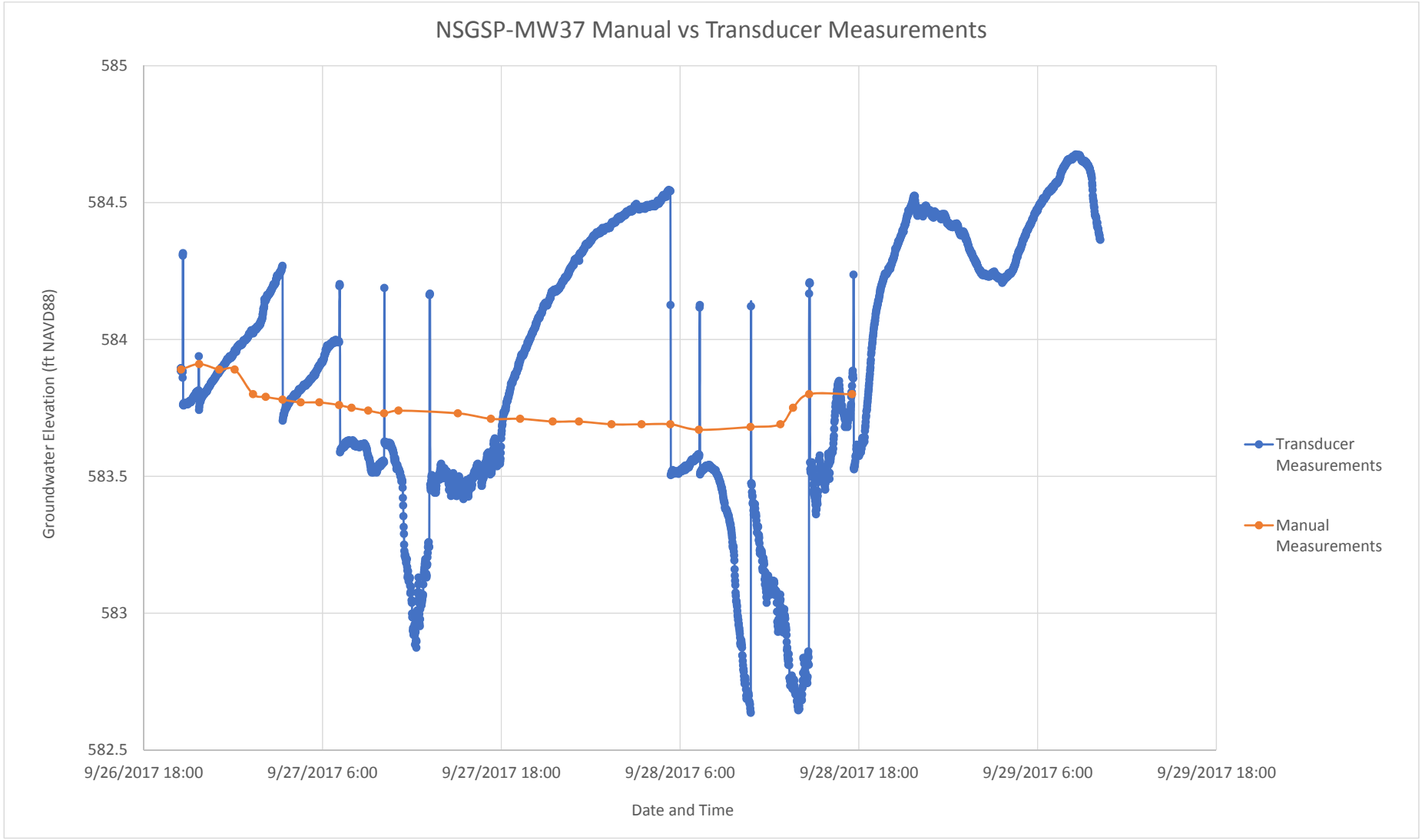
9/29/2017 18:00
Date and Time
Transducer
Manual Measurements


NSGSP-MW37 Manual vs Transducer Measurements
585
584.5
584
583.5
583
582.5
Groundwater Elevation (ft NAVD88)
9/26/2017 18:00
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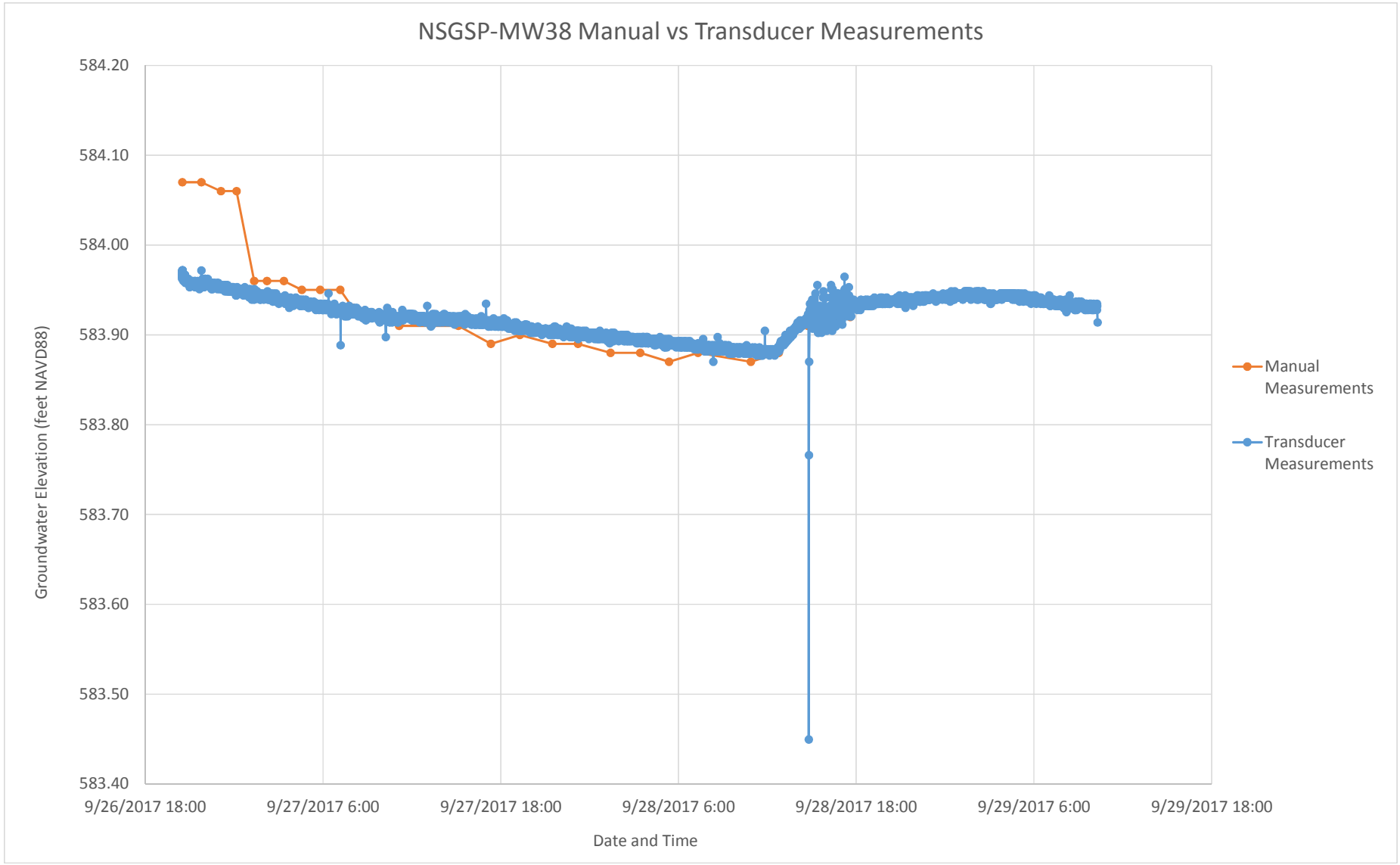
9/27/2017 18:00
9/28/2017 6:00
9/28/2017 18:00
9/29/2017 6:00
9/29/2017 18:00
Date and Time
Transducer Measurements
Manual Measurements


NSGSP-MW38 Manual vs Transducer Measurements
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Groundwater Elevation (feet NAVD88)
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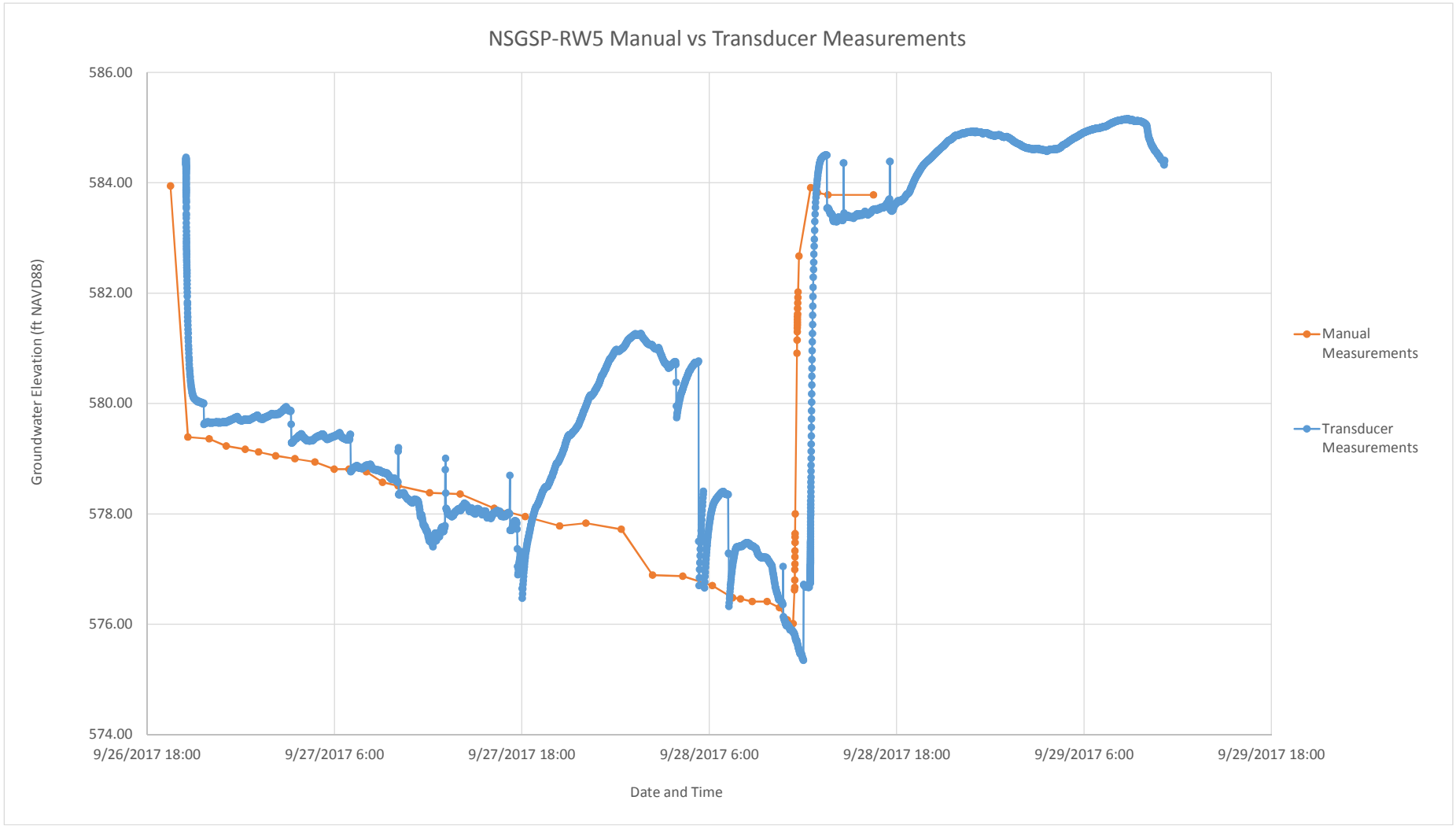
9/27/2017 6:00
9/27/2017 18:00
9/28/2017 6:00
9/28/2017 18:00
9/29/2017 6:00
9/29/2017 18:00
Date and Time
Manual Measurements
Transducer Measurements


NSGSP-RW5 Manual vs Transducer Measurements
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582.00
580.00
578.00
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574.00
Groundwater Elevation (ft NAVD88)
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9/27/2017 6:00
9/27/2017 18:00
9/28/2017 6:00
9/28/2017 18:00
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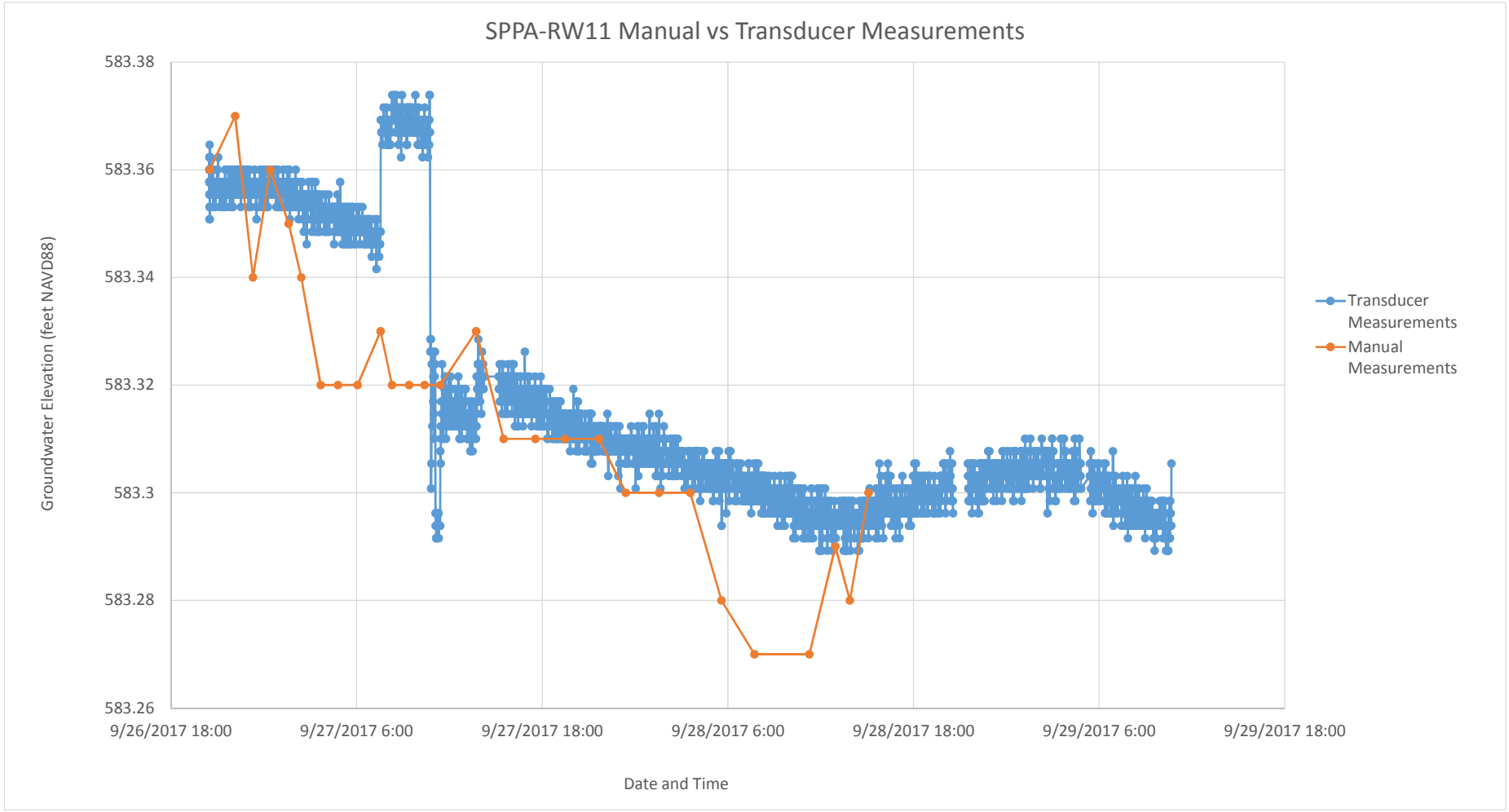
9/29/2017 18:00
Date and Time
Manual Measurements
Transducer Measurements


SPPA-RW11 Manual vs Transducer Measurements
Groundwater Elevation (feet NAVD88)
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583.32
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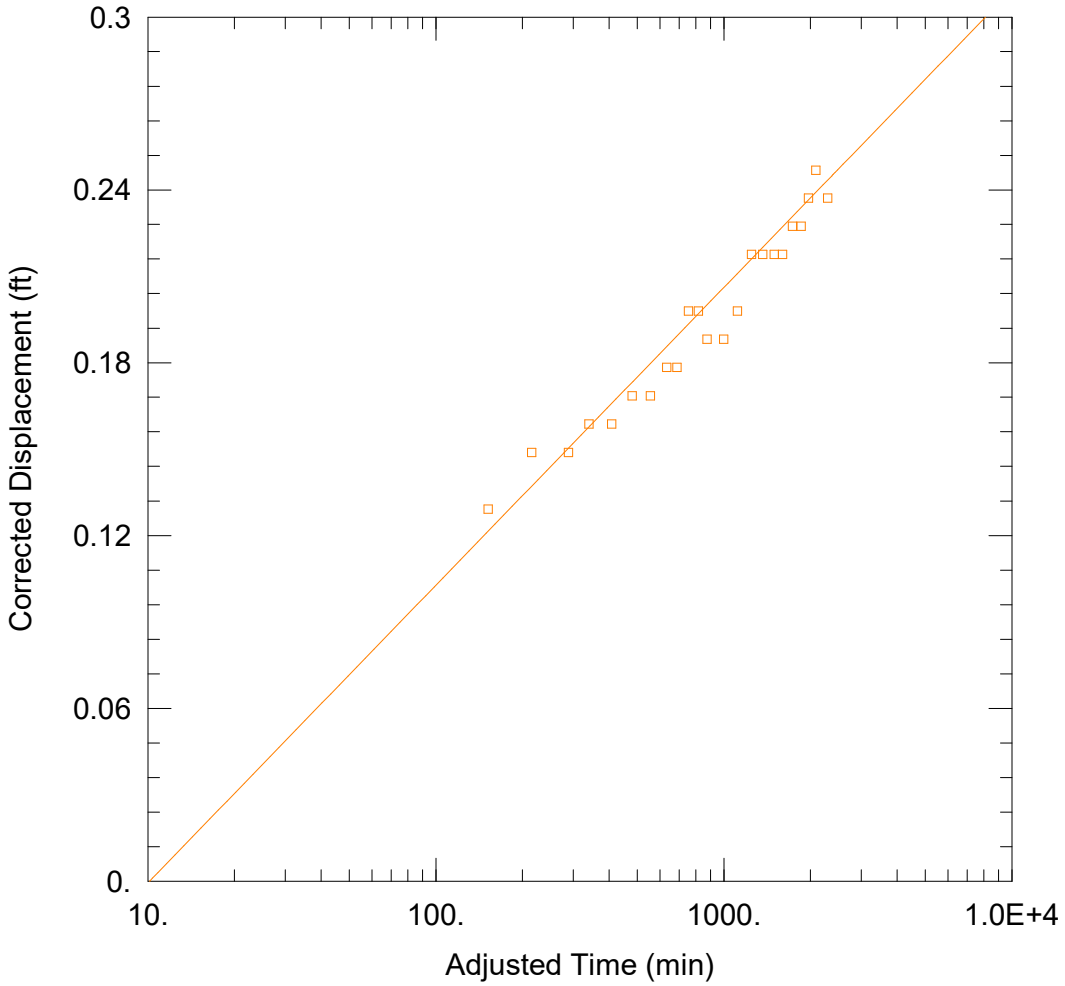
9/27/2017 18:00
9/28/2017 6:00
9/28/2017 18:00
9/29/2017 6:00
9/29/2017 18:00
Date and Time
Transducer Measurements
Manual Measurements

Attachment B

AQTESOLV Plots



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: OBG
Test Well: RW-5
Test Date: 09/26/2017

AQUIFER DATA

Saturated Thickness: 10. ft

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RW-5	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
MW-36	4.2	0

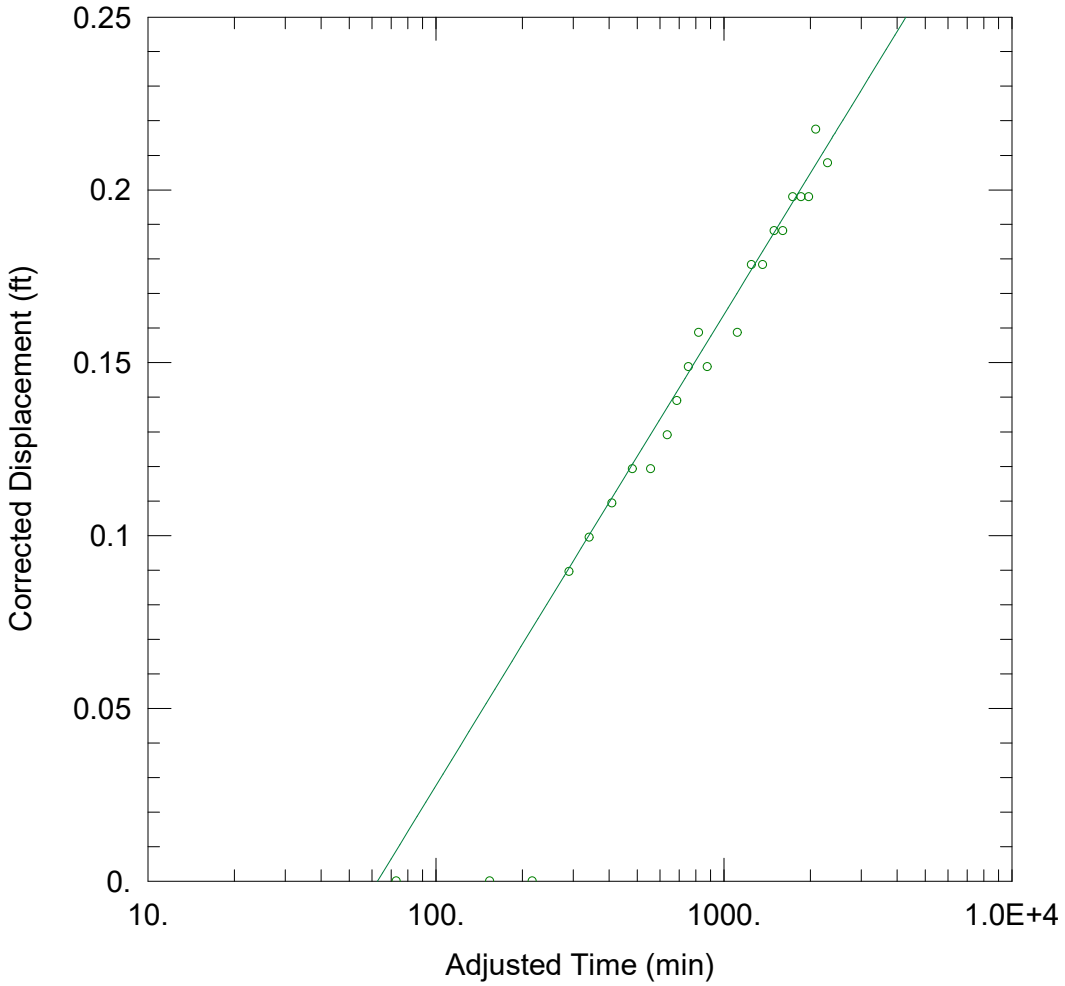
SOLUTION

Aquifer Model: Unconfined

Solution Method: Cooper-Jacob

T = 580. ft^2/day

S = 0.52



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: OBG
Test Well: RW-5
Test Date: 09/26/2017

AQUIFER DATA

Saturated Thickness: 10. ft

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RW-5	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
○ MW-37	16.4	0

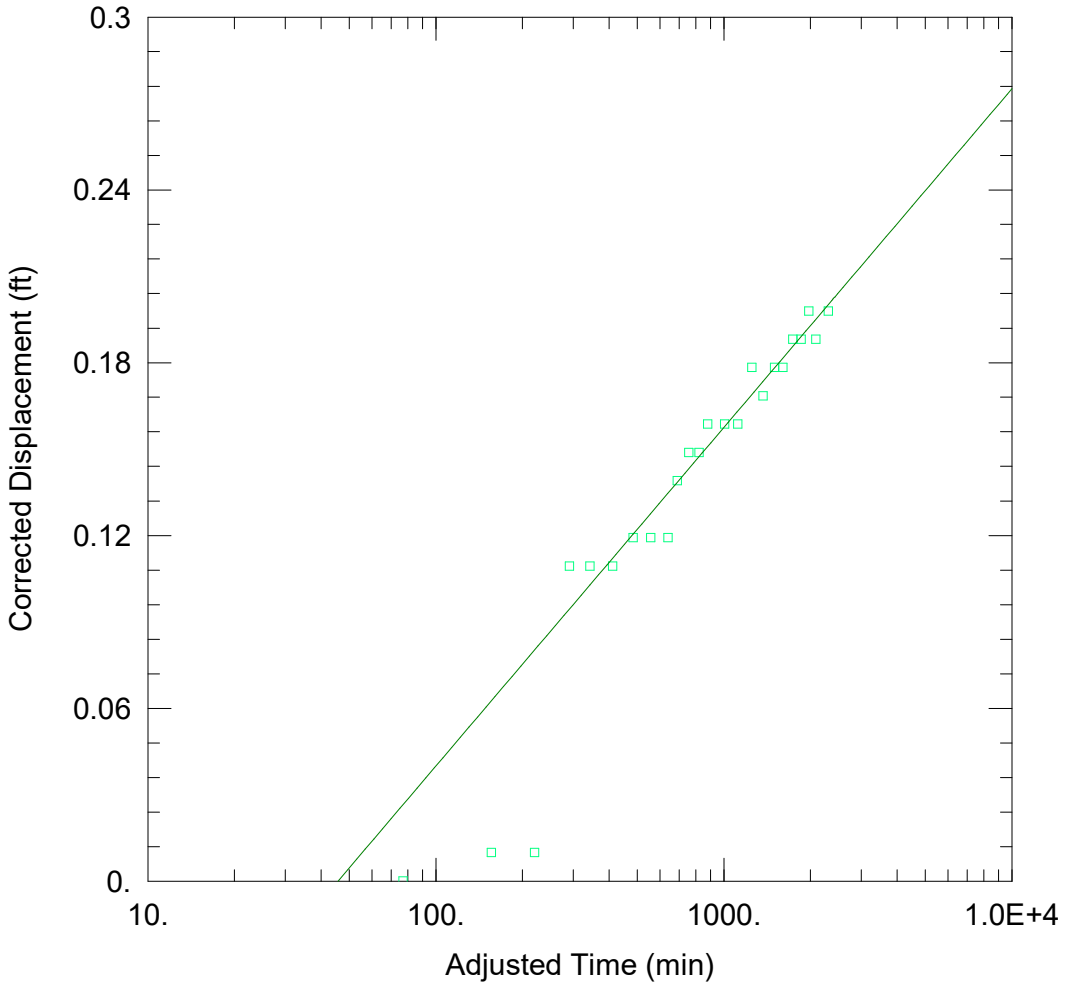
SOLUTION

Aquifer Model: Unconfined

Solution Method: Cooper-Jacob

T = 440. ft^2/day

S = 0.16



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: OBG
Test Well: RW-5
Test Date: 09/26/2017

AQUIFER DATA

Saturated Thickness: 10. ft

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RW-5	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
MW-38	36.7	0

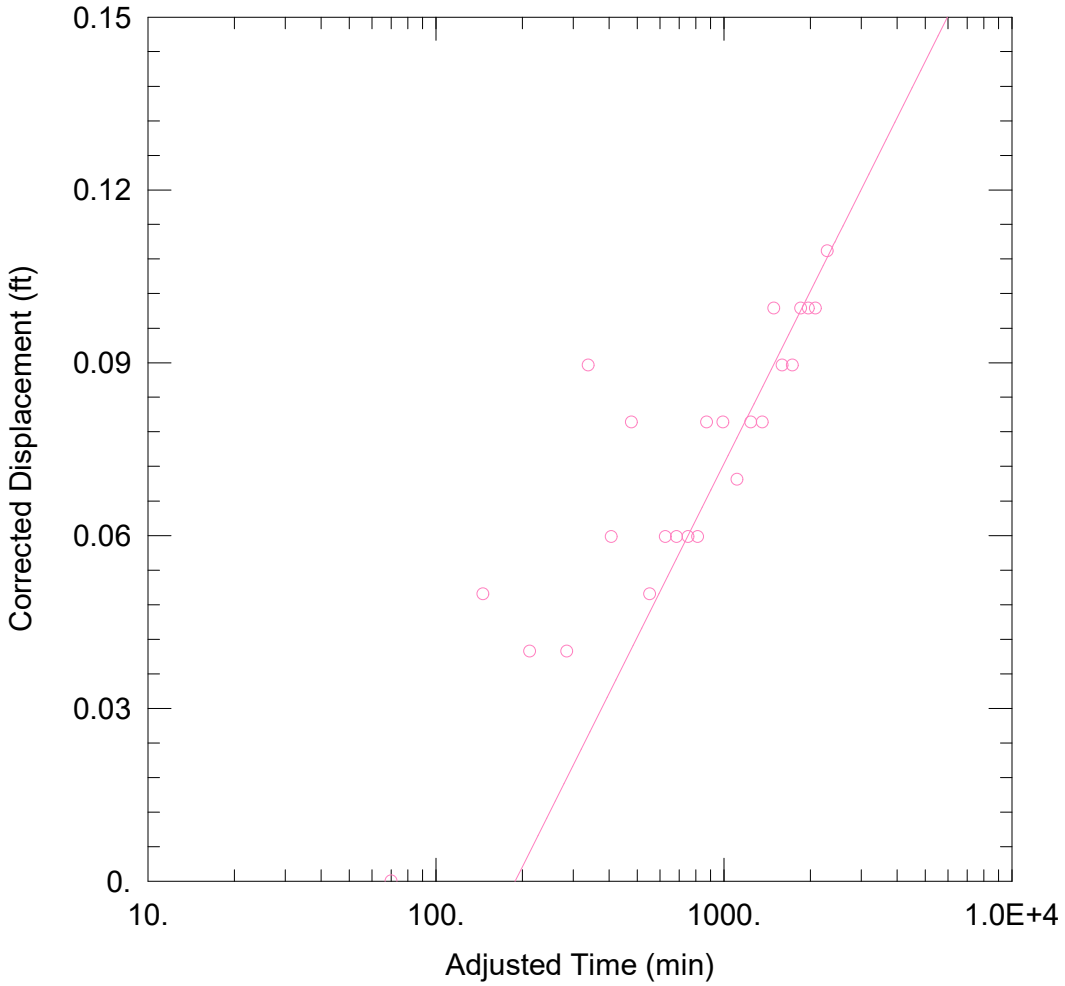
SOLUTION

Aquifer Model: Unconfined

Solution Method: Cooper-Jacob

T = 510. ft^2/day

S = 0.027



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: OBG
Test Well: RW-5
Test Date: 09/26/2017

AQUIFER DATA

Saturated Thickness: 10. ft

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RW-5	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
○ MW-35	50.2	0

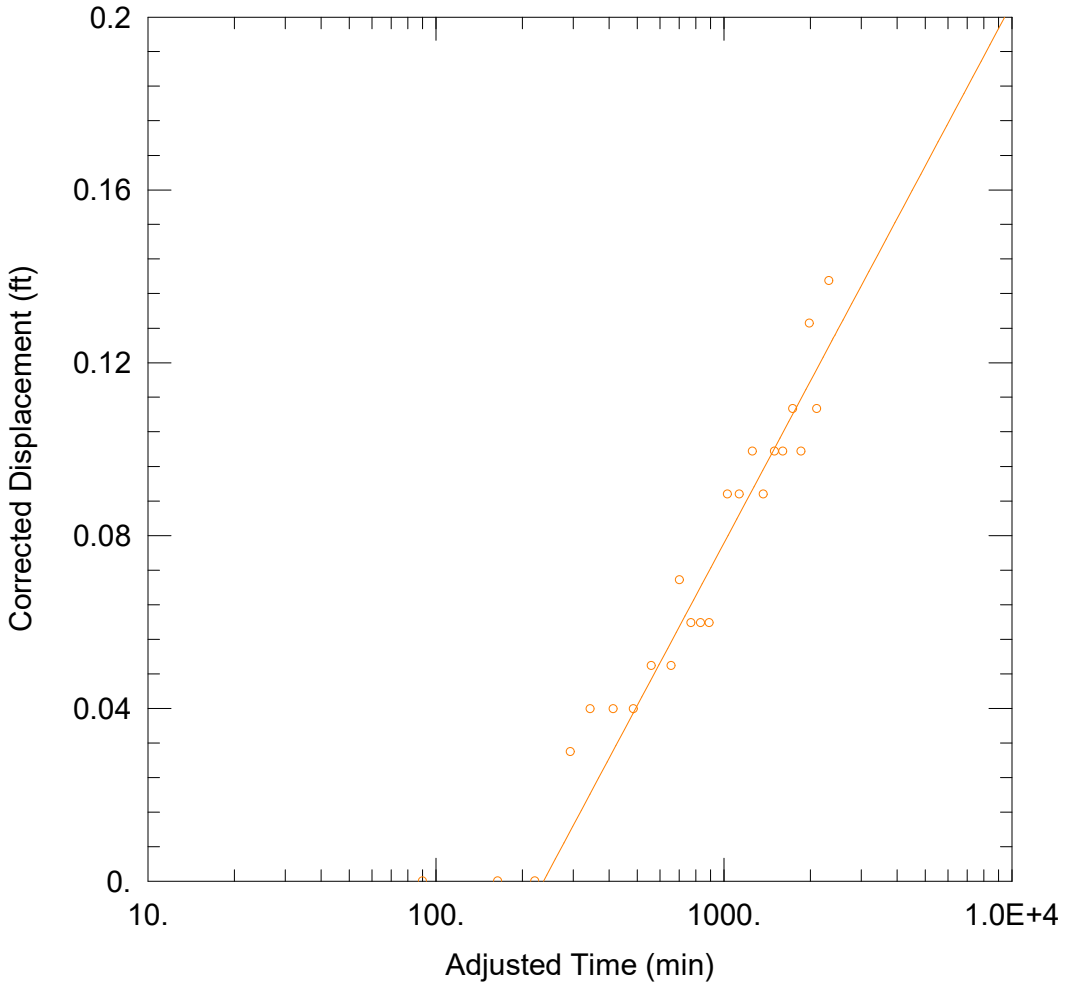
SOLUTION

Aquifer Model: Unconfined

Solution Method: Cooper-Jacob

T = 600. ft^2/day

S = 0.07



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: OBG
Test Well: RW-5
Test Date: 09/26/2017

AQUIFER DATA

Saturated Thickness: 10. ft

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RW-5	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
◦ MW-26	59.5	0

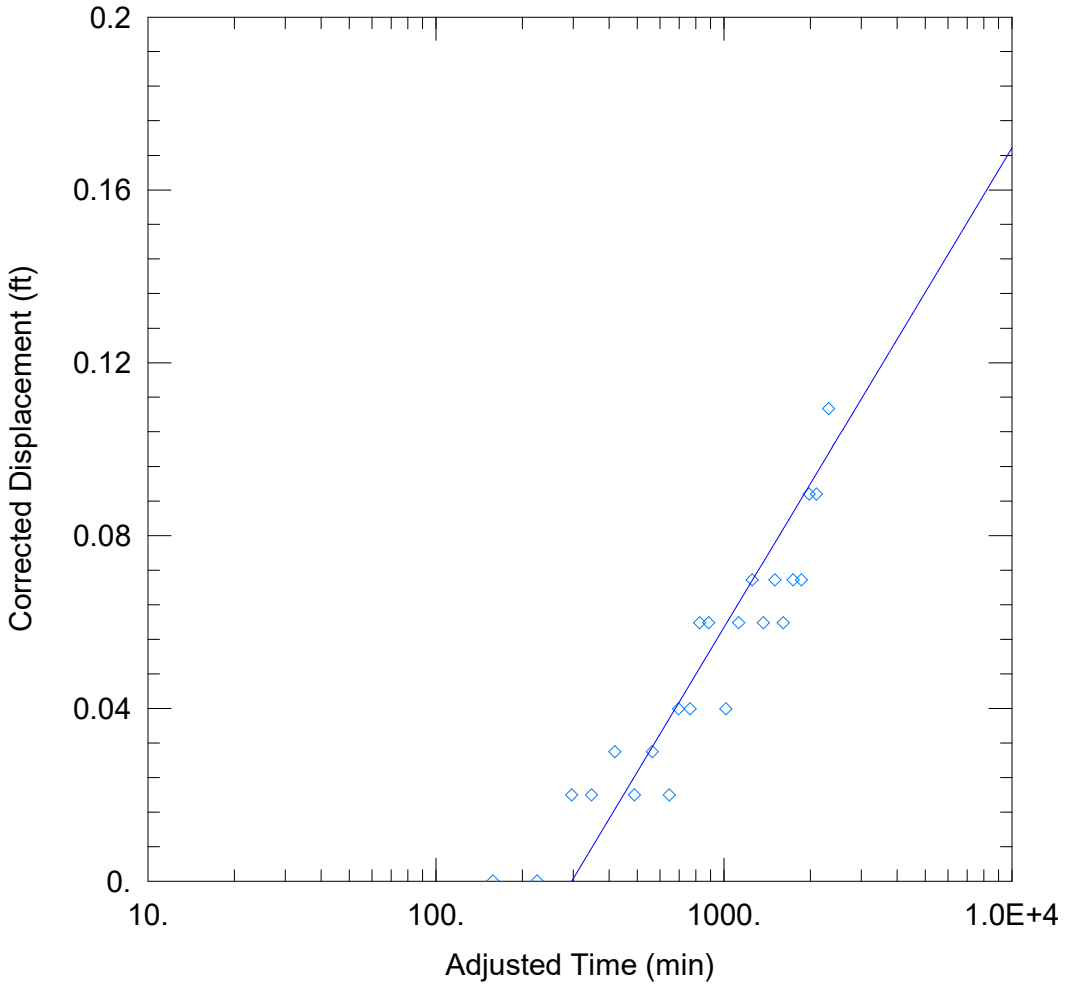
SOLUTION

Aquifer Model: Unconfined

Solution Method: Cooper-Jacob

T = 480. ft^2/day

S = 0.05



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: OBG
Test Well: RW-5
Test Date: 09/26/2017

AQUIFER DATA

Saturated Thickness: 10. ft

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RW-5	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
◇ MW-23	99.9	0

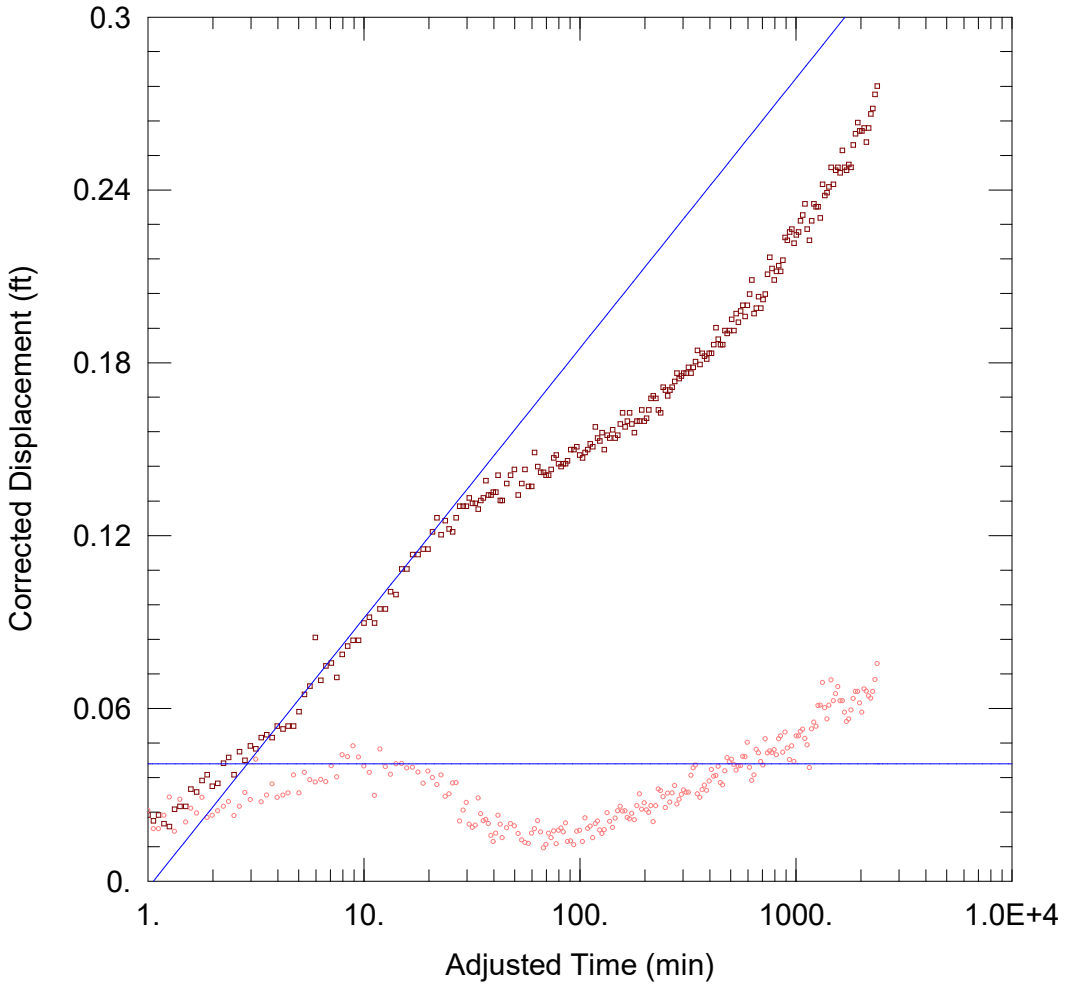
SOLUTION

Aquifer Model: Unconfined

Solution Method: Cooper-Jacob

T = 540. ft^2/day

S = 0.025



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: OBG
Test Well: RW-5
Test Date: 09/26/2017

AQUIFER DATA

Saturated Thickness: 10. ft

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RW-5	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
MW-36 (Transducer)	4.2	0

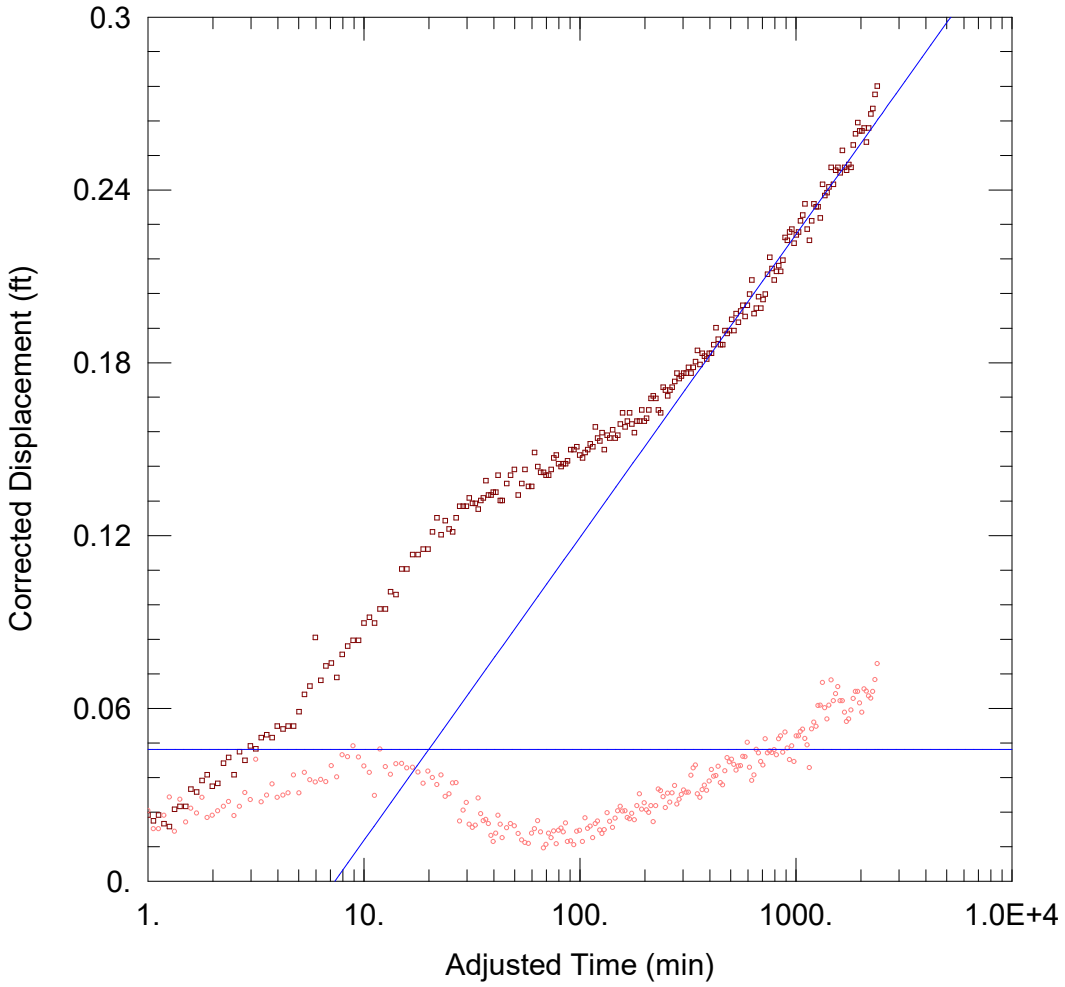
SOLUTION

Aquifer Model: Unconfined

Solution Method: Cooper-Jacob

T = 640. ft^2/day

S = 0.06



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: OBG
Test Well: RW-5
Test Date: 09/26/2017

AQUIFER DATA

Saturated Thickness: 10. ft

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RW-5	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
MW-36 (Transducer)	4.2	0

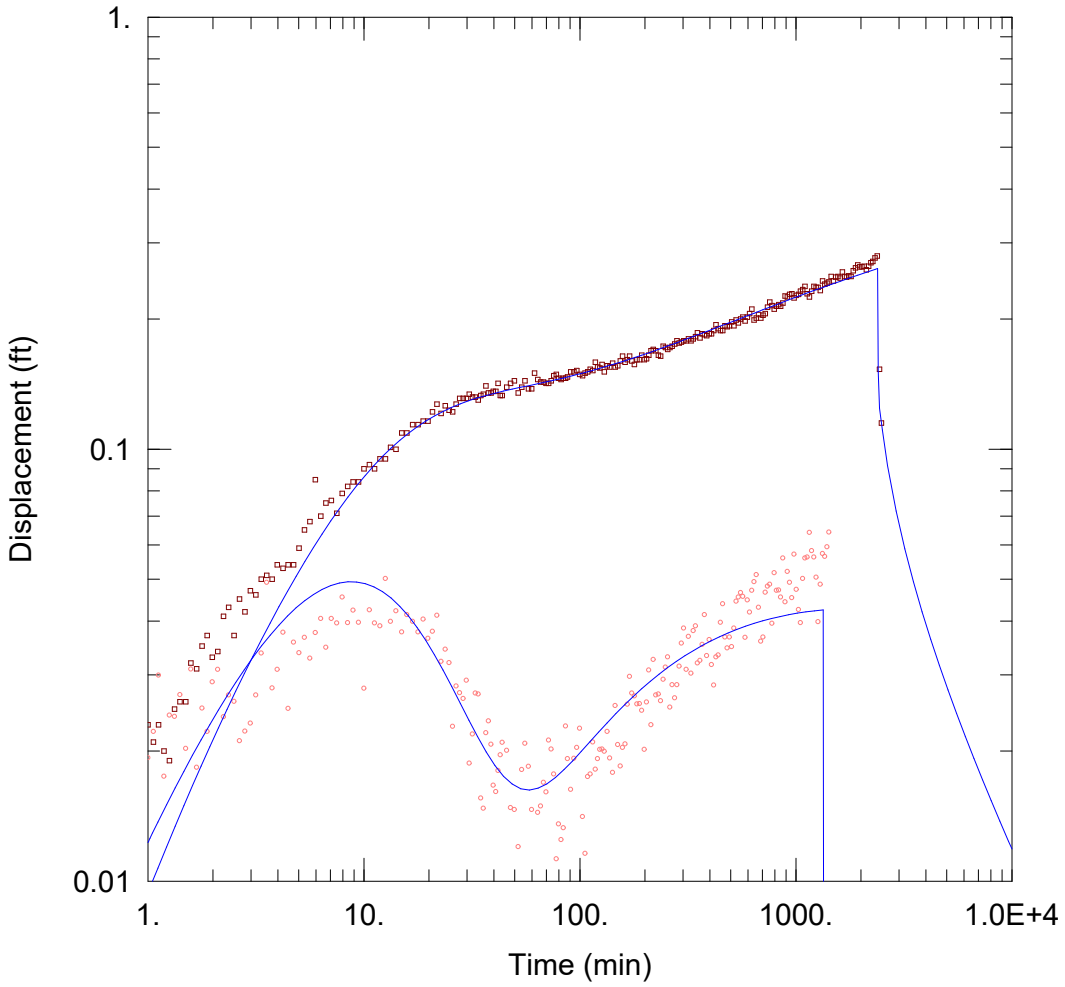
SOLUTION

Aquifer Model: Unconfined

Solution Method: Cooper-Jacob

T = 570. ft^2/day

S = 0.37



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: OBG
Test Well: RW-5
Test Date: 09/26/2017

AQUIFER DATA

Saturated Thickness: 10. ft

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RW-5	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
MW-36 (Transducer)	4.2	0

SOLUTION

Aquifer Model: Unconfined

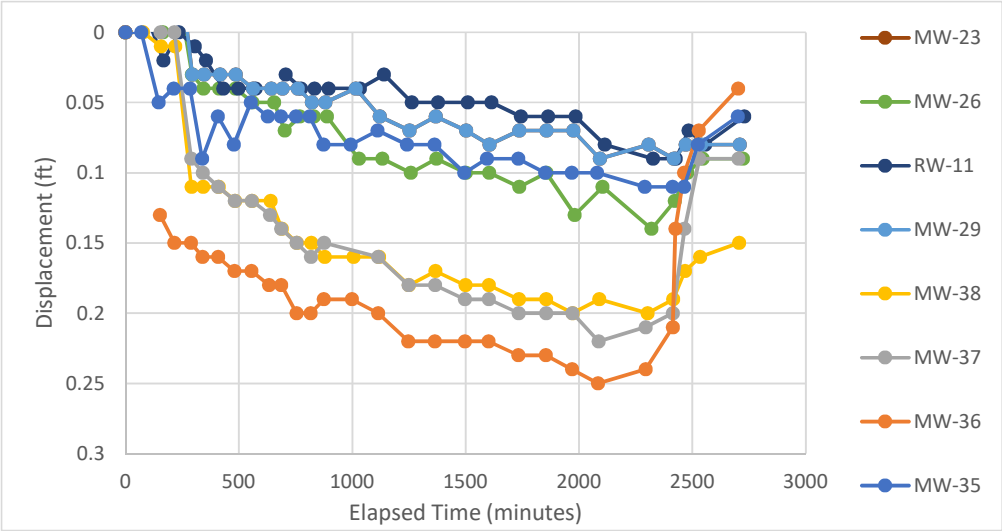
Solution Method: Moench

T = 600. ft^2/day
Sy = 0.3
Sw = 2.
r(c) = 1.2 ft

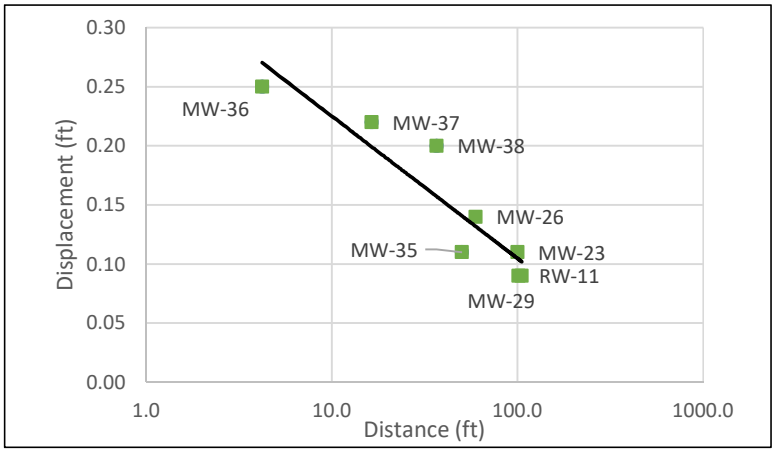
S = 0.003
Kz/Kr = 0.1
r(w) = 1. ft
alpha = 1.0E+30 min^{-1}

Attachment C

Distance-Drawdown Analysis



Well	Distance (ft)	Drawdown (ft)
RW-5	0.5	7.93
MW-36	4.2	0.25
MW-37	16.4	0.22
MW-38	36.7	0.20
MW-35	50.2	0.11
MW-26	59.5	0.14
MW-23	99.9	0.11
RW-11	101.2	0.09
MW-29	105.4	0.09



$$T = \frac{2.3Q}{4pi\Delta s}$$

$$S = \frac{2.25Tt}{r_0^2}$$

Pumping Rate, RW-5	1.7	gpm
Test Duration	2392	minutes
Transmissivity, T	497	ft2/d
Aquifer Thickness, b	10	feet
Hydraulic Conductivity, K	**49.7**	ft/d
Storativity, S	**0.003**	

Attachment C
Distance-Drawdown Analysis: RW-5 Test
2017 RW-5 Pumping Test Memo
Former South Plant MGP
Waukegan, Illinois

OBG

Appendix J

Hydraulic Modeling Memorandum

TO:	Marcus Byker, PE	cc:	Brian Hennings, PG
FROM:	Katie Moran, PG		
RE:	South Plant Former MGP Site Groundwater Model Technical Memo		
FILE:			
DATE:	January 7, 2019		

This technical memorandum documents groundwater modeling activities in support of interim remedial design for the North Shore Gas Company Former South Plant Manufactured Gas Plant (MGP) site located in Waukegan, Illinois (Site). A site-specific groundwater flow model was developed to simulate site groundwater conditions and evaluate groundwater well configurations and flow rates for the proposed simultaneous extraction and injection components of the dense non-aqueous-phase liquids (DNAPL) recovery remedy. This technical memo consists of the following sections:

- Review of the site setting, geology/hydrogeology, and conceptual site model
- Construction of the groundwater flow model
- Calibration of the groundwater flow model to observed Site groundwater conditions
- Presentation and discussion of remedial simulation results

BACKGROUND

The following sections describe the site setting, site geology and hydrogeology, and the conceptual site model.

SITE SETTING

The Site is located in the town of Waukegan, Illinois, on the western shore of Lake Michigan (Figure 1). As described in the Preliminary Design Report and preceding documents, the 1.9-acre property is currently vacant. MGP residuals, including DNAPL have been identified on the property and at adjacent properties, which include the Waukegan Port District marina and associated buildings and parking, the Akzo Nobel Aerospace Coating facility and parking lots, and other unoccupied parcels. Waukegan Harbor (Harbor) and Lake Michigan are located approximately 600 feet east of the former MGP. Ground surface cover varies - some parcels are vacant and vegetated, and other areas on or near the Site are occupied by buildings or pavement for parking lots and roads.

SITE GEOLOGY

The Site is located in a low-lying area near Lake Michigan; ground surface is relatively flat with a gentle slope towards the Harbor. The subsurface geology at the Site consists of fill and unconsolidated sediments underlain by a clay confining unit, with dolomitic bedrock approximately 50 feet or more below ground surface (bgs).

Fill is present from approximately 2 to 20 feet bgs at the Site. Permeable sands are encountered below the fill and form the primary water-bearing unit at the Site. The thickness of the sand unit varies between approximately 6 and 20 feet, and generally increases from west to east. The 2017 pre-design investigation (PDI) activities indicated variability in the composition of the sand unit, with areas of gravels and silty-sand.

The sand unit is underlain by a thick layer of silt and clay. This surface dips from the west to the east, towards the Harbor. Stiff clay is encountered at depths of less than 20 feet bgs at the western areas of the Site. The clay material belongs to the Wedron Group, which varies between 30-40 feet thick in the vicinity of Lake Michigan. The 2017 PDI indicated the presence of up to 25 feet of fine grained silty material overlying the clay in the eastern portion of the Site. The top of these fine-grained materials forms a low-permeability barrier to vertical migration of DNAPL, documented during the PDI.

SITE HYDROGEOLOGY AND CONCEPTUAL MODEL

A conceptual groundwater flow model is a narrative description of the principle components of a groundwater flow system and is developed from regional, local, and site-specific data. A groundwater flow system is described by the extent, configuration, and characteristics of relevant aquifers and aquitards, including: their hydraulic properties; recharge to and discharge from these units, both natural and from anthropogenic influences (sources and sinks); and, the areal and vertical distributions of hydraulic head. These aquifer system components serve as the framework for the construction of a numerical groundwater flow model.

Groundwater flow at the Site occurs within the unconsolidated sand and fill materials, with the water table encountered at 4-8 feet bgs. Results of hydraulic testing indicate this unit is relatively transmissive, with estimated hydraulic conductivities of 15-60 feet per day (ft/d). The shallow sand aquifer is underlain by a low-permeability clay and silt aquitard.

The spatial extent of the shallow sand aquifer is limited by the outcropping of a stiff clay of the Wedron Group at a bluff to the west of the Site. Recharge to groundwater in this area consists of local infiltration of precipitation and minor runoff along the edge of the bluff. Shallow groundwater in this unit generally flows west to east, towards the Harbor and Lake Michigan. Localized flow directions at the Site are influenced by low-permeability sheet pile installed along the Harbor, which extends to approximately 22 feet bgs; and, by the Waukegan River, which flows into Lake Michigan south of the Site and functions as a groundwater discharge boundary under normal flow conditions.

GROUNDWATER FLOW MODEL DEVELOPMENT

The development process for a numerical groundwater flow model consists of construction of a finite-difference grid for the model area, specification of model structure, assignment of boundary conditions, specification of hydraulic parameter values and zones, and selection of appropriate water-level measurements for calibration of the model. These features represent elements of the conceptual site model, which provides the basis for the construction and calibration of the numerical model to observed groundwater flow conditions at the Site.

CODE SELECTION AND DESCRIPTION

For the construction and calibration of the numerical groundwater flow model for the Site, OBG selected the model code MODFLOW, a publicly-available groundwater flow simulation program developed by the U.S. Geological Survey (USGS) (Harbaugh et al 2000). MODFLOW is thoroughly documented, widely used by consultants, government agencies and researchers, and is consistently accepted in regulatory and litigation proceedings. MODFLOW can simulate transient or steady-state saturated groundwater flow in three dimensions and offers different types of boundary conditions including specified head, areal recharge, injection or extraction wells, evapotranspiration, horizontal flow barriers, drains, and rivers. Aquifers simulated by MODFLOW may be confined or unconfined, or convert between confined and unconfined conditions.

MODEL DISCRETIZATION

The finite-difference technique employed in MODFLOW to simulate hydraulic head distributions in multi-aquifer systems requires areal and vertical discretization, or subdivision of the continuous aquifer system into a set of discrete blocks that form a three-dimensional model grid. In the block-centered finite-difference formulation used in these codes, the center of each grid block corresponds to a computational point or node. When MODFLOW solves the set of linear algebraic finite-difference equations for the complete set of blocks, the solution yields values of hydraulic head at each node (or three-dimensional block) in the three-dimensional grid.

Water levels computed for each block represent an average water level over the volume of the block. Thus, adequate discretization (i.e., a sufficiently fine grid) is required to resolve features of interest, and yet not be computationally onerous. MODFLOW enables variable grid spacing to permit a finer grid in areas of interest where greater accuracy is required and a coarser grid in areas requiring less detail. The boundaries of the model

grid are specified to coincide with natural hydrogeologic boundaries where possible, with other boundaries set back sufficiently from the Site area to minimize potential influence on simulation results.

Figure 2 presents the extent of the three-dimensional numerical model for the Site and simulated boundary conditions. This flow model is bounded by Lake Michigan / the Harbor to the east. The western edge extends just beyond the natural boundary of the shallow aquifer at the outcrop of the clay (Wedron Group). The model domain is rotated 90 degrees counter-clockwise to align the primary direction of groundwater flow with the model y-axis. The model domain covers an area of approximately 2,000 feet by 3,000 feet. The finite-difference grid is composed of 371 columns, 357 rows, and 3 layers, for a total of 397,341 nodes (of which 382,878 are active). Variable model grid spacing of 3 to 30 feet allowed fine resolution for the area of interest while maintaining a reasonable number of total grid nodes.

The elevation and thickness of the model layers were delineated from Site boring logs and regional information. Site hydrogeologic structure is represented by three vertical layers in the model. Model layers 1 and 2 represent the permeable alluvium and fill that correspond to the shallow sand aquifer. Model layer 1 is of variable thickness; model layer 2 is set to a uniform thickness of 3 feet, to represent the zone of potential DNAPL presence / migration for remedial simulations. The bottom elevation of model layer 2 is consistent with the DNAPL migration barrier surface, identified in previous site borings and further delineated during PDI activities (Figure 4). Model layer 3 represents the generally low-permeability fine grained silty materials below the DNAPL barrier, which are present at greater thickness in the eastern portion of the Site. The base of the model is represented by a no-flow boundary coincident with the top of the clay.

BOUNDARY CONDITIONS

Boundary conditions define the spatial boundaries of the model on the top, bottom, and all sides of the model grid. Additional boundary conditions within the model domain can be specified to represent groundwater sources or sinks, or flow-specified or limiting conditions. This flow model includes four types of boundary conditions: constant head (specified head), no-flow, recharge (specified flux), and drain (head-dependent flux). The locations and types of boundary conditions are presented in Figure 2. Predictive simulations also specify well boundaries (constant flux) for groundwater injection and extraction.

The Harbor / Lake Michigan are represented in all model layers as a constant-head boundary, at 580.53 feet above mean sea level (ft amsl). This functions as the principal discharge boundary in the groundwater model. Additional water is discharged through the drain boundary representing the Waukegan River (model layer 1 only). Limited characterization information is available for the Waukegan river, therefore, a calibration-based approach for assignment of drain cell properties was selected (instead of a parameter-based approach using measured or estimated values of drain-bed thickness and drain hydraulic conductivity).

No-flow boundaries are specified at the outcrop of the clay unit, west of the Site area, which represents a physical boundary. No-flow boundaries define the southern and northern edges of the model domain, parallel to groundwater flowlines under existing ambient flow conditions (hydraulic boundaries); the simulated no-flow boundaries are located at sufficient distance from the area of interest to minimize influence on groundwater flow at the Site for predictive simulations. Figure 3, which compares simulated flow model groundwater elevations for the calibrated model and remedial scenario 1A along a transect perpendicular to the no-flow boundaries at the north and south edges of the model, supports the placement of the northern no-flow boundary as sufficiently distant from the area of interest to avoid flow line distortion at the boundary due to changes in flow within remedial simulations.

Recharge flux was applied to the uppermost layer of the model. Inflow from recharge of precipitation is the only source of water to the model for ambient flow conditions. Precipitation in the Chicago area averages approximately 37 inches per year (in/yr, National Weather Service); background recharge values of 7 – 12 in/yr were evaluated during model calibration. A narrow zone of high recharge (32.9 in/yr) was specified along the western edge of the active model area to simulate runoff from the bluff.

HYDRAULIC CONDUCTIVITY

In constructing the model for the Site, representative values for horizontal and vertical hydraulic conductivity of various hydrogeologic units were selected based on the results of hydraulic testing conducted at the site as well as regional information. The model was constructed with uniform hydraulic conductivity in each layer, except for a one-cell (3-foot) wide zone placed in each layer to represent the sheet pile along the edge of the Harbor at the marina. The sheet pile was simulated with an isotropic hydraulic conductivity of 0.1 ft/d in model layers 1 and 2, and 0.2 ft/d in model layer 3 to represent its partial penetration through that unit. The sheet pile at the harbor was constructed in 1982 of 24-inch-wide CZ128 cold rolled steel sheets.

During model calibration, values of hydraulic conductivity for the remaining zones were adjusted within a reasonable range to minimize the difference between observed and simulated groundwater elevations.

GROUNDWATER FLOW MODEL CALIBRATION

Calibration of a groundwater flow model refers to the iterative process of adjusting model parameters and boundary conditions to obtain a reasonable match between observed conditions and simulation results. The calibration of a groundwater model should rely on discrete measurements of groundwater elevation to avoid the potential for interpretive bias that may result from attempting to match a contoured potentiometric surface (Konikow 1978; Anderson and Woessner 1992).

CALIBRATION TARGETS

The primary criterion for evaluating the calibration of a groundwater flow model is the difference between observed and simulated water levels at a set of calibration targets. Calibration targets are a set of field measurements, typically groundwater elevations. For the calibration of a steady-state (time-invariant) model, the goal in selecting calibration targets is to define a set of water level measurements that represent the average elevation of the water table or potentiometric surface at locations throughout the Site.

Site groundwater elevation data collected since 2010 were evaluated for flow model calibration target selection. Monitoring wells at the Site are screened at different intervals within the shallow sand aquifer; water levels are relatively consistent over time, with less than two feet of variation observed within the past several years. A set of 68 groundwater elevations measured on October 9-11, 2017 was selected as calibration targets (Table 1). Groundwater elevations measured during October 2017 were near the upper end of the range of water levels measured at the Site, which is considered to be conservative for the objective of estimating maximum flow rates for the proposed simultaneous injection and extraction.

MODEL CALIBRATION AND SENSITIVITY TESTING

A model residual is defined as the calculated difference between the observed and simulated hydraulic head at a specific location (observed – simulated). A positive residual indicates that the model is under-predicting observed water levels, accordingly, a negative residual indicates over-prediction of observed conditions. Residual statistics are used to quantify and evaluate the relative fit of a model simulation to measured water level targets. The mean of model residuals is a representation of overall model bias; a value near zero is desired. The residual standard deviation indicates the magnitude and spread of the residuals. A residual standard deviation of less than 10% of the total range of water level targets is considered acceptable (0.35). The residual sum-of-squares (RSS) is a metric to evaluate the overall model fit, with the objective of minimizing this value throughout the calibration process.

Calibration of the groundwater flow model required numerous individual simulations in an iterative process. During calibration, hydraulic conductivity values, drain conductance values, and recharge were adjusted, both by trial-and-error and using parameter estimation techniques, until a reasonable solution was achieved. Calibration targets were used to evaluate the model calibration by analyzing the simulated hydraulic head distributions at the Site and the residual statistics.

During the model calibration process and subsequent sensitivity testing to evaluate the degree of change in model results for various parameter adjustments, it became clear that due to the relative simplicity of the model geometry, in which the primary discharge boundary parallels the upgradient no-flow boundary, similar and satisfactory residual statistics could be obtained for a range of hydraulic conductivity and areal recharge values. As a result, two model calibrations were completed for evaluation. The primary model calibration (Primary Calibration) uses an estimated hydraulic conductivity of 50 ft/d (the approximate average result from the PDI constant-rate test) for model layers 1 and 2. However, some uncertainty exists in the characterization of hydraulic conductivity across the Site, due to the limitations on hydraulic testing in an area with measurable DNAPL thickness in monitoring wells, and variations in material observed within the sand unit identified in the PDI. Additionally, both the estimated flow rates and the required well spacing for the proposed remedial design of simultaneous extraction and injection are sensitive to hydraulic conductivity. For these reasons, a second model calibration (Alternate Calibration) was executed. The Alternate Calibration uses a hydraulic conductivity of 30 ft/d for model layers 1 and 2. The objective for selecting a hydraulic conductivity value consistent with the lower end of the estimated range for the Alternate Calibration is to provide a more conservative (lower limit) estimate of minimum remedial well spacing.

Simulated groundwater elevations and model residuals for the primary and alternate model calibrations are presented on Table 1 and in Figures 5 and 6. The residual statistics and simulated hydraulic head distributions for each calibration indicate a high degree of model calibration and a satisfactory model match to observed groundwater flow conditions. Finalized parameters and results for each model calibration, specifically the hydraulic conductivity, recharge, and model flow balances, are presented on Table 2.

REMEDIAL SIMULATIONS

Steady-state remedial simulations were performed using the calibrated model to estimate total flow rates and evaluate well spacing and hydraulic gradients for the proposed waterflooding remedy. Remedial scenarios consisted of simulating groundwater extraction and injection using MODFLOW well boundary cells. Vertical extraction wells were simulated in model layer 2. Vertical injection wells and horizontal injection wells were placed in model layer 1. Figure 7 presents the initial simulated saturated thickness above the DNAPL migration barrier, which coincides with the bottom of model layer 2. Posted values on Figure 7 represent the initial saturated thickness at a series of well points, to aid evaluation of drawdown and mounding at well points for the remedial scenarios.

The following objectives were considered for the simulation of remedial well configurations:

- **Avoid dewatering below initial DNAPL surface at extraction points** - Obtaining maximum DNAPL extraction during waterflooding requires avoiding any flow of water through previously-DNAPL saturated material at or near the extraction well. For these scenarios, extraction well rates were decreased as necessary to avoid fully dewatering model layer 1 and ensure a minimum well screen saturation of 3 feet across model layer 2.
- **Prevent mounding within 2 feet of ground surface at the injection wells** - Potential daylighting of injected fluids was evaluated through comparison of simulated groundwater elevations to ground surface elevations.
- **Increase total and per-well rates to maximize groundwater gradients** - Waterflooding to mobilize and extract DNAPL from the surface is dependent on maintaining increased hydraulic gradient towards the extraction wells.
- **Maintain hydraulic control within the delineated extent of potentially-recoverable DNAPL (DNAPL footprint)** - A potential result of simultaneous extraction and re-injection at equivalent flow rates is escape of fluids outside the capture zone of the extraction wells. Simulated flow directions were qualitatively evaluated to identify locations within the DNAPL footprint that may be at risk of escape from extraction well capture. Locations of individual wells were adjusted as necessary to maximize containment.

REMEDIAL SCENARIOS

Two remedial scenarios are presented. Scenarios 1A and 1B specify the revised well layout discussed in meetings with the USEPA, with considerations for property access on adjacent parcels. The difference between Scenarios 1A and 1B is the base calibration; Scenario 1A uses the Alternate Calibration (30 ft/d hydraulic conductivity in model layers 1 and 2), and Scenario 1B uses the Primary Calibration (50 ft/d hydraulic conductivity).

- Scenario 1A consists of simultaneous extraction and injection of water at a total flow rate of 137 gallons per minute (gpm). 30 vertical extraction wells are simulated in model layer 2. Extraction wells in the eastern area of the Site withdraw 6 gpm each; extraction wells to the west withdraw 3-4 gpm each. 13 vertical injection wells are simulated with rates of 4 or 6 gpm. Three horizontal injection wells are specified in model layer 1. Scenario 1A uses the Alternate Calibration of the model as a base for the simulation. Figure 8 presents the well configuration, simulated groundwater elevations, and per-well flow rates and head change for Scenario 1A.
- Scenario 1B consisted of the equivalent remedial design as for Scenario 1A, however the Primary Calibration hydraulic conductivity value (50 ft/d in model layers 1 and 2) was used as a base for this simulation. Results of this simulation are presented on Figure 9.

The design and results for each remedial scenario are summarized on Table 3. Simulated groundwater elevations are presented in Figures 8 and 9. These figures also designate the per-well and total flow rates for each scenario, and the water level drawdown or mounding simulated at extraction or injection locations, respectively.

Evaluation of gradients and well efficiency

An evaluation of induced gradients and potential well efficiencies was performed for Scenarios 1A and 1B (Figures 10 and 11). The waterflooding remedy concept is based on increasing hydraulic gradients to optimize DNAPL recovery; hydraulic gradients were calculated for a series of specific injection-extraction transects to provide a basis for comparison of the two scenarios. As expected, induced gradients for scenario 1A (lower hydraulic conductivity) were higher than for Scenario 1B, for equivalent flow rates.

Well efficiency should be considered in a waterflooding remedy given the importance of avoiding dewatering below the top of the DNAPL at the well screen. Well efficiency is defined as the ratio of aquifer losses (drawdown in the aquifer) to observed drawdown in the well. Efficiency is a well-specific property, determined by well construction and development, and measured at a particular well through well performance testing (step-drawdown testing and/or multi-well aquifer testing). Required well efficiencies for remedial scenarios were calculated at each extraction well by comparing simulated drawdown (posted values on Figures 8 and 9) to the maximum permissible drawdown at each location, defined at the top of model layer 2 (minimum 3 feet of saturated thickness within DNAPL zone). The well efficiencies presented on the inset tables on Figures 10 and 11 represent the minimum well efficiencies required at each location to obtain the remedial scenario well rates without fully dewatering model layer 1.

Calculation of minimum well efficiency at each extraction well incorporated a head correction factor to account for well diameter and model grid size. The 95% design documents specify an extraction well borehole diameter of 10 inches (r_w = 0.41 ft). An effective well block radius of r_e=0.62 ft was calculated using the Prickett (1967) equation for uniform model grid cells dy=dx=3 ft (for the well-containing cells in this model). The calculated value for r_e is greater than the design value r_w, therefore correction is required to calculate h_w (head in the well) from h_{block} (head at the model node as calculated by MODFLOW). For an unconfined system, this equation takes the following form (Anderson and Woessner, 1992, p.149):

$$h_w = \sqrt{h_{block}{}^2 - \frac{Q}{\pi K} \ln \frac{r_e}{r_w}}$$

The differences between h_w and h_{block} at each of the simulated extraction wells vary between 0.2 and 0.56 ft (Scenario 1A) and 0.1 and 0.19 ft (Scenario 1B).

Evaluation of capture

MODPATH is a particle tracking code developed by the USGS as a tool to evaluate groundwater flowpaths within a MODFLOW model (Pollock, 1994). The results of particle tracking provide visualization of advective flow lines and identification of specific groundwater sources and sinks. Preliminary MODPATH analysis was conducted for Scenario 1A to evaluate capture from within the DNAPL footprint (Figure 12). Particle starting locations were specified in the center of each grid cell within the DNAPL footprint, in model layer 2; forward tracking of particles identified areas with incomplete capture (receptor of the harbor / lake). MODPATH results indicate that particles within the DNAPL footprint are captured by Scenario 1A extraction wells, excepting three small areas of incomplete capture (Figure 12).

Modeling assumptions

Assumptions incorporated into model construction and simulation of remedial scenarios include the following:

- Model simulations were performed to evaluate the hydraulics of the groundwater system; DNAPL was not explicitly represented or simulated in the flow model.
- Remedial simulations were steady-state, assuming long-term system operation.
- Extraction and injection wells were simulated using the basic well package in MODFLOW. Potential well losses were evaluated at extraction wells by calculating minimum well design efficiencies, as discussed above and presented in Figures 10 and 11. Further refinement of extraction and injection well simulation may be performed using the results from Phase 1 implementation.

DISCUSSION OF RESULTS

Evaluation of remedial scenario simulations indicated the following:

- **The proposed remedial well configurations and simulated groundwater aquifer are capable of supporting a high total flow rate** - Scenarios 1A and 1B indicate that dewatering of extraction wells below the top of model layer 2 does not occur at the simulated 139 gpm total flow rate. This flow rate was identified through iterative modification of extraction well rates; while minor enhancements to this rate may be possible through further per-well rate adjustment, a significant increase in extraction rates will likely result in undesirable dewatering for the lower hydraulic-conductivity model or require different well spacing to achieve more uniform dewatering within DNAPL footprint (closely-spaced wells with lower per-well flow rates).
- **A well spacing of 50 feet is appropriate for simulated flow conditions** - Remedial scenarios indicate that a 50-foot extraction well spacing is appropriate for the range of aquifer specifications that were simulated. Specifically, this well spacing supports moderate per-well pumping rates without dewatering into the DNAPL zone (simulated as 3 feet, model layer 2) for a simulated hydraulic conductivity of 30 ft/d. Further refinement of well spacing may be performed to optimize drawdown or hydraulic gradients following Phase 1 implementation.
- **Higher rates of pumping may be obtained at the eastern portion of the Site** - The overall saturated thickness of saturated aquifer material is greater near the Harbor than further upgradient; accordingly, this area supports higher per-well extraction and injection flow rates.
- **The sheet pile wall limits capture of water from the Harbor by the extraction system** - Simulated flow rates produce minimal inflow from the Harbor even for significant volumes of groundwater extraction.
- **Simulated system configurations do not result in significant loss of containment from the existing DNAPL delineation area** - Preliminary MODPATH pathline analysis indicated few areas of incomplete capture within the DNAPL footprint. Further evaluation of containment from the recirculation system using MODPATH may be performed following Phase 1 implementation.

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ATTACHMENTS

TABLES

FIGURES

Tables

Table 1. Calibration Statistics

Appendix J - Groundwater Model Technical Memo
Former South Plant Manufactured Gas Plant Site
Waukegan, IL
North Shore Gas, CERCLIS ID - ILD984809228

		Primary Calibration		Alternate Calibration	
Well ID	**Observed groundwater elevation (ft amsl)**	**Simulated groundwater elevation (ft amsl)**	**Residual (observed-simulated, ft)**	**Simulated groundwater elevation (ft amsl)**	**Residual (observed-simulated, ft)**
AKZO-MW01D	583.53	583.09	0.44	583.03	0.50
AKZO-MW02D	582.99	582.95	0.04	582.89	0.10
AKZO-MW03D	583.03	582.89	0.14	582.86	0.17
AKZO-MW04D	582.53	582.39	0.14	582.30	0.23
AKZO-MW05S	582.61	582.53	0.08	582.41	0.20
AKZO-MW06D	582.30	582.06	0.24	581.93	0.37
AKZO-MW07D	582.80	582.58	0.22	582.46	0.34
AKZO-MW08D	582.78	582.60	0.18	582.44	0.34
AKZO-MW09D	581.55	581.42	0.13	581.30	0.25
AKZO-MW10	581.78	582.32	-0.54	582.05	-0.27
AKZO-MW18	581.11	581.17	-0.06	581.04	0.07
COW-MW01D	583.52	582.83	0.69	582.62	0.90
COW-MW02D	583.25	583.33	-0.08	583.26	-0.01
COW-MW03D	583.22	583.42	-0.20	583.38	-0.16
NSGSP-MW01	583.68	583.68	0.00	583.75	-0.07
NSGSP-MW02A	583.36	583.23	0.13	583.27	0.08
NSGSP-MW03A	582.98	583.18	-0.20	583.25	-0.28
NSGSP-MW04	583.24	583.43	-0.19	583.44	-0.20
NSGSP-MW23	584.18	584.04	0.14	584.14	0.04
NSGSP-MW24	584.61	584.26	0.35	584.45	0.16
NSGSP-MW25	584.17	584.00	0.17	584.10	0.07
NSGSP-MW26	583.79	583.81	-0.02	583.89	-0.10
NSGSP-MW27	584.51	584.22	0.29	584.36	0.15
NSGSP-MW28	584.34	584.20	0.14	584.32	0.02
NSGSP-MW29	583.96	584.16	-0.20	584.25	-0.29
NSGSP-MW30	584.06	583.87	0.19	583.99	0.07
NSGSP-MW31	583.94	583.78	0.16	583.92	0.02
NSGSP-MW32	583.58	583.73	-0.15	583.69	-0.11
NSGSP-MW33	583.76	584.01	-0.25	584.04	-0.28
NSGSP-MW34	583.55	583.77	-0.22	583.79	-0.24
NSGSP-MW35	583.60	583.74	-0.14	583.79	-0.19
NSGSP-MW36	583.55	583.74	-0.19	583.80	-0.25
NSGSP-MW37	583.72	583.83	-0.11	583.89	-0.17
NSGSP-MW38	583.81	583.88	-0.07	583.95	-0.14
NSGSP-MW39	583.79	583.92	-0.13	583.98	-0.19
NSGSP-MW40	583.72	583.99	-0.27	584.04	-0.32
NSGSP-MW41	583.78	583.75	0.03	583.83	-0.05
NSGSP-MW42	583.76	583.70	0.06	583.79	-0.03
NSGSP-MW43	583.96	583.73	0.23	583.88	0.08
NSGSP-MW51	584.51	584.24	0.27	584.40	0.11

Table 1. Calibration Statistics

Appendix J - Groundwater Technical Memo
Former South Plant Manufactured Gas Plant Site
Waukegan, IL
North Shore Gas, CERCLIS ID - ILD984809228

(continued from page 1)

		Primary Calibration		Alternate Calibration	
Well ID	**Observed groundwater elevation (ft amsl)**	**Simulated groundwater elevation (ft amsl)**	**Residual (observed-simulated, ft)**	**Simulated groundwater elevation (ft amsl)**	**Residual (observed-simulated, ft)**
SPPA-MW10	582.03	582.11	-0.08	581.91	0.12
SPPA-MW11	581.97	582.08	-0.11	581.91	0.06
SPPA-MW12	581.69	581.83	-0.14	581.70	-0.01
SPPA-MW13	581.15	581.47	-0.33	581.40	-0.25
SPPA-MW14	582.64	582.11	0.53	581.91	0.73
SPPA-MW15	581.22	581.11	0.11	581.11	0.11
SPPA-MW16	582.05	582.09	-0.04	582.04	0.01
SPPA-MW17	581.46	581.36	0.10	581.37	0.09
SPPA-MW18	582.27	582.05	0.22	582.11	0.16
SPPA-MW19	582.38	582.26	0.12	582.33	0.05
SPPA-MW2	582.21	582.84	-0.63	582.89	-0.68
SPPA-MW20	582.98	583.01	-0.03	583.13	-0.15
SPPA-MW21	582.73	582.77	-0.04	582.85	-0.12
SPPA-MW22	582.29	582.30	-0.01	582.32	-0.03
SPPA-MW3	582.43	582.42	0.01	582.41	0.02
SPPA-MW4	582.90	583.03	-0.13	583.03	-0.13
SPPA-MW44	582.14	582.28	-0.14	582.15	-0.01
SPPA-MW45D	582.21	582.32	-0.11	582.18	0.03
SPPA-MW46	582.62	582.64	-0.02	582.65	-0.03
SPPA-MW47D	583.25	583.41	-0.16	583.43	-0.18
SPPA-MW48	582.14	582.22	-0.08	582.06	0.08
SPPA-MW49	582.24	582.31	-0.07	582.16	0.08
SPPA-MW5	582.94	582.98	-0.04	582.91	0.03
SPPA-MW50	581.94	581.99	-0.05	581.80	0.14
SPPA-MW52	583.26	583.47	-0.21	583.47	-0.21
SPPA-MW7	581.68	581.36	0.32	581.25	0.43
SPPA-MW8	581.92	581.71	0.21	581.54	0.38

Residual Statistics	**Primary Calibration**	**Alternate Calibration**
Residual Mean	0.01	0.03
Absolute Residual Mean	0.17	0.18
Residual Standard Deviation	0.22	0.25
Sum of Squares	3.31	4.15
RMS Error	0.22	0.25

Table 2. Calibrated Model Parameters

Appendix J - Groundwater Model Technical Memo
Former South Plant Manufactured Gas Plant Site
Waukegan, IL
North Shore Gas, CERCLIS ID - ILD984809228

	Primary Calibration	Alternate Calibration	Notes / Comments
Hydraulic Conductivity (ft/d)			
Model Layers 1 and 2 (shallow sand aquifer)	50	30	
Model Layer 3 (low-permeability silt/clay)	0.1	0.1	
Sheet Pile- Layers 1 and 2 (3)*	0.1 (0.2)	0.1 (0.2)	conservative estimate for sheet pile
Recharge (in/yr)			
Upgradient Bluff Edge (one cell thickness)	32.9	32.9	
"Background" Areal Recharge	11.4	7.0	
Flow Volumes (cfd)			
Inflow - Recharge	10,740	6,921	
Outflow - Constant Heads (Harbor/Lake)	8,771 (81.7%)	5,407 (78%)	
Outflow - Drains (Waukegan River)	1,969 (18.3%)	1,520 (22%)	

Notes

1. The hydraulic conductivity of the sheet pile was increased in model layer 3 relative to layers 1 and 2 due to incomplete penetration of the sheet pile through this layer.

2. Anisotropy (Kv/Kh) was set to 0.1 for model layers 1-3. The anisotropy for the sheet pile was set to 1.

3. Model inflow / outflow rates have a small total flow error, of 0.13 and 4 cfd, respectively.

ft/d = feet per day: in/yr = inches per year: cfd = cubic feet per day

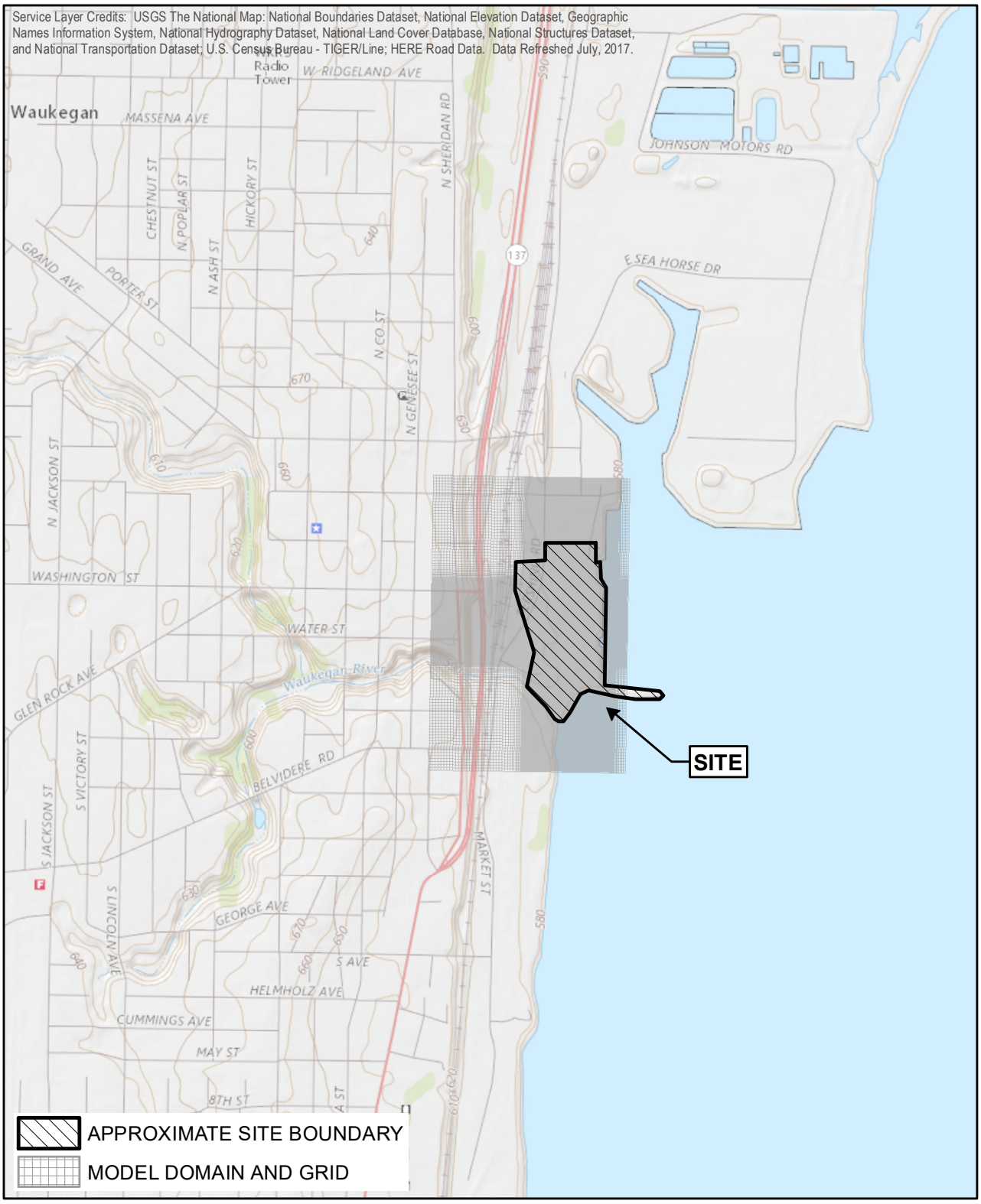
Table 3. Remedial Scenario Specifications

Appendix J - Groundwater Model Technical Memo
Former South Plant Manufactured Gas Plant Site
Waukegan, IL
North Shore Gas, CERCLIS ID - ILD984809228

	Scenario 1A	**Scenario 1B**
Figure #	7, 9	8, 10
Calibration	Alternate (30 ft/d)	Primary (50 ft/d)
Total Flow Rates (gpm)	139	139
Vertical Extraction Wells (layer 2)	31	31
Vertical Injection Wells (layer 1)	13	13
Horizontal Injection Wells (layer 1)	3	3
Influx from Harbor (gpm)	0.1	0.0

Notes
gpm = gallons per minute: ft/d = feet per day:

Figures



SITE LOCATION MAP

GROUNDWATER MODEL TECHNICAL MEMO
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

N

0 750 1,500 3,000
Feet

O'BRIEN & GERE ENGINEERS, INC.

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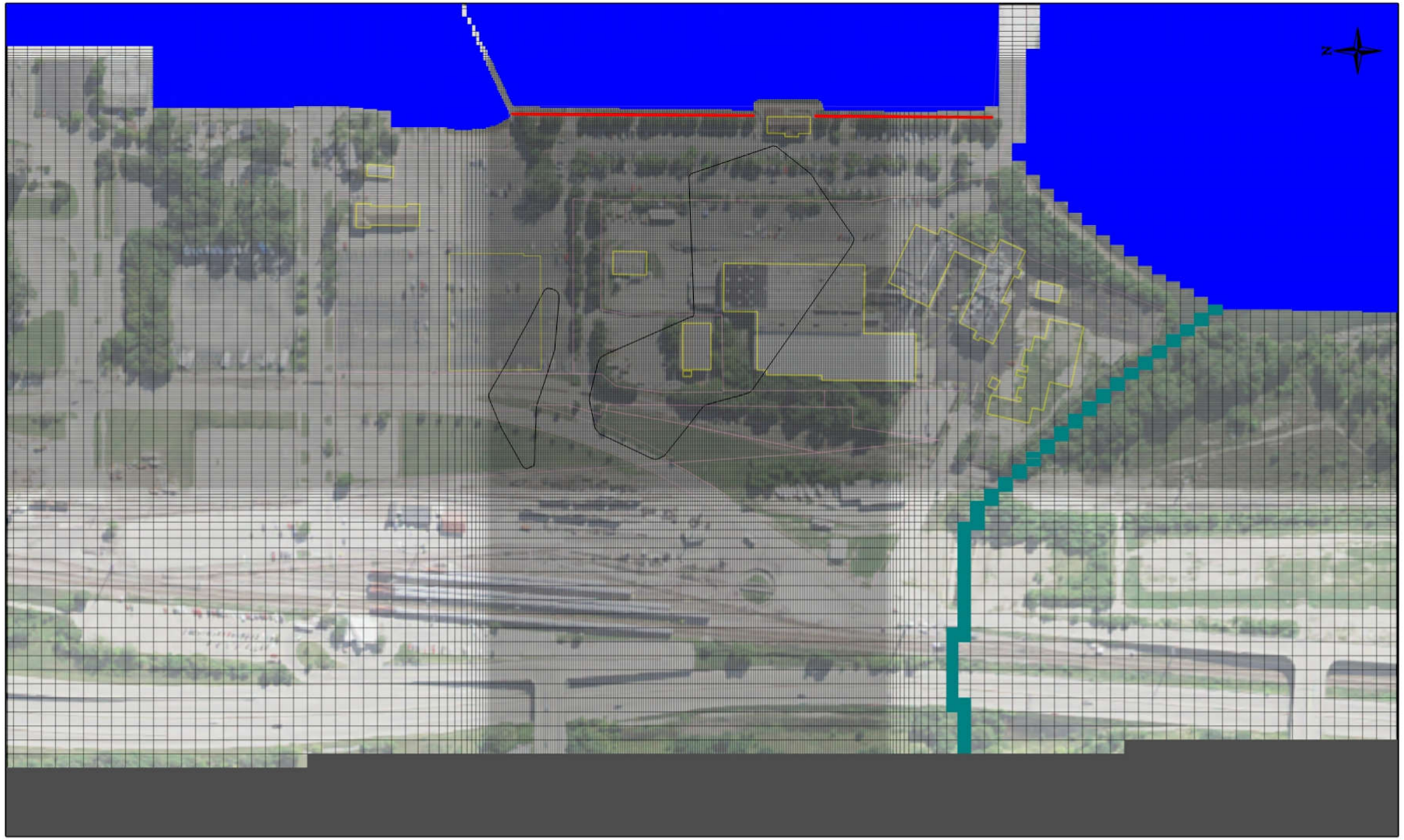
Y:\GIS\Projects\19\1983\MXD\GW_MODEL_TechMemo\Figure 1_Site Location Map_grid.mxd



LEGEND

- Constant Head Boundary, all Model Layers (Lake Michigan / Waukegan Harbor)
- Drain Boundary, Model Layer 1 (Waukegan River)
- Inactive Area (No-Flow Boundary, all layers)
- Model Grid (variable spacing of 3 to 30 feet)
- Harbor Sheet Pile (represented as zone of low hydraulic conductivity in all Model Layers)
- Site Features: DNAPL Footprint (black), Property Boundaries (pink), Buildings (yellow)

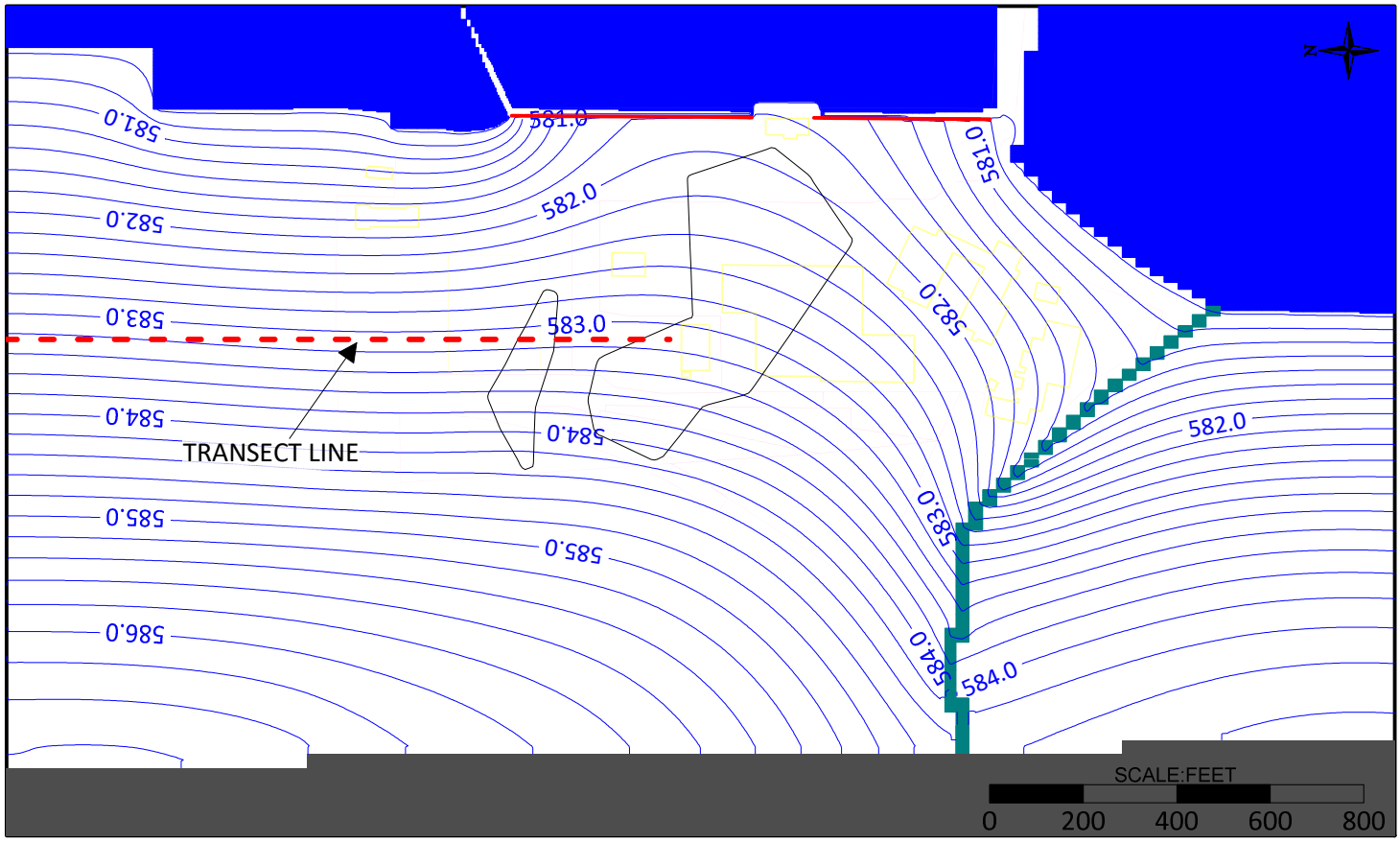
GROUNDWATER MODEL TECHNICAL MEMO
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

FIGURE 2
BOUNDARY CONDITIONS AND MODEL GRID

SCALE:FEET

0 100 200 300 400

O'BRIEN & GERE ENGINEERS, INC.



Constant Head Boundary, all Model Layers (Lake Michigan / Waukegan Harbor)

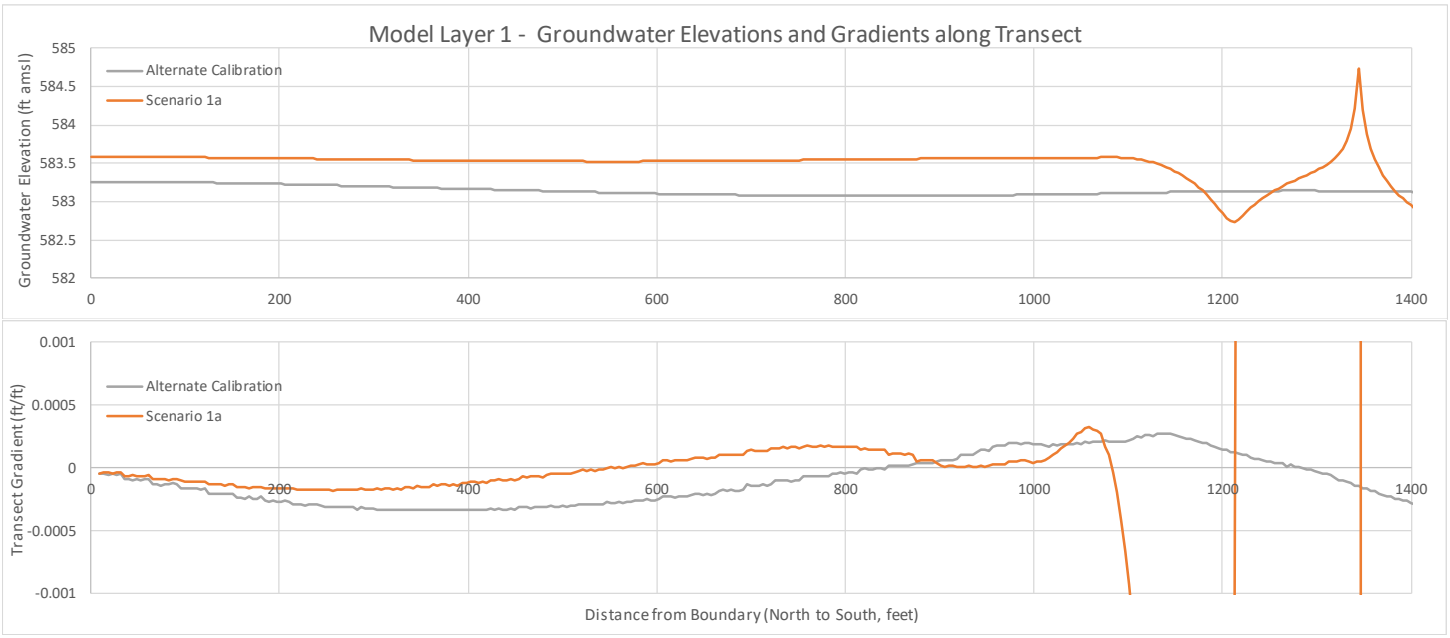
Drain Boundary, Model Layer 1 (Waukegan River)

Inactive Area (No-Flow Boundary, all layers)

Harbor Sheet Pile (represented as zone of low hydraulic conductivity in all Model Layers)

Site Features: DNAPL Footprint (black), Property Boundaries (pink), Buildings (yellow)

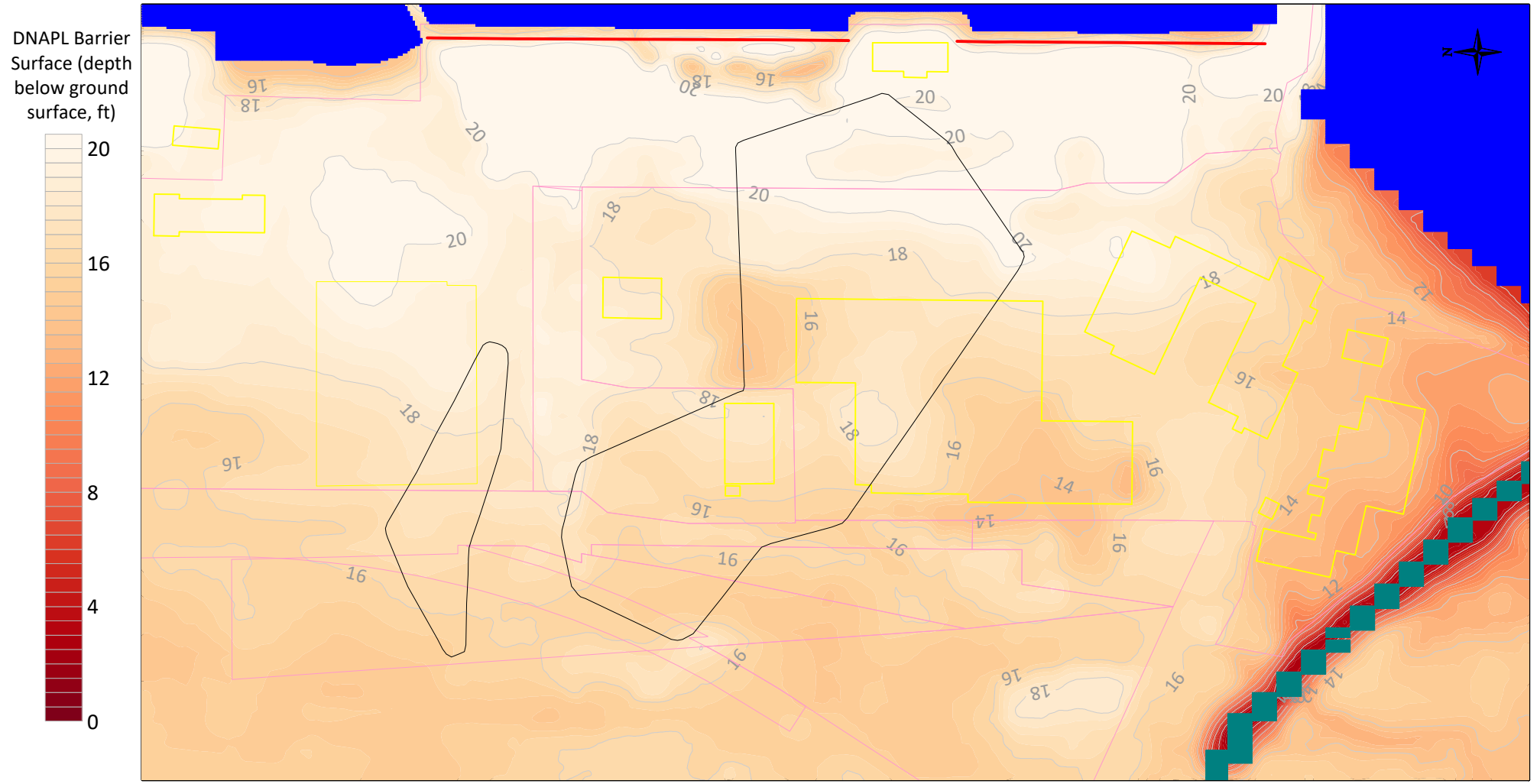
582 Simulated groundwater elevation contour, Model Layer 1 (ft amsl) (Alternate Calibration K=30 ft/d)



GROUNDWATER MODEL TECHNICAL MEMO
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

Figure 3
Simulated Groundwater Elevation Transect

O'BRIEN & GERE ENGINEERS, INC.



LEGEND

- Constant Head Boundary (Lake Michigan / Waukegan Harbor)
- Drain Boundary (Waukegan River)
- Harbor Sheet Pile
- Site Features: DNAPL Footprint (black), Property Boundaries (pink), Buildings (yellow)

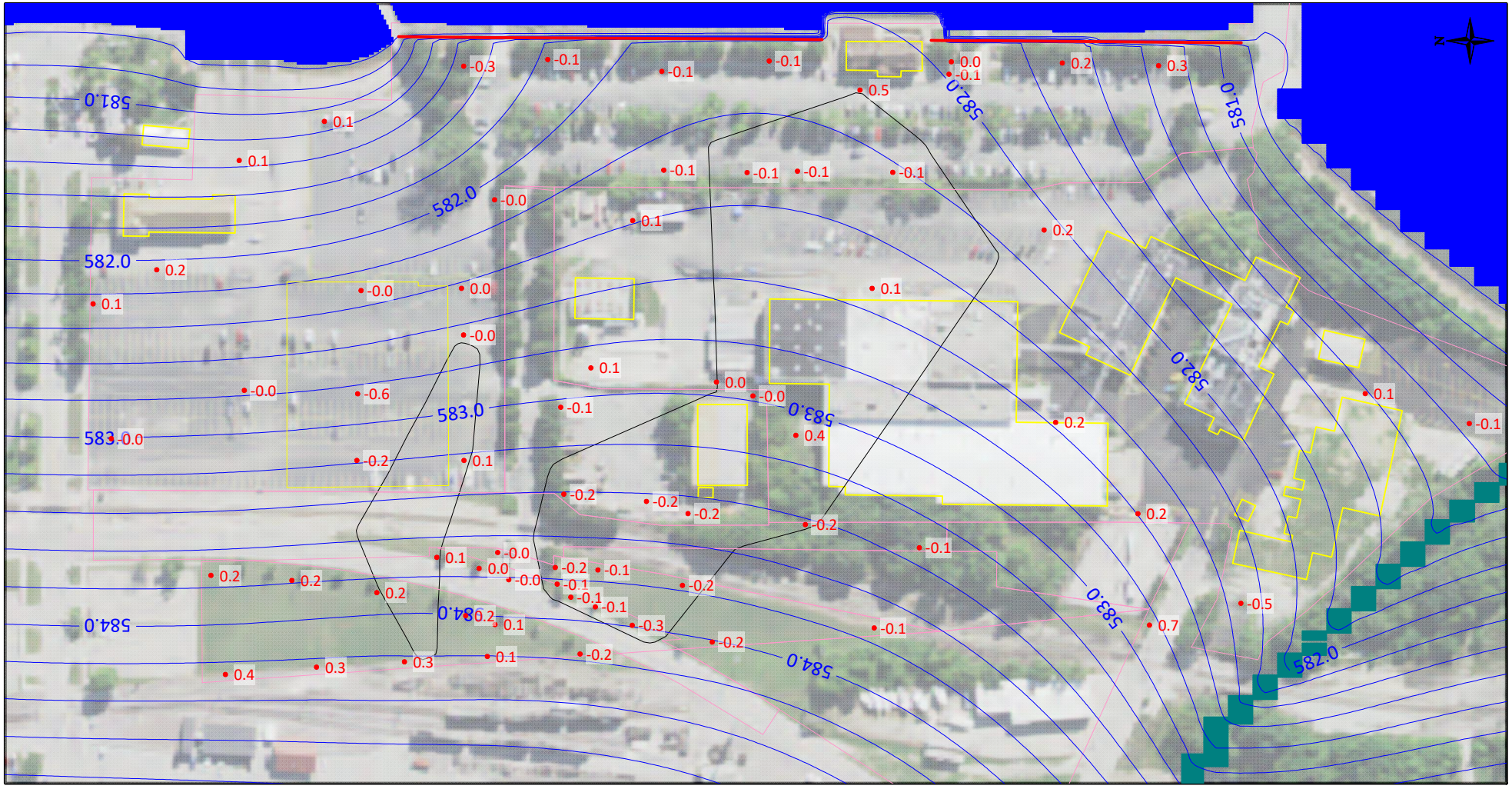
GROUNDWATER MODEL TECHNICAL MEMO
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

FIGURE 4
SIMULATED DNAPL BARRIER SURFACE DEPTH (BELOW GROUND SURFACE)

SCALE:FEET
0 100 200 300 400

Notes
DNAPL Barrier Depth interpreted from PDI and previous investigations. Depths displayed on map are equivalent to the bottom elevation of Model Layer 2.

O'BRIEN & GERE ENGINEERS, INC.



LEGEND

- 582 — Simulated groundwater elevation contour (ft amsl)
- -0.5 — L1 Residual (observed - simulated, feet)
- Constant Head Boundary (Lake Michigan / Waukegan Harbor)
- Drain Boundary (Waukegan River)
- Harbor Sheet Pile
- Site Features: DNAPL Footprint (black), Property Boundaries (pink), Buildings (yellow)

Notes
Hydraulic Conductivity,
Model Layers 1 and 2 = 50 ft/d

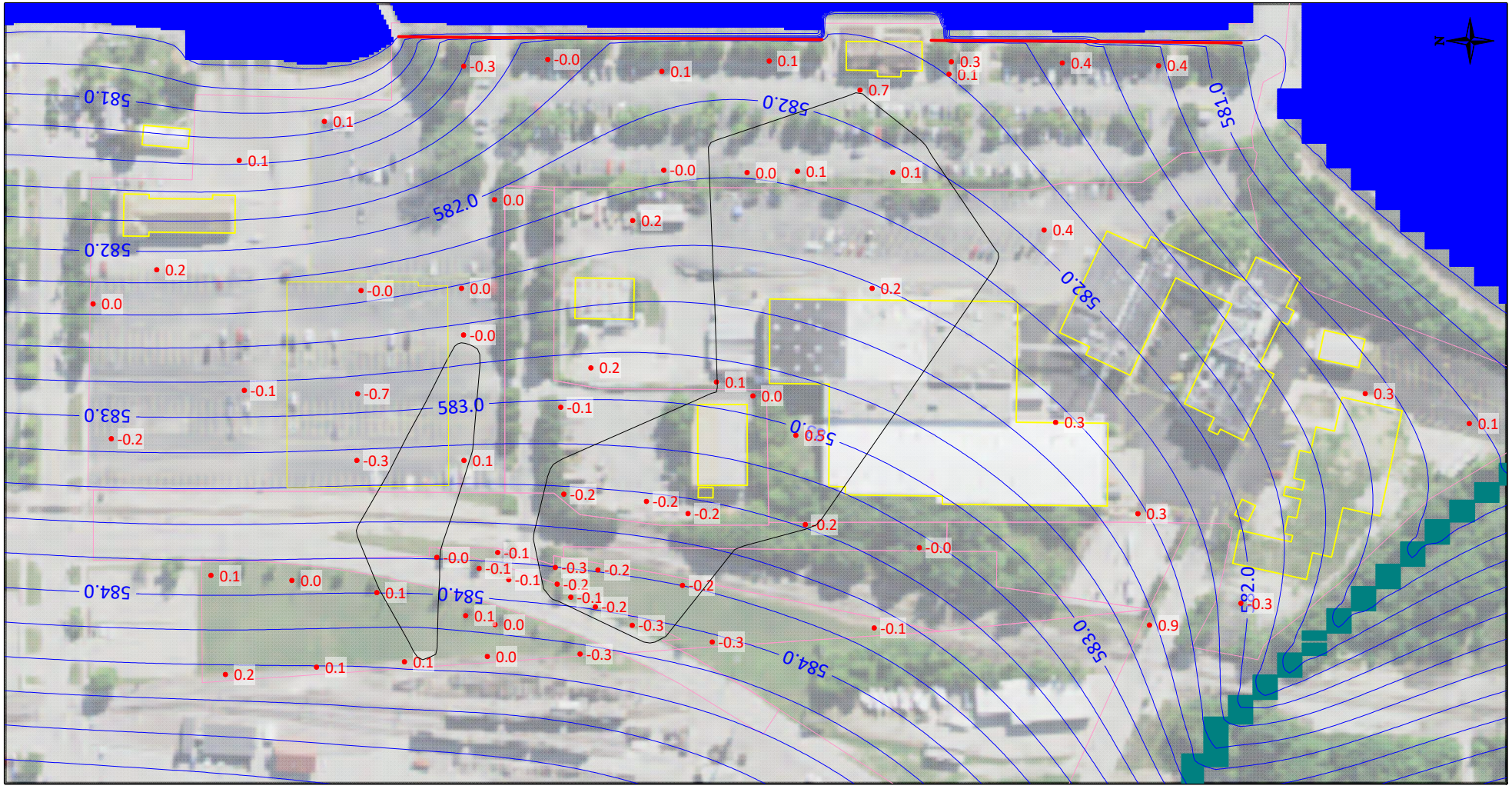
GROUNDWATER MODEL TECHNICAL MEMO
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

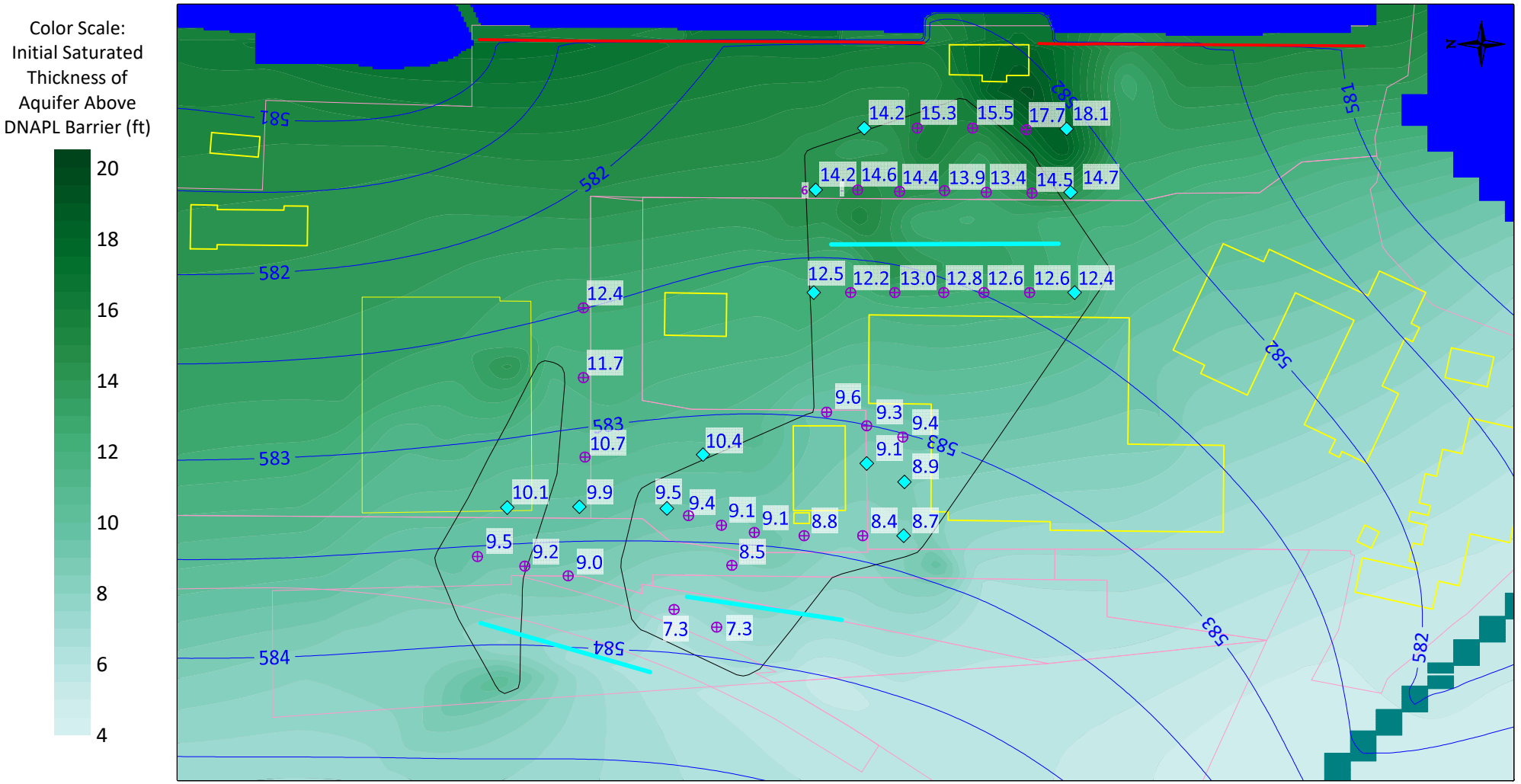
FIGURE 5

SIMULATED GROUNDWATER ELEVATIONS AND RESIDUALS - MODEL LAYER 1 PRIMARY CALIBRATION (50 FEET PER DAY)

SCALE:FEET
0 100 200 300 400

O'BRIEN & GERE ENGINEERS, INC.


581.0
582.0
583.0
584.0
LEGEND
582 Simulated groundwater elevation contour (ft amsl)
-0.5 L1 Residual (observed - simulated, feet)
Constant Head Boundary (Lake Michigan / Waukegan Harbor)
Drain Boundary (Waukegan River)
Harbor Sheet Pile
Site Features: DNAPL Footprint (black), Property Boundaries (pink), Buildings (yellow)
Notes
Hydraulic Conductivity, Model Layers 1 and 2 = 30 ft/d
GROUNDWATER MODEL TECHNICAL MEMO
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS
FIGURE 6
SIMULATED GROUNDWATER ELEVATIONS AND RESIDUALS - MODEL LAYER 1
ALTERNATE CALIBRATION (30 FEET PER DAY)
SCALE:FEET
0 100 200 300 400
O'BRIEN & GERE ENGINEERS, INC.



LEGEND

- 582 — Simulated groundwater elevation contour, Model Layer 1 (ft amsl)
- Constant Head Boundary (Lake Michigan / Waukegan Harbor)
- Drain Boundary (Waukegan River)
- ⊕ Vertical Extraction Well
- ◇ Vertical Injection Well
- Horizontal Injection Well
- • 0.5 Initial Saturated Thickness above DNAPL barrier (ft)
- Harbor Sheet Pile
- Site Features: DNAPL Footprint (black), Property Boundaries (pink), Buildings (yellow)

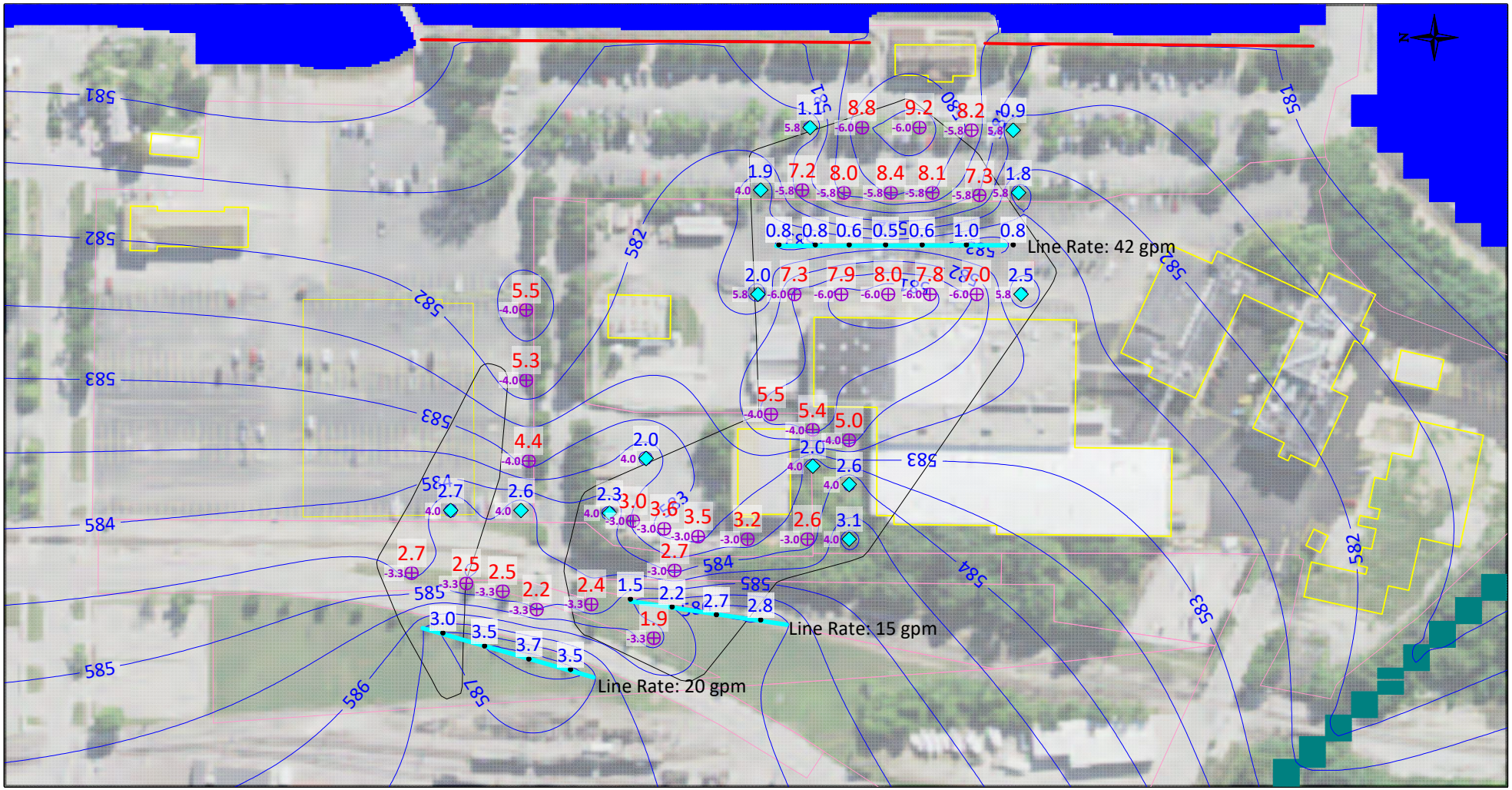
Notes
Alternate Model Calibration

GROUNDWATER MODEL TECHNICAL MEMO
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

FIGURE 7
INITIAL SATURATED THICKNESS ABOVE DNAPL BARRIER (MODEL LAYER 2 BOTTOM)

SCALE:FEET
0 100 200 300 400

O'BRIEN & GERE ENGINEERS, INC.



LEGEND

- 582 — Simulated groundwater elevation contour, Model Layer 1 (ft amsl)
- Constant Head Boundary (Lake Michigan / Waukegan Harbor)
- Drain Boundary (Waukegan River)
- ⊕ Vertical Extraction Well
- ◆ Vertical Injection Well
- Horizontal Injection Well
- -0.5 Drawdown (feet, Extraction Well)
- 0.5 Increase in Head (feet, Injection Well)
- -4.0 Extraction / Injection Rate (gpm)
- Harbor Sheet Pile
- Site Features: DNAPL Footprint (black), Property Boundaries (pink), Buildings (yellow)

Notes
Alternate Model Calibration
(Hydraulic Conductivity = 30 ft/d)

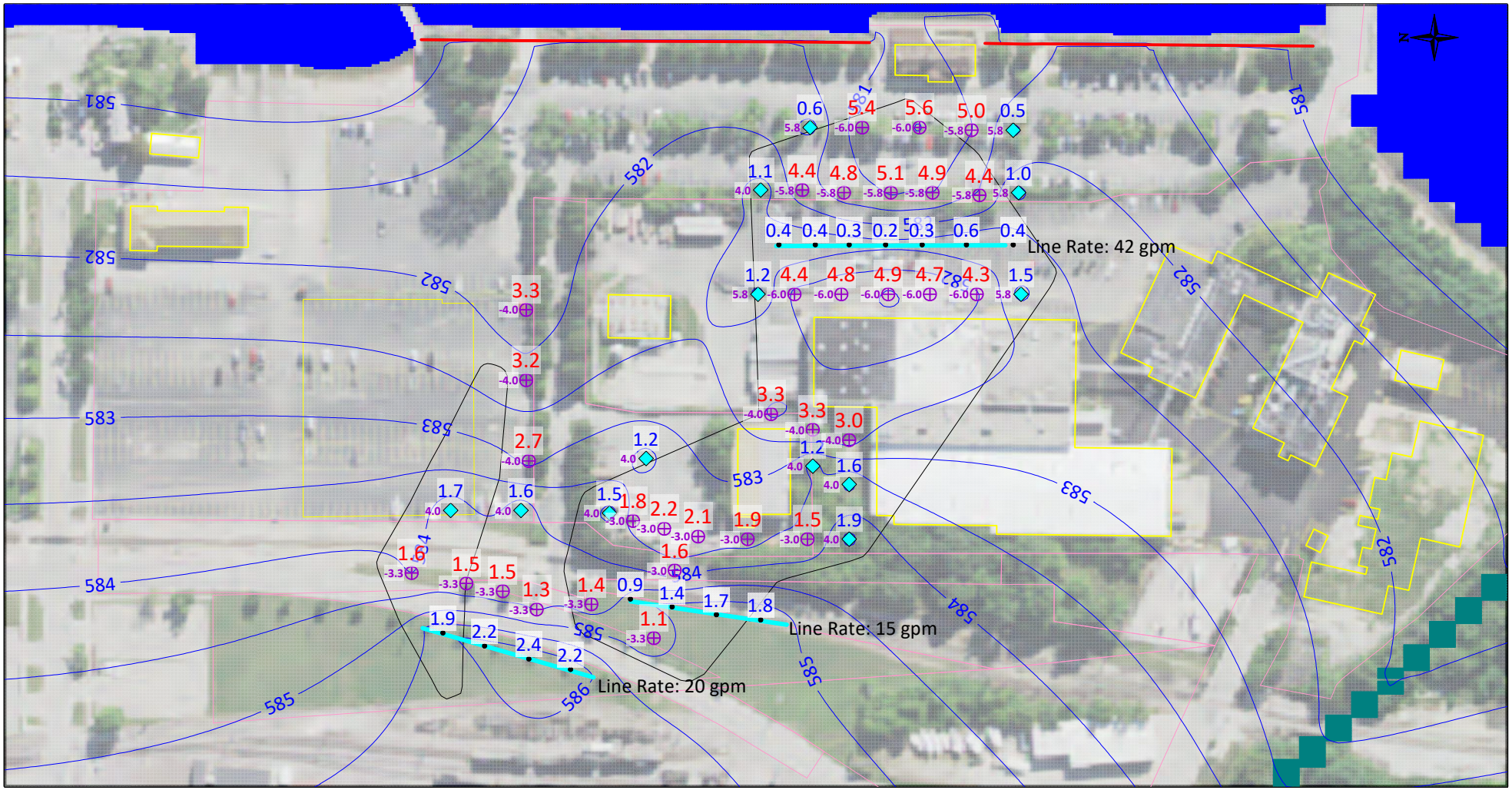
Total Injection / Extraction Rate:
139 gpm

GROUNDWATER MODEL TECHNICAL MEMO
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

FIGURE 8
SIMULATED GROUNDWATER ELEVATIONS
REMEDIAL SCENARIO 1A

SCALE:FEET
0 100 200 300 400

O'BRIEN & GERE ENGINEERS, INC.



LEGEND

582 — Simulated groundwater elevation contour, Model Layer 1 (ft amsl)

Constant Head Boundary (Lake Michigan / Waukegan Harbor)

Drain Boundary (Waukegan River)

⊕ Vertical Extraction Well

◆ Vertical Injection Well

Horizontal Injection Well

-0.5 Drawdown (feet, Extraction Well)

0.5 Increase in Head (feet, Injection Well)

-4.0 Extraction / Injection Rate (gpm)

Harbor Sheet Pile

Site Features: DNAPL Footprint (black), Property Boundaries (pink), Buildings (yellow)

Notes

Primary Model Calibration
(Hydraulic Conductivity = 50 ft/d)

Total Injection / Extraction Rate:
139 gpm

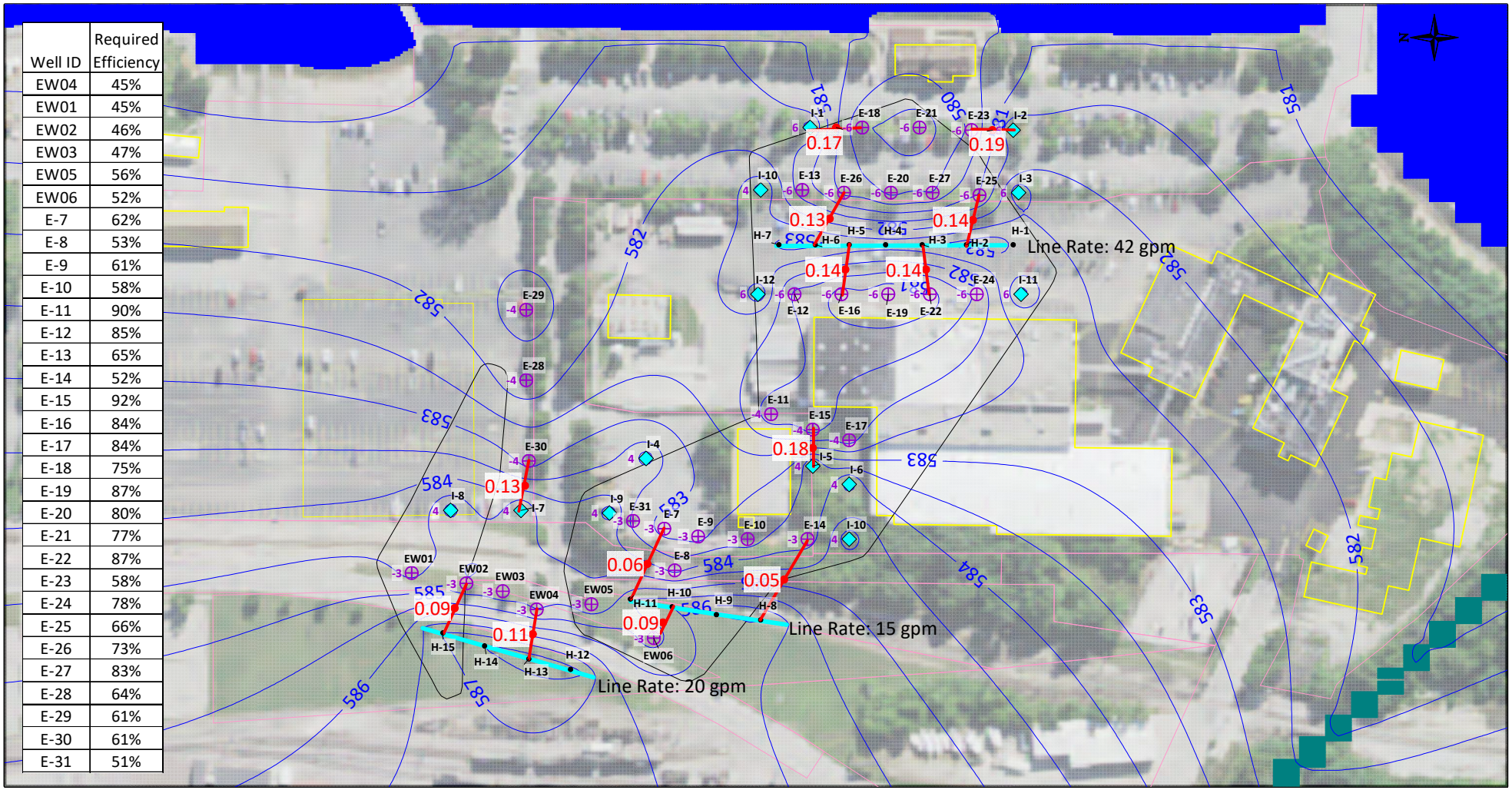
GROUNDWATER MODEL TECHNICAL MEMO
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

FIGURE 9
SIMULATED GROUNDWATER ELEVATIONS
REMEDIAL SCENARIO 1B

SCALE:FEET
0 100 200 300 400

O'BRIEN & GERE ENGINEERS, INC.

Well ID	Required Efficiency
EW04	45%
EW01	45%
EW02	46%
EW03	47%
EW05	56%
EW06	52%
E-7	62%
E-8	53%
E-9	61%
E-10	58%
E-11	90%
E-12	85%
E-13	65%
E-14	52%
E-15	92%
E-16	84%
E-17	84%
E-18	75%
E-19	87%
E-20	80%
E-21	77%
E-22	87%
E-23	58%
E-24	78%
E-25	66%
E-26	73%
E-27	83%
E-28	64%
E-29	61%
E-30	61%
E-31	51%



LEGEND

- 582 — Simulated groundwater elevation contour, Model Layer 1 (ft amsl)
- Constant Head Boundary (Lake Michigan / Waukegan Harbor)
- Drain Boundary (Waukegan River)
- ⊕ Vertical Extraction Well
- ◆ Vertical Injection Well
- Horizontal Injection Well
- ● 0.1 Groundwater Gradient (each transect)
- E-22 Well ID
- -4 Extraction / Injection Rate (gpm)
- Groundwater Gradient Transect
- Site Features: DNAPL Footprint (black), Property Boundaries (pink), Buildings (yellow)

Notes
Alternate Model Calibration
(Hydraulic Conductivity = 30 ft/d)

Total Injection / Extraction Rate:
139 gpm

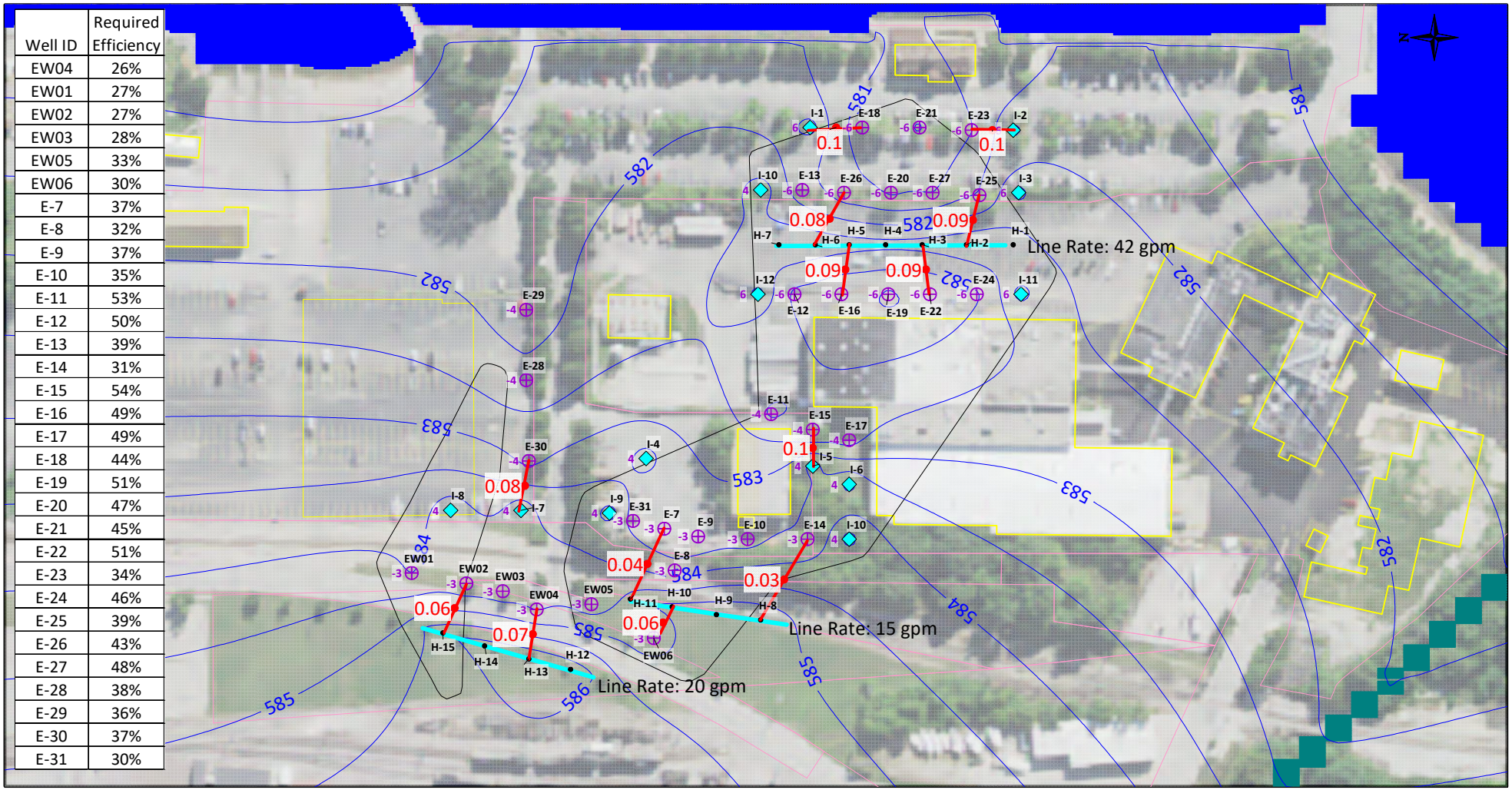
GROUNDWATER MODEL TECHNICAL MEMO
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

FIGURE 10
SIMULATED REMEDIAL GRADIENTS
REMEDIAL SCENARIO 1A

SCALE:FEET
0 100 200 300 400

O'BRIEN & GERE ENGINEERS, INC.

Well ID	Required Efficiency
EW04	26%
EW01	27%
EW02	27%
EW03	28%
EW05	33%
EW06	30%
E-7	37%
E-8	32%
E-9	37%
E-10	35%
E-11	53%
E-12	50%
E-13	39%
E-14	31%
E-15	54%
E-16	49%
E-17	49%
E-18	44%
E-19	51%
E-20	47%
E-21	45%
E-22	51%
E-23	34%
E-24	46%
E-25	39%
E-26	43%
E-27	48%
E-28	38%
E-29	36%
E-30	37%
E-31	30%



LEGEND

582 — Simulated groundwater elevation contour, Model Layer 1 (ft amsl)

Constant Head Boundary (Lake Michigan / Waukegan Harbor)

Drain Boundary (Waukegan River)

Vertical Extraction Well

Vertical Injection Well

Horizontal Injection Well

0.1 — Groundwater Gradient (each transect)

E-22 — Well ID

-4 — Extraction / Injection Rate (gpm)

Groundwater Gradient Transect

Site Features: DNAPL Footprint (black), Property Boundaries (pink), Buildings (yellow)

Notes

Primary Model Calibration
(Hydraulic Conductivity = 50 ft/d)

Total Injection / Extraction Rate:
139 gpm

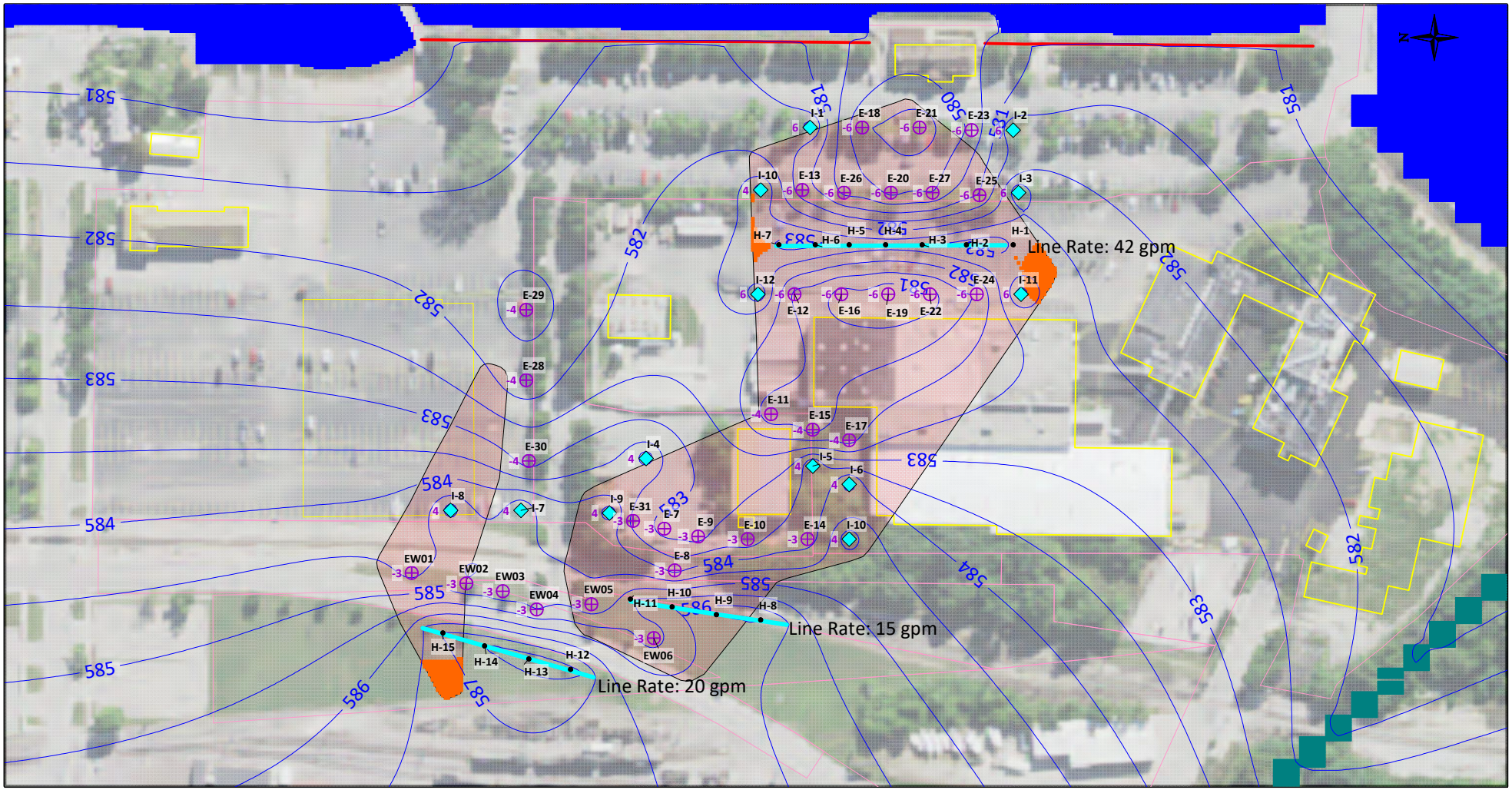
GROUNDWATER MODEL TECHNICAL MEMO
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

FIGURE 11
SIMULATED REMEDIAL GRADIENTS
REMEDIAL SCENARIO 1B

SCALE:FEET

0 100 200 300 400

O'BRIEN & GERE ENGINEERS, INC.



LEGEND

- 582 — Simulated groundwater elevation contour, Model Layer 1 (ft amsl)
- Constant Head Boundary (Lake Michigan / Waukegan Harbor)
- Drain Boundary (Waukegan River)
- ⊕ Vertical Extraction Well
- ◆ Vertical Injection Well
- Horizontal Injection Well
- MODPATH Results - DNAPL footprint areas NOT captured by wells
- E-22 Well ID
- -4 Extraction / Injection Rate (gpm)
- Harbor Sheet Pile
- Site Features: DNAPL Footprint (black border pink), Property Boundaries (pink), Buildings (yellow)

Notes
Alternate Model Calibration
(Hydraulic Conductivity = 30 ft/d)

Total Injection / Extraction Rate:
139 gpm

GROUNDWATER MODEL TECHNICAL MEMO
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS

FIGURE 12
MODPATH SIMULATION RESULTS
REMEDIAL SCENARIO 1A

SCALE:FEET
0 100 200 300 400

O'BRIEN & GERE ENGINEERS, INC.

Appendix K

DNAPL Characterization

Appendix K - DNAPL Characteristics

Former South Plant Manufactured Gas Plant Site
Waukegan, IL
North Shore Gas, CERCLIS ID - ILD984809228

Report ID	Nine Digit Sample ID	Sample Location	Matrix	Temperature (°F)	Specific Gravity	Density (g/cc)	Viscosity	
							Centistokes	Centipoise
eFinal_46477_2016824[1]	081116100	RW-8-WG-20160811	DNAPL	70	1.071	1.068	38.9	41.6
				100	1.063	1.056	16.6	17.5
				130	1.059	1.044	9.01	9.41
	081116101	RW-8-WG-20160811	Water	70	1.002	0.9995	1.02	1.02
				100	0.9987	0.9918	0.71	0.704
				130	0.9964	0.9825	0.532	0.523
eFinal_47415	100417009	SPPA-RW-11	Water	50	1.001	1.0005	1.41	1.41
				60	1.001	0.9996	1.15	1.15
				70	1.001	0.9988	1.02	1.02
	100317004	SPPA-RW-11	DNAPL	50	1.082	1.082	144	156
				60	1.078	1.077	95.4	103
				70	1.076	1.0741	60.9	65.4
	100517011	RW-2	Water	50	0.99	0.9893	1.35	1.34
				60	0.989	0.9882	1.14	1.13
				70	0.989	0.9871	1.02	1.01
	100517012	RW-2	DNAPL	50	1.083	1.082	170	184
				60	1.079	1.078	109	118
				70	1.077	1.0753	71.9	77.3
	100417007	SPPA-RW-7	Water	50	1.001	1.0008	1.37	1.37
				60	1.001	0.9996	1.16	1.16
				70	1.001	0.9993	1.00	1.00
	1003117002	SPPA-RW-7	DNAPL	50	1.061	1.061	41.5	44.1
				60	1.059	1.058	31.6	33.4
				70	1.057	1.0548	23.4	24.7
	100417008	SPPA-RW-10	Water	50	1.002	1.0012	1.35	1.36
				60	1.001	1.0001	1.15	1.15
				70	1.001	0.9994	1.01	1.01
	1003117003	SPPA-RW-10	DNAPL	50	1.061	1.061	44.8	47.5
				60	1.061	1.06	32.7	34.7
				70	1.058	1.0557	23.9	25.3

[O: ANS 1/19/18, C: KJK 1/22/18]

Notes:

°F = degrees Fahrenheit

g/cc = grams per cubic centimeter

DNAPL = dense nonaqueous phase liquid

1. Samples in this report were run for temperatures outside a range expected to be encountered during operation of the extraction system. Data is here to provide a complete summary but was not utilized in any decisions based on DNAPL characteristics.

STAT Analysis Corporation
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Accreditations: IEPA ELAP 100445; ORELAP IL300001; AIHA-LAP, LLC 101160; NVLAP LabCode 101202-0

October 18, 2017

Natural Resource Technology, Inc.
415A S. 3rd Street
Milwaukee, WI 53204
Telephone: (414) 837-3607
Fax: (262) 523-9001

Analytical Report for STAT Work Order: 17100145 Revision 0

RE: 1983, South Plant Former MGP, Waukegan, IL

Dear Marcus Byker:

STAT Analysis received 1 sample for the referenced project on 10/4/2017 3:58:00 PM. The analytical results are presented in the following report.

All analyses were performed in accordance with the requirements of 35 IAC Part 186 / NELAC standards. Analyses were performed in accordance with methods as referenced on the analytical report. Those analytical results expressed on a dry weight basis are also noted on the analytical report.

All analyses were performed within established holding time criteria, and all Quality Control criteria met EPA or laboratory specifications except when noted in the Case Narrative or Analytical Report. If required, an estimate of uncertainty for the analyses can be provided. A listing of accredited methods/parameters can also be provided.

Thank you for the opportunity to serve you and I look forward to working with you in the future. If you have any questions regarding the enclosed materials, please contact me at (312) 733-0551.

Sincerely,

Craig Chawla
Project Manager

STAT Analysis Corporation

Date: October 18, 2017

Client: Natural Resource Technology, Inc.
Project: 1983, South Plant Former MGP, Waukegan, IL
Work Order: 17100145 Revision 0

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Tag Number	Collection Date	Date Received
17100145-001A	100317006		10/3/2017 3:00:00 PM	10/4/2017

STAT Analysis Corporation

Date: *October 18, 2017*

CLIENT: Natural Resource Technology, Inc.
Project: 1983, South Plant Former MGP, Waukegan, IL
Work Order: 17100145 Revision 0

CASE NARRATIVE

BTU, Density and Viscosity analysis were subcontracted to Precision Petroleum Labs, Inc., Houston, TX.

Please refer to Analytical QC Summary Report for QC outliers.

STAT Analysis Corporation
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Accreditations:IEPA ELAP 100445;ORELAP IL300001;AIHA-LAP, LLC 101160;NVLAP LabCode 101202-0

Report Date: October 18, 2017
Print Date: October 18, 2017

ANALYTICAL RESULTS

Client: Natural Resource Technology, Inc.
Client Sample ID: 100317006
Work Order: 17100145 Revision 0
Tag Number:
Project: 1983, South Plant Former MGP, Waukegan, IL
Collection Date: 10/3/2017 3:00:00 PM
Lab ID: 17100145-001A
Matrix: Oil

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
TCLP Volatile Organic Compounds by GC/MS	**SW1311/8260B (SW5030B)**			Prep Date: **10/4/2017**		Analyst: **ERP**
Benzene	8.2	0.50		mg/L	100	10/11/2017
2-Butanone	ND	0.20		mg/L	10	10/10/2017
Carbon tetrachloride	ND	0.050		mg/L	10	10/10/2017
Chlorobenzene	ND	0.050		mg/L	10	10/10/2017
Chloroform	ND	0.050		mg/L	10	10/10/2017
1,2-Dichloroethane	ND	0.050		mg/L	10	10/10/2017
1,1-Dichloroethene	ND	0.050		mg/L	10	10/10/2017
Tetrachloroethene	ND	0.050		mg/L	10	10/10/2017
Trichloroethene	ND	0.050		mg/L	10	10/10/2017
Vinyl chloride	ND	0.050		mg/L	10	10/10/2017
TCLP Semivolatile Organic Compounds	**SW1311/8270C (SW3510C)**			Prep Date: **10/9/2017**		Analyst: **DM**
1,4-Dichlorobenzene	ND	0.010		mg/L	1	10/10/2017
2,4-Dinitrotoluene	ND	0.010		mg/L	1	10/10/2017
Hexachlorobenzene	ND	0.010		mg/L	1	10/10/2017
Hexachlorobutadiene	ND	0.010		mg/L	1	10/10/2017
Hexachloroethane	ND	0.010		mg/L	1	10/10/2017
Nitrobenzene	ND	0.010		mg/L	1	10/10/2017
2-methylphenol	ND	0.010		mg/L	1	10/10/2017
3- & 4-Methylphenol	ND	0.010		mg/L	1	10/10/2017
Pentachlorophenol	ND	0.050		mg/L	1	10/10/2017
Pyridine	ND	0.010		mg/L	1	10/10/2017
2,4,5-Trichlorophenol	ND	0.010		mg/L	1	10/10/2017
2,4,6-Trichlorophenol	ND	0.010		mg/L	1	10/10/2017
PCBs in Oil	**SW8082A (SW3580A)**			Prep Date: **10/5/2017**		Analyst: **GVC**
Aroclor 1016	ND	0.86		mg/Kg	1	10/6/2017
Aroclor 1221	ND	0.86		mg/Kg	1	10/6/2017
Aroclor 1232	ND	0.86		mg/Kg	1	10/6/2017
Aroclor 1242	ND	0.86		mg/Kg	1	10/6/2017
Aroclor 1248	ND	0.86		mg/Kg	1	10/6/2017
Aroclor 1254	ND	0.86		mg/Kg	1	10/6/2017
Aroclor 1260	ND	0.86		mg/Kg	1	10/6/2017
TCLP Pesticides	**SW1311/8081B (SW3510C)**			Prep Date: **10/9/2017**		Analyst: **GVC**
Chlordane	ND	0.010		mg/L	1	10/10/2017
Endrin	ND	0.0010		mg/L	1	10/10/2017
gamma-BHC	ND	0.0050		mg/L	1	10/10/2017
Heptachlor	ND	0.00050		mg/L	1	10/10/2017
Heptachlor epoxide	ND	0.00050		mg/L	1	10/10/2017

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
HT - Sample received past holding time
* - Non-accredited parameter
RL - Reporting / Quantitation Limit for the analysis
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range
H - Holding time exceeded

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Report Date: October 18, 2017
Print Date: October 18, 2017

ANALYTICAL RESULTS

Client: Natural Resource Technology, Inc. **Client Sample ID:** 100317006
Work Order: 17100145 Revision 0 **Tag Number:**
Project: 1983, South Plant Former MGP, Waukegan, IL **Collection Date:** 10/3/2017 3:00:00 PM
Lab ID: 17100145-001A **Matrix:** Oil

Analyses	Result	RL	Qualifier	Units	DF	Date Analyzed
TCLP Pesticides	**SW1311/8081B (SW3510C)**			Prep Date: **10/9/2017**		Analyst: **GVC**
Methoxychlor	ND	0.00050		mg/L	1	10/10/2017
Toxaphene	ND	0.010		mg/L	1	10/10/2017
Total Petroleum Hydrocarbons	**SW8015M (SW3580A)**			Prep Date: **10/5/2017**		Analyst: **CNC**
TPH (GRO)	190000	2000		mg/Kg	100	10/6/2017
TPH (DRO)	360000	2000		mg/Kg	100	10/6/2017
TPH (ERO)	93000	2000	*	mg/Kg	100	10/6/2017
Herbicides, TCLP Leached	**SW1311/8321B (SW3510C)**			Prep Date: **10/9/2017**		Analyst: **MEP**
2,4,5-TP (Silvex)	ND	0.0020		mg/L	1	10/10/2017
2,4-D	ND	0.0040		mg/L	1	10/10/2017
TCLP Metals by ICP/MS	**SW1311/6020A (SW3005A)**			Prep Date: **10/9/2017**		Analyst: **JG**
Arsenic	0.16	0.010		mg/L	5	10/10/2017
Barium	0.26	0.050		mg/L	5	10/10/2017
Cadmium	ND	0.0050		mg/L	5	10/10/2017
Chromium	ND	0.010		mg/L	5	10/10/2017
Lead	ND	0.0050		mg/L	5	10/10/2017
Selenium	ND	0.010		mg/L	5	10/10/2017
Silver	ND	0.010		mg/L	5	10/10/2017
TCLP Mercury	**SW1311/7470A**			Prep Date: **10/10/2017**		Analyst: **LB**
Mercury	ND	0.00020		mg/L	1	10/10/2017
Cyanide, Reactive	**SW7.3.3.2**			Prep Date: **10/5/2017**		Analyst: **MD**
Reactive Cyanide	ND	1.0		mg/Kg	1	10/5/2017
Sulfide, Reactive	**SW7.3.4.2**			Prep Date: **10/5/2017**		Analyst: **MD**
Reactive Sulfide	ND	10		mg/Kg	1	10/5/2017
pH (1:10, 25 °C)	**SW9045C**			Prep Date: **10/5/2017**		Analyst: **PBG**
pH	5.6			pH Units	1	10/5/2017
Flash Point (Closed Cup)	**SW1010**			Prep Date: **10/10/2017**		Analyst: **RW**
Flashpoint	135			°F	1	10/10/2017
Heat Content In BTU	**D240**			Prep Date:		Analyst: **SUB**
Heat of Combustion	17361		*	BTU/lb	1	10/10/2017
Density by ASTM D1298	**D1298**			Prep Date:		Analyst: **SUB**
Density @ 15°C	1.0616		*		1	10/10/2017
Viscosity, cSt	**D-445**			Prep Date:		Analyst: **SUB**
@ 122 °F	9.49		*	cSt	1	10/10/2017

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
HT - Sample received past holding time
* - Non-accredited parameter
RL - Reporting / Quantitation Limit for the analysis
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range
H - Holding time exceeded

STAT Analysis Corporation

2242 W. Harrison Suite 200, Chicago, Illinois 60612 Phone: (312) 733-0551 Fax: (312) 733-2386

e-mail address: STATinfo@STATAnalysis.com

CHAIN OF CUSTODY RECORD

No. 908582 Page: 1 of 1

Company: Natural Resource Technology
Project Number: 1983 Client Tracking No.:
Project Name: South Plant Former MGP
Project Location: Waukegan, IL
Sampler(s): Andrea Sakis
Report To: Marcus Byker Phone: ~~X~~ AWS 773-196-4359
Fax:
e-mail: marcus.byker@obg.com
QC Level: 1 ___ 2 X 3 ___ 4 ___

Quote No.:
P.O. No.: 1983/11.1
Turn Around Time (Days): 1 2 3 4 5-7 (10)
Results Needed: / / am/pm

Client Sample Number/Description	Date Taken	Time Taken	Matrix	Comp.	Grab	Preserv.	No. of Containers	pH	Flash Point	Reactive Sulfide	Reactive Cyanide	PCBs	TCLP Metals	TCLP Herbicides/Pesticides	TCLP VOC	TCLP SVOC	Hydrocarbon characterization	BTU Content	Absolute Viscosity	Density	Additional Information	Lab No.
10031700006	10/3/17	1500	DNAPL	X		A	2	X												X		001

AWS 10/5/17

Relinquished by: (Signature) [signature]	Date/Time: 10/4/17 1302	
Received by: (Signature) [signature]	Date/Time: 10/4/17 15:02	
Relinquished by: (Signature) [signature]	Date/Time: 10/4/17 15:58	
Received by: (Signature) [signature]	Date/Time: 10/4/17 15:58	
Relinquished by: (Signature)	Date/Time:	
Received by: (Signature)	Date/Time:	

Comments: See email from Marcus Byker, dated 9/21/17 for specific methods required for each test

Preservation Code: A = None B = HNO_3 C = NaOH D = H_2SO_4 E = HCl F = 5035/EnCore G = Other

Laboratory Work Order No.: 1710O145

Received on Ice: Yes X No

Temperature: 4.5 °C

STAT Analysis Corporation

Sample Receipt Checklist

Client Name NRT | Date and Time Received: 10/4/2017 3:58:00 PM

Work Order Number 17100145 | Received by: JNW

Checklist completed by: Signature 10/4/17 Date | Reviewed by: JOK Initials 10/5/17 Date

Matrix: | Carrier name STAT Analysis

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shippping container/cooler?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels/containers?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
Container or Temp Blank temperature in compliance?	Yes ☑	No ☐	Temperature 4.5 °C
Water - VOA vials have zero headspace?	No VOA vials submitted ☐	Yes ☐	No ☐
Water - Samples pH checked?	Yes ☐	No ☐	Checked by:
Water - Samples properly preserved?	Yes ☐	No ☐	pH Adjusted?

Any No response must be detailed in the comments section below.

Comments:

Client / Person contacted: Date contacted: Contacted by:

Response:

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL
Test No: SW1311/8260B **Matrix:** W

QC SUMMARY REPORT
SURROGATE RECOVERIES

Sample ID	BR4FBZ	BZMED8	DBFM	DCA12D4				
VBLK101017B-7	111	94.5	98.0	95.6				
VLCS101017B-7	115 *	95.3	98.0	96.7				
VLCSD101017B-7	111	96.2	99.3	95.8				
VBLK100317-7	107	94.8	99.5	96.3				
17100145-001A:10	113	92.7	101	96.6				
17100159-008AMS	114 *	94.4	98.1	94.1				
17100159-008AMSD	110	95.9	97.9	94.3				
VBLK101117-7	108	95.2	98.3	100				
VLCS101117-7	113	96.3	99.0	94.3				
VLCSD101117-7	112	96.3	97.3	97.0				
17100145-001A:100	110	92.8	99.8	97.9				

Acronym		Surrogate	QC Limits
BR4FBZ	=	4-Bromofluorobenzene	79-114
BZMED8	=	Toluene-d8	91-109
DBFM	=	Dibromofluoromethane	85-123
DCA12D4	=	1,2-Dichloroethane-d4	86-119

*** Surrogate recovery outside acceptance limits**

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL

ANALYTICAL QC SUMMARY REPORT
GCMS Volatiles
BatchID: R136692

ANALYTICAL RUN SUMMARY

SeqNo	Sample ID	Type	Test Code	Batch	DF	Date Analyzed
3799287	BFB101017B-7	TUNE	BFB	R136692	1	10/10/2017 19:56
3799223	VSTD050	CCV	VOC_W+	R136692	1	10/10/2017 20:28
3799225	VBLK101017B-7	MBLK	VOC_W+	R136692	1	10/10/2017 21:37
3799226	VLCS101017B-7	LCS	VOC_W+	R136692	1	10/10/2017 22:11
3799230	VLCSD101017B-7	LCSD	VOC_W+	R136692	1	10/10/2017 22:45
3799232	VBLK100317-7	MBLK	VOC_TCLP	R136692	10	10/10/2017 23:22
3799235	17100145-001A	SAMP	VOC_TCLP	R136692	10	10/10/2017 23:56
3799238	17100159-008A	SAMP	VOC_W	R136692	1	10/11/2017 00:30
3799243	17100159-008A	SAMP	VOC_W+	R136692	1	10/11/2017 00:30
3801226	17100159-008AMS	MS	VOC_W+	R136692	1	10/11/2017 01:03
3802250	17100159-008AMS	MS	VOC_W	R136692	1	10/11/2017 01:03
3801229	17100159-008AMSD	MSD	VOC_W+	R136692	1	10/11/2017 01:37
3802398	17100159-008AMSD	MSD	VOC_W	R136692	1	10/11/2017 01:37
3799248	17100159-006A	SAMP	VOC_W	R136692	1	10/11/2017 02:11
3799300	17100159-006A	SAMP	VOC_W+	R136692	1	10/11/2017 02:11
3799250	17100159-007A	SAMP	VOC_W	R136692	1	10/11/2017 02:45
3799303	17100159-007A	SAMP	VOC_W+	R136692	1	10/11/2017 02:45
3799251	17100159-009A	SAMP	VOC_W	R136692	1	10/11/2017 03:18
3799305	17100159-009A	SAMP	VOC_W+	R136692	1	10/11/2017 03:18
3799253	17100159-010A	SAMP	VOC_W	R136692	1	10/11/2017 03:52
3799307	17100159-010A	SAMP	VOC_W+	R136692	1	10/11/2017 03:52
3799255	17100159-011A	SAMP	VOC_W	R136692	1	10/11/2017 04:26
3799308	17100159-011A	SAMP	VOC_W+	R136692	1	10/11/2017 04:26
3799256	17100175-007A	SAMP	VOC_W	R136692	1	10/11/2017 05:00
3799258	17100175-008A	SAMP	VOC_W	R136692	1	10/11/2017 05:33
3799261	17100176-021A	SAMP	BTEX_W-MS	R136692	1	10/11/2017 06:07
3799263	17100176-022A	SAMP	BTEX_W-MS	R136692	1	10/11/2017 06:40
3799265	17100176-023A	SAMP	BTEX_W-MS	R136692	1	10/11/2017 07:14
3799267	17100176-024A	SAMP	BTEX_W-MS	R136692	1	10/11/2017 07:48

QC SUMMARY

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
VBLK100317-7	**ZZZZZ**	**MBLK**	**mg/L**	**SW1311/8260B**		**10/10/2017**	**VOA-7_171010B**	**3799232**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Benzene	ND	0.050									
2-Butanone	ND	0.20									
Carbon tetrachloride	ND	0.050									
Chlorobenzene	ND	0.050									
Chloroform	ND	0.050									
1,2-Dichloroethane	ND	0.050									
1,1-Dichloroethene	ND	0.050									
Tetrachloroethene	ND	0.050									
Trichloroethene	ND	0.050									
Vinyl chloride	ND	0.050									

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
* - Non Accredited Parameter
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
H/HT - Holding Time Exceeded
B - Analyte detected in the associated Method Blank
E - Value above quantitation range

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100159-008AMS	**ZZZZZ**	**MS**	**mg/L**	**SW8260B**		**10/11/2017**	**VOA-7_171010B**	**3802250**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Benzene	0.01953	0.0050	0.02	0.00043	95.5	76	127	0	0		
2-Butanone	0.03145	0.020	0.04	0	78.6	70	130	0	0		
Carbon tetrachloride	0.02	0.0050	0.02	0	100	70	130	0	0		
Chlorobenzene	0.02262	0.0050	0.02	0	113	75	130	0	0		
Chloroform	0.01887	0.0050	0.02	0	94.4	70	130	0	0		
1,2-Dichloroethane	0.01714	0.0050	0.02	0	85.7	70	130	0	0		
1,1-Dichloroethene	0.01869	0.0050	0.02	0	93.4	61	145	0	0		
Tetrachloroethene	0.02312	0.0050	0.02	0	116	70	130	0	0		
Trichloroethene	0.01987	0.0050	0.02	0	99.4	71	120	0	0		
Vinyl chloride	0.01825	0.0020	0.02	0	91.2	70	130	0	0		

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100159-008AMSD	**ZZZZZ**	**MSD**	**mg/L**	**SW8260B**		**10/11/2017**	**VOA-7_171010B**	**3802398**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Benzene	0.02041	0.0050	0.02	0.00043	99.9	76	127	0.01953	4.41	15	
2-Butanone	0.03004	0.020	0.04	0	75.1	70	130	0.03145	4.59	15	
Carbon tetrachloride	0.0208	0.0050	0.02	0	104	70	130	0.02	3.92	15	
Chlorobenzene	0.02275	0.0050	0.02	0	114	75	130	0.02262	0.573	15	
Chloroform	0.01971	0.0050	0.02	0	98.6	70	130	0.01887	4.35	15	
1,2-Dichloroethane	0.01863	0.0050	0.02	0	93.2	70	130	0.01714	8.33	15	
1,1-Dichloroethene	0.01963	0.0050	0.02	0	98.2	61	145	0.01869	4.91	15	
Tetrachloroethene	0.02417	0.0050	0.02	0	121	70	130	0.02312	4.44	15	
Trichloroethene	0.02055	0.0050	0.02	0	103	71	120	0.01987	3.36	15	
Vinyl chloride	0.01859	0.0020	0.02	0	93	70	130	0.01825	1.85	15	

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
VBLK101017B-7	**ZZZZZ**	**MBLK**	**mg/L**	**SW8260B**		**10/10/2017**	**VOA-7_171010B**	**3799225**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
1,1-Dichloroethene	ND	0.0050									
1,2-Dichloroethane	ND	0.0050									
2-Butanone	ND	0.020									
Benzene	ND	0.0050									
Carbon tetrachloride	ND	0.0050									
Chlorobenzene	ND	0.0050									
Chloroform	ND	0.0050									
Tetrachloroethene	ND	0.0050									
Trichloroethene	ND	0.0050									
Vinyl chloride	ND	0.0020									

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
VLCS101017B-7	**ZZZZZ**	**LCS**	**mg/L**	**SW8260B**		**10/10/2017**	**VOA-7_171010B**	**3799226**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
1,1-Dichloroethene	0.01921	0.0050	0.02	0	96	70	130	0	0		
1,2-Dichloroethane	0.01757	0.0050	0.02	0	87.8	70	130	0	0		
2-Butanone	0.028	0.020	0.04	0	70	50	150	0	0		
Benzene	0.01924	0.0050	0.02	0	96.2	70	130	0	0		
Carbon tetrachloride	0.02019	0.0050	0.02	0	101	70	130	0	0		
Chlorobenzene	0.02214	0.0050	0.02	0	111	70	130	0	0		

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL

ANALYTICAL QC SUMMARY REPORT

GCMS Volatiles

BatchID: R136692

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
VLCS101017B-7	**ZZZZZ**	**LCS**	**mg/L**	**SW8260B**		**10/10/2017**	**VOA-7_171010B**	**3799226**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Chloroform	0.01834	0.0050	0.02	0	91.7	70	130	0	0		
Tetrachloroethene	0.0225	0.0050	0.02	0	112	70	130	0	0		
Trichloroethene	0.0189	0.0050	0.02	0	94.5	70	130	0	0		
Vinyl chloride	0.01769	0.0020	0.02	0	88.4	70	130	0	0		

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
VLCSD101017B-7	**ZZZZZ**	**LCSD**	**mg/L**	**SW8260B**		**10/10/2017**	**VOA-7_171010B**	**3799230**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
1,1-Dichloroethene	0.0178	0.0050	0.02	0	89	70	130	0.01921	7.62	20	
1,2-Dichloroethane	0.01758	0.0050	0.02	0	87.9	70	130	0.01757	0.0569	20	
2-Butanone	0.03279	0.020	0.04	0	82	50	150	0.028	15.8	20	
Benzene	0.01891	0.0050	0.02	0	94.6	70	130	0.01924	1.73	20	
Carbon tetrachloride	0.02034	0.0050	0.02	0	102	70	130	0.02019	0.740	20	
Chlorobenzene	0.0213	0.0050	0.02	0	106	70	130	0.02214	3.87	20	
Chloroform	0.01847	0.0050	0.02	0	92.4	70	130	0.01834	0.706	20	
Tetrachloroethene	0.02177	0.0050	0.02	0	109	70	130	0.0225	3.30	20	
Trichloroethene	0.01922	0.0050	0.02	0	96.1	70	130	0.0189	1.68	20	
Vinyl chloride	0.01685	0.0020	0.02	0	84.2	70	130	0.01769	4.86	20	

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
* - Non Accredited Parameter
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
H/HT - Holding Time Exceeded
B - Analyte detected in the associated Method Blank
E - Value above quantitation range

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL

ANALYTICAL QC SUMMARY REPORT
GCMS Volatiles
BatchID: R136699

ANALYTICAL RUN SUMMARY

SeqNo	Sample ID	Type	Test Code	Batch	DF	Date Analyzed
3799403	BFB101117-7	TUNE	BFB	R136699	1	10/11/2017 09:12
3799398	VSTD050	CCV	VOC_W+	R136699	1	10/11/2017 09:38
3799399	VBLK101117-7	MBLK	VOC_W+	R136699	1	10/11/2017 10:45
3799400	VLCS101117-7	LCS	VOC_W+	R136699	1	10/11/2017 11:19
3799401	VLCSD101117-7	LCSD	VOC_W+	R136699	1	10/11/2017 11:53
3799402	17100145-001A	SAMP	VOC_TCLP	R136699	100	10/11/2017 12:45
3800001	17100176-021A	SAMP	BTEX_W-MS	R136699	50	10/11/2017 13:19
3800016	17100181-001A	SAMP	VOC_W	R136699	1	10/11/2017 13:53
3800017	17100225-001A	SAMP	BTEX_W-MS	R136699	1	10/11/2017 14:27
3800018	17100227-014A	SAMP	BTEX_W-MS	R136699	1	10/11/2017 15:01
3800019	17100227-015A	SAMP	BTEX_W-MS	R136699	1	10/11/2017 15:35
3800020	17100227-012A	SAMP	VOC_W	R136699	1	10/11/2017 16:09
3800021	17100227-013A	SAMP	VOC_W	R136699	1	10/11/2017 16:43
3800022	17100214-001A	SAMP	VOC_W	R136699	1	10/11/2017 17:17
3800023	17100232-003A	SAMP	VOC_W	R136699	1	10/11/2017 17:50

QC SUMMARY

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
VBLK101117-7	**ZZZZZ**	**MBLK**	**mg/L**	**SW8260B**		**10/11/2017**	**VOA-7_171011A**	**3799399**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
1,1-Dichloroethene	ND	0.0050									
1,2-Dichloroethane	ND	0.0050									
2-Butanone	ND	0.020									
Benzene	ND	0.0050									
Carbon tetrachloride	ND	0.0050									
Chlorobenzene	ND	0.0050									
Chloroform	ND	0.0050									
Tetrachloroethene	ND	0.0050									
Trichloroethene	ND	0.0050									
Vinyl chloride	ND	0.0020									

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
VLCS101117-7	**ZZZZZ**	**LCS**	**mg/L**	**SW8260B**		**10/11/2017**	**VOA-7_171011A**	**3799400**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
1,1-Dichloroethene	0.02006	0.0050	0.02	0	100	70	130	0	0		
1,2-Dichloroethane	0.01792	0.0050	0.02	0	89.6	70	130	0	0		
2-Butanone	0.03169	0.020	0.04	0	79.2	50	150	0	0		
Benzene	0.02094	0.0050	0.02	0	105	70	130	0	0		
Carbon tetrachloride	0.02179	0.0050	0.02	0	109	70	130	0	0		
Chlorobenzene	0.02311	0.0050	0.02	0	116	70	130	0	0		
Chloroform	0.01989	0.0050	0.02	0	99.4	70	130	0	0		
Tetrachloroethene	0.0234	0.0050	0.02	0	117	70	130	0	0		
Trichloroethene	0.02055	0.0050	0.02	0	103	70	130	0	0		
Vinyl chloride	0.02035	0.0020	0.02	0	102	70	130	0	0		

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
* - Non Accredited Parameter
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
H/HT - Holding Time Exceeded
B - Analyte detected in the associated Method Blank
E - Value above quantitation range

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL

ANALYTICAL QC SUMMARY REPORT

GCMS Volatiles

BatchID: R136699

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
VLCSD101117-7	**ZZZZZ**	**LCSD**	**mg/L**	**SW8260B**		**10/11/2017**	**VOA-7_171011A**	**3799401**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
1,1-Dichloroethene	0.01855	0.0050	0.02	0	92.8	70	130	0.02006	7.82	20	
1,2-Dichloroethane	0.0172	0.0050	0.02	0	86	70	130	0.01792	4.10	20	
2-Butanone	0.02734	0.020	0.04	0	68.4	50	150	0.03169	14.7	20	
Benzene	0.01897	0.0050	0.02	0	94.8	70	130	0.02094	9.87	20	
Carbon tetrachloride	0.02005	0.0050	0.02	0	100	70	130	0.02179	8.32	20	
Chlorobenzene	0.02157	0.0050	0.02	0	108	70	130	0.02311	6.89	20	
Chloroform	0.01836	0.0050	0.02	0	91.8	70	130	0.01989	8.00	20	
Tetrachloroethene	0.02135	0.0050	0.02	0	107	70	130	0.0234	9.16	20	
Trichloroethene	0.01899	0.0050	0.02	0	95	70	130	0.02055	7.89	20	
Vinyl chloride	0.01807	0.0020	0.02	0	90.4	70	130	0.02035	11.9	20	

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
* - Non Accredited Parameter
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
H/HT - Holding Time Exceeded
B - Analyte detected in the associated Method Blank
E - Value above quantitation range

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL
Test No: SW1311/8270C **Matrix:** W

QC SUMMARY REPORT
SURROGATE RECOVERIES

Sample ID	CLPH2D4	DCBZ12D4	NO2BZD5	PH246BR	PH2F	PHD5	PHEN2F	PHEND14
MB-103854	88.8	86.4	89.9	134 *	64.7	46.8	108	106
LCS-103854	77.8	80.5	81.1	118	59.1	44.3	96.6	107
LCSD-103854	75.4	79.1	80.3	118	58.6	44.6	94.9	102
17100226-003BMS	73.1	72.9	78.0	119	54.8	43.1	88.5	103
17100226-003BMSD	74.7	76.3	79.0	119	54.4	43.1	95.0	101
MB-103854-TCLP	90.9	83.4	89.4	131 *	62.7	48.1	101	107
17100228-003BMS	70.4	63.3	78.3	97.4	51.9	42.7	78.6	84.2
17100228-003BMSD	80.2	71.6	87.9	105	59.7	46.6	85.4	87.6
17100145-001A	65.8	60.4	74.7	59.2	49.3	43.4	95.4	92.9

Acronym		Surrogate	QC Limits
CLPH2D4	=	2-Chlorophenol-d4	33-110
DCBZ12D4	=	1,2-Dichlorobenzene-d4	16-110
NO2BZD5	=	Nitrobenzene-d5	35-114
PH246BR	=	2,4,6-Tribromophenol	10-123
PH2F	=	2-Fluorophenol	21-110
PHD5	=	Phenol-d5	10-110
PHEN2F	=	2-Fluorobiphenyl	43-116
PHEND14	=	4-Terphenyl-d14	33-141

*** Surrogate recovery outside acceptance limits**

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL

ANALYTICAL QC SUMMARY REPORT

GCMS Semivolatiles

BatchID: 103854

PREP BATCH SUMMARY

Sample ID	Matrix	pH	SampAmt	Sol Added	Sol Recov	Fin Vol	factor	PrepStart	PrepEnd
MB-103854			1	0	0	1	1.000	10/9/2017	10/9/2017
LCS-103854			1	0	0	1	1.000	10/9/2017	10/9/2017
LCSD-103854			1	0	0	1	1.000	10/9/2017	10/9/2017
MB-103854-TCLP			0.5	0	0	1	2.000	10/9/2017	10/9/2017
17100088-030A	Soil		0.5	0	0	1	2.000	10/9/2017	10/9/2017
17100145-001A	Oil		0.5	0	0	1	2.000	10/9/2017	10/9/2017
17100158-001A	Soil		0.5	0	0	1	2.000	10/9/2017	10/9/2017
17100192-004A	Soil		0.5	0	0	1	2.000	10/9/2017	10/9/2017
17100223-001A	Solid		0.5	0	0	1	2.000	10/9/2017	10/9/2017
17100224-001A	Solid		0.5	0	0	1	2.000	10/9/2017	10/9/2017
17100226-001B	Aqueous		1	0	0	1	1.000	10/9/2017	10/9/2017
17100226-002B	Aqueous		1	0	0	1	1.000	10/9/2017	10/9/2017
17100226-003B	Aqueous		1	0	0	1	1.000	10/9/2017	10/9/2017
17100226-003BMS	Aqueous		1	0	0	1	1.000	10/9/2017	10/9/2017
17100226-003BMSD	Aqueous		1	0	0	1	1.000	10/9/2017	10/9/2017
17100166-002B	Aqueous		0.5	0	0	0.5	1.000	10/10/2017	10/10/2017
17100213-001B	Soil		0.5	0	0	1	2.000	10/10/2017	10/10/2017
17100214-001B	Aqueous		1	0	0	1	1.000	10/10/2017	10/10/2017
17100228-001B	Aqueous		1	0	0	1	1.000	10/10/2017	10/10/2017
17100228-002B	Aqueous		1	0	0	1	1.000	10/10/2017	10/10/2017
17100228-003B	Aqueous		1	0	0	1	1.000	10/10/2017	10/10/2017
17100228-003BMS	Aqueous		1	0	0	1	1.000	10/10/2017	10/10/2017
17100228-003BMSD	Aqueous		1	0	0	1	1.000	10/10/2017	10/10/2017
17100228-004B	Aqueous		1	0	0	1	1.000	10/10/2017	10/10/2017
17100228-005B	Aqueous		1	0	0	1	1.000	10/10/2017	10/10/2017
17100228-006B	Aqueous		1	0	0	1	1.000	10/10/2017	10/10/2017

QC SUMMARY

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
MB-103854-TCLP	**ZZZZZ**	**MBLK**	**mg/L**	**SW1311/8270C**	**10/9/2017**	**10/11/2017**	**SVOC-7_171011A**	**3799508**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
1,4-Dichlorobenzene	ND	0.010									
2,4-Dinitrotoluene	ND	0.010									
Hexachlorobenzene	ND	0.010									
Hexachlorobutadiene	ND	0.010									
Hexachloroethane	ND	0.010									
Nitrobenzene	ND	0.010									
2-methylphenol	ND	0.010									
3- & 4-Methylphenol	ND	0.010									
Pentachlorophenol	ND	0.050									
Pyridine	ND	0.010									
2,4,5-Trichlorophenol	ND	0.010									
2,4,6-Trichlorophenol	ND	0.010									

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
MB-103854	**ZZZZZ**	**MBLK**	**mg/L**	**SW8270C**	**10/9/2017**	**10/10/2017**	**SVOC-7_171010A**	**3798081**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
1,4-Dichlorobenzene	ND	0.0050									

Qualifiers:
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R - RPD outside accepted recovery limits
H/HT - Holding Time Exceeded
B - Analyte detected in the associated Method Blank
E - Value above quantitation range

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
MB-103854	**ZZZZZ**	**MBLK**	**mg/L**	**SW8270C**	**10/9/2017**	**10/10/2017**	**SVOC-7_171010A**	**3798081**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
2,4-Dinitrotoluene	ND	0.0050									
Hexachlorobenzene	ND	0.0050									
Hexachlorobutadiene	ND	0.0050									
Hexachloroethane	ND	0.0050									
2-Methylphenol	ND	0.0050									
4-Methylphenol	ND	0.0050									
Nitrobenzene	ND	0.0050									
Pentachlorophenol	ND	0.025									
Pyridine	ND	0.0050									
2,4,5-Trichlorophenol	ND	0.010									
2,4,6-Trichlorophenol	ND	0.0050									

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
LCS-103854	**ZZZZZ**	**LCS**	**mg/L**	**SW8270C**	**10/9/2017**	**10/10/2017**	**SVOC-7_171010A**	**3798083**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Acenaphthene	0.04638	0.0050	0.05	0	92.8	54	116	0	0		
4-Chloro-3-methylphenol	0.0956	0.0050	0.1	0	95.6	49	117	0	0		
2-Chlorophenol	0.07883	0.0050	0.1	0	78.8	44	103	0	0		
1,4-Dichlorobenzene	0.03594	0.0050	0.05	0	71.9	41	90	0	0		
2,4-Dinitrotoluene	0.0488	0.0050	0.05	0	97.6	46	122	0	0		
4-Nitrophenol	0.05545	0.025	0.1	0	55.4	15	78	0	0		
N-Nitrosodi-n-propylamine	0.03959	0.0050	0.05	0	79.2	43	108	0	0		
Pentachlorophenol	0.108	0.025	0.1	0	108	10	221	0	0		
Phenol	0.04578	0.0050	0.1	0	45.8	23	58	0	0		
Pyrene	0.05018	0.0050	0.05	0	100	53	140	0	0		
1,2,4-Trichlorobenzene	0.0427	0.0050	0.05	0	85.4	42	96	0	0		

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
LCSD-103854	**ZZZZZ**	**LCSD**	**mg/L**	**SW8270C**	**10/9/2017**	**10/10/2017**	**SVOC-7_171010A**	**3798176**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Acenaphthene	0.04846	0.0050	0.05	0	96.9	54	116	0.04638	4.39	21	
4-Chloro-3-methylphenol	0.09211	0.0050	0.1	0	92.1	49	117	0.0956	3.72	27	
2-Chlorophenol	0.07826	0.0050	0.1	0	78.3	44	103	0.07883	0.726	29	
1,4-Dichlorobenzene	0.03626	0.0050	0.05	0	72.5	41	90	0.03594	0.886	38	
2,4-Dinitrotoluene	0.04867	0.0050	0.05	0	97.3	46	122	0.0488	0.267	23	
4-Nitrophenol	0.05421	0.025	0.1	0	54.2	15	78	0.05545	2.26	29	
N-Nitrosodi-n-propylamine	0.04043	0.0050	0.05	0	80.9	43	108	0.03959	2.10	24	
Pentachlorophenol	0.106	0.025	0.1	0	106	10	221	0.108	1.86	29	
Phenol	0.04379	0.0050	0.1	0	43.8	23	58	0.04578	4.44	30	
Pyrene	0.04842	0.0050	0.05	0	96.8	53	140	0.05018	3.57	24	
1,2,4-Trichlorobenzene	0.04078	0.0050	0.05	0	81.6	42	96	0.0427	4.60	32	

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100226-003BMS	**ZZZZZ**	**MS**	**mg/L**	**SW8270C**	**10/9/2017**	**10/10/2017**	**SVOC-7_171010A**	**3798190**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Acenaphthene	0.04356	0.0050	0.05	0	87.1	62	97	0	0		
4-Chloro-3-methylphenol	0.09244	0.0050	0.1	0	92.4	64	104	0	0		
2-Chlorophenol	0.07336	0.0050	0.1	0	73.4	41	95	0	0		

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL

ANALYTICAL QC SUMMARY REPORT
GCMS Semivolatiles
BatchID: 103854

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100226-003BMS	**ZZZZZ**	**MS**	**mg/L**	**SW8270C**	**10/9/2017**	**10/10/2017**	**SVOC-7_171010A**	**3798190**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
1,4-Dichlorobenzene	0.03114	0.0050	0.05	0	62.3	44	85	0	0		
2,4-Dinitrotoluene	0.04767	0.0050	0.05	0	95.3	66	106	0	0		
4-Nitrophenol	0.05643	0.025	0.1	0	56.4	22	77	0	0		
N-Nitrosodi-n-propylamine	0.03995	0.0050	0.05	0	79.9	47	93	0	0		
Pentachlorophenol	0.1065	0.025	0.1	0	107	50	151	0	0		
Phenol	0.04382	0.0050	0.1	0	43.8	27	52	0	0		
Pyrene	0.04958	0.0050	0.05	0	99.2	67	104	0	0		
1,2,4-Trichlorobenzene	0.03754	0.0050	0.05	0	75.1	48	90	0	0		

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100228-003BMS	**ZZZZZ**	**MS**	**mg/L**	**SW8270C**	**10/10/2017**	**10/12/2017**	**SVOC-8_171012B**	**3802053**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Acenaphthene	0.04174	0.0050	0.05	0	83.5	62	97	0	0		
4-Chloro-3-methylphenol	0.08627	0.0050	0.1	0	86.3	64	104	0	0		
2-Chlorophenol	0.07038	0.0050	0.1	0	70.4	41	95	0	0		
1,4-Dichlorobenzene	0.02884	0.0050	0.05	0	57.7	44	85	0	0		
2,4-Dinitrotoluene	0.04851	0.0050	0.05	0	97	66	106	0	0		
4-Nitrophenol	0.05763	0.025	0.1	0	57.6	22	77	0	0		
N-Nitrosodi-n-propylamine	0.04038	0.0050	0.05	0	80.8	47	93	0	0		
Pentachlorophenol	0.119	0.025	0.1	0	119	50	151	0	0		
Phenol	0.04349	0.0050	0.1	0	43.5	27	52	0	0		
Pyrene	0.0453	0.0050	0.05	0	90.6	67	104	0	0		
1,2,4-Trichlorobenzene	0.03324	0.0050	0.05	0	66.5	48	90	0	0		

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100226-003BMSD	**ZZZZZ**	**MSD**	**mg/L**	**SW8270C**	**10/9/2017**	**10/10/2017**	**SVOC-7_171010A**	**3798269**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Acenaphthene	0.04659	0.0050	0.05	0	93.2	62	97	0.04356	6.72	18	
4-Chloro-3-methylphenol	0.08999	0.0050	0.1	0	90	64	104	0.09244	2.69	22	
2-Chlorophenol	0.07689	0.0050	0.1	0	76.9	41	95	0.07336	4.70	37	
1,4-Dichlorobenzene	0.03398	0.0050	0.05	0	68	44	85	0.03114	8.72	24	
2,4-Dinitrotoluene	0.04984	0.0050	0.05	0	99.7	66	106	0.04767	4.45	21	
4-Nitrophenol	0.05534	0.025	0.1	0	55.3	22	77	0.05643	1.95	31	
N-Nitrosodi-n-propylamine	0.04073	0.0050	0.05	0	81.5	47	93	0.03995	1.93	29	
Pentachlorophenol	0.1051	0.025	0.1	0	105	50	151	0.1065	1.37	20	
Phenol	0.04364	0.0050	0.1	0	43.6	27	52	0.04382	0.412	33	
Pyrene	0.04951	0.0050	0.05	0	99	67	104	0.04958	0.141	19	
1,2,4-Trichlorobenzene	0.03873	0.0050	0.05	0	77.5	48	90	0.03754	3.12	25	

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100228-003BMSD	**ZZZZZ**	**MSD**	**mg/L**	**SW8270C**	**10/10/2017**	**10/12/2017**	**SVOC-8_171012B**	**3802055**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Acenaphthene	0.04552	0.0050	0.05	0	91	62	97	0.04174	8.66	18	
4-Chloro-3-methylphenol	0.09267	0.0050	0.1	0	92.7	64	104	0.08627	7.15	22	
2-Chlorophenol	0.07988	0.0050	0.1	0	79.9	41	95	0.07038	12.6	37	
1,4-Dichlorobenzene	0.03448	0.0050	0.05	0	69	44	85	0.02884	17.8	24	
2,4-Dinitrotoluene	0.05255	0.0050	0.05	0	105	66	106	0.04851	8.00	21	
4-Nitrophenol	0.0623	0.025	0.1	0	62.3	22	77	0.05763	7.79	31	

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
* - Non Accredited Parameter
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
H/HT - Holding Time Exceeded
B - Analyte detected in the associated Method Blank
E - Value above quantitation range

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL

ANALYTICAL QC SUMMARY REPORT

GCMS Semivolatiles

BatchID: 103854

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100228-003BMSD	**ZZZZZ**	**MSD**	**mg/L**	**SW8270C**	**10/10/2017**	**10/12/2017**	**SVOC-8_171012B**	**3802055**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
N-Nitrosodi-n-propylamine	0.04421	0.0050	0.05	0	88.4	47	93	0.04038	9.06	29	
Pentachlorophenol	0.1289	0.025	0.1	0	129	50	151	0.119	7.99	20	E
Phenol	0.04739	0.0050	0.1	0	47.4	27	52	0.04349	8.58	33	
Pyrene	0.04857	0.0050	0.05	0	97.1	67	104	0.0453	6.97	19	
1,2,4-Trichlorobenzene	0.03726	0.0050	0.05	0	74.5	48	90	0.03324	11.4	25	

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
* - Non Accredited Parameter
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
H/HT - Holding Time Exceeded
B - Analyte detected in the associated Method Blank
E - Value above quantitation range

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL
Test No: SW1311/8081B **Matrix:** W

QC SUMMARY REPORT
SURROGATE RECOVERIES

Sample ID	CL10BZ2	XYL2456CLM						
LCS-103853-PEST	78.0	76.0						
LCSD-103853-PEST	73.0	71.0						
17100226-003BMST	100	74.5						
17100226-003BMSDT	97.0	71.0						
MB-103853-PP	80.0	84.0						
17100145-001A	115	73.0						
17100228-003BMST	49.5	70.0						
17100228-003BMSDT	76.5	66.5						

Acronym		Surrogate	QC Limits
CL10BZ2	=	Decachlorobiphenyl	30-150
XYL2456CLM	=	Tetrachloro-m-xylene	30-150

*** Surrogate recovery outside acceptance limits**

PREP BATCH SUMMARY

Sample ID	Matrix	pH	SampAmt	Sol Added	Sol Recov	Fin Vol	factor	PrepStart	PrepEnd
MB-103853-PP			1	0	0	10	10.000	10/9/2017	10/9/2017
LCS-103853-PCB			1	0	0	10	10.000	10/9/2017	10/9/2017
LCSD-103853-PCB			1	0	0	10	10.000	10/9/2017	10/9/2017
LCS-103853-PEST			1	0	0	10	10.000	10/9/2017	10/9/2017
LCSD-103853-PEST			1	0	0	10	10.000	10/9/2017	10/9/2017
17100145-001A	Oil		0.1	0	0	10	100.000	10/9/2017	10/9/2017
17100192-004A	Soil		0.06	0	0	10	166.667	10/9/2017	10/9/2017
17100226-001B	Aqueous		0.5	0	0	5	10.000	10/9/2017	10/9/2017
17100226-002B	Aqueous		0.5	0	0	5	10.000	10/9/2017	10/9/2017
17100226-003B	Aqueous		0.5	0	0	5	10.000	10/9/2017	10/9/2017
17100226-003BMS	Aqueous		0.5	0	0	5	10.000	10/9/2017	10/9/2017
17100226-003BMSD	Aqueous		0.5	0	0	5	10.000	10/9/2017	10/9/2017
17100226-003BMST	Aqueous		0.5	0	0	5	10.000	10/9/2017	10/9/2017
17100226-003BMSDT	Aqueous		0.5	0	0	5	10.000	10/9/2017	10/9/2017
MB-103853-TCLP			0.5	0	0	10	20.000	10/9/2017	10/9/2017
17100166-002B	Aqueous		1	0	0	10	10.000	10/10/2017	10/10/2017
17100214-001B	Aqueous		1	0	0	10	10.000	10/10/2017	10/10/2017
17100228-001B	Aqueous		1	0	0	10	10.000	10/10/2017	10/10/2017
17100228-002B	Aqueous		1	0	0	10	10.000	10/10/2017	10/10/2017
17100228-003B	Aqueous		0.5	0	0	5	10.000	10/10/2017	10/10/2017
17100228-003BMS	Aqueous		0.5	0	0	5	10.000	10/10/2017	10/10/2017
17100228-003BMSD	Aqueous		0.5	0	0	5	10.000	10/10/2017	10/10/2017
17100228-004B	Aqueous		1	0	0	10	10.000	10/10/2017	10/10/2017
17100228-005B	Aqueous		1	0	0	10	10.000	10/10/2017	10/10/2017
17100228-006B	Aqueous		1	0	0	10	10.000	10/10/2017	10/10/2017
17100228-003BMST	Aqueous		0.5	0	0	5	10.000	10/10/2017	10/10/2017
17100228-003BMSDT	Aqueous		0.5	0	0	5	10.000	10/10/2017	10/10/2017

QC SUMMARY

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
MB-103853-PP	**ZZZZZ**	**MBLK**	**mg/L**	**SW8081B**	**10/9/2017**	**10/10/2017**	**GC-ECD_171010A**	**3799405**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
4,4´-DDD	ND	0.000050									
4,4´-DDE	ND	0.000050									
4,4´-DDT	ND	0.000050									
Aldrin	ND	0.000050									
alpha-BHC	ND	0.000050									
alpha-Chlordane	ND	0.000050									
beta-BHC	ND	0.000050									
Chlordane	ND	0.0010									
delta-BHC	ND	0.000050									
Dieldrin	ND	0.000050									
Endosulfan I	ND	0.000050									
Endosulfan II	ND	0.000050									
Endosulfan sulfate	ND	0.000050									
Endrin	ND	0.000050									
Endrin aldehyde	ND	0.000050									
Endrin ketone	ND	0.000050									

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
MB-103853-PP	**ZZZZZ**	**MBLK**	**mg/L**	**SW8081B**	**10/9/2017**	**10/10/2017**	**GC-ECD_171010A**	**3799405**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
gamma-BHC	ND	0.000050									
gamma-Chlordane	ND	0.000050									
Heptachlor	ND	0.000050									
Heptachlor epoxide	ND	0.000050									
Methoxychlor	ND	0.000050									
Toxaphene	ND	0.0010									

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
LCS-103853-PEST	**ZZZZZ**	**LCS**	**mg/L**	**SW8081B**	**10/9/2017**	**10/10/2017**	**GC-ECD_171010A**	**3798550**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
4,4´-DDD	0.00028	0.000050	0.00025	0	112	30	150	0	0		
4,4´-DDE	0.00029	0.000050	0.00025	0	116	30	150	0	0		
4,4´-DDT	0.00027	0.000050	0.00025	0	108	30	150	0	0		
Aldrin	0.00026	0.000050	0.00025	0	104	30	150	0	0		
alpha-BHC	0.0002	0.000050	0.00025	0	80	30	150	0	0		
alpha-Chlordane	0.00028	0.000050	0.00025	0	112	30	150	0	0		
beta-BHC	0.00026	0.000050	0.00025	0	104	30	150	0	0		
delta-BHC	0.0002	0.000050	0.00025	0	80	30	150	0	0		
Dieldrin	0.0003	0.000050	0.00025	0	120	30	150	0	0		
Endosulfan I	0.00025	0.000050	0.00025	0	100	30	150	0	0		
Endosulfan II	0.00027	0.000050	0.00025	0	108	30	150	0	0		
Endosulfan sulfate	0.00019	0.000050	0.00025	0	76	30	150	0	0		
Endrin	0.00035	0.000050	0.00025	0	140	30	150	0	0		
Endrin aldehyde	0.00025	0.000050	0.00025	0	100	30	150	0	0		
Endrin ketone	0.00028	0.000050	0.00025	0	112	30	150	0	0		
gamma-BHC	0.00023	0.000050	0.00025	0	92	30	150	0	0		
gamma-Chlordane	0.0003	0.000050	0.00025	0	120	30	150	0	0		
Heptachlor	0.00026	0.000050	0.00025	0	104	30	150	0	0		
Heptachlor epoxide	0.00029	0.000050	0.00025	0	116	30	150	0	0		
Methoxychlor	0.00031	0.000050	0.00025	0	124	30	150	0	0		

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
LCSD-103853-PEST	**ZZZZZ**	**LCSD**	**mg/L**	**SW8081B**	**10/9/2017**	**10/10/2017**	**GC-ECD_171010A**	**3798551**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
4,4´-DDD	0.00027	0.000050	0.00025	0	108	30	150	0.00028	3.64	25	
4,4´-DDE	0.00029	0.000050	0.00025	0	116	30	150	0.00029	0	25	
4,4´-DDT	0.00026	0.000050	0.00025	0	104	30	150	0.00027	3.77	25	
Aldrin	0.00026	0.000050	0.00025	0	104	30	150	0.00026	0	25	
alpha-BHC	0.0002	0.000050	0.00025	0	80	30	150	0.0002	0	25	
alpha-Chlordane	0.00029	0.000050	0.00025	0	116	30	150	0.00028	3.51	25	
beta-BHC	0.00027	0.000050	0.00025	0	108	30	150	0.00026	3.77	25	
delta-BHC	0.0002	0.000050	0.00025	0	80	30	150	0.0002	0	25	
Dieldrin	0.0003	0.000050	0.00025	0	120	30	150	0.0003	0	25	
Endosulfan I	0.00025	0.000050	0.00025	0	100	30	150	0.00025	0	25	
Endosulfan II	0.0003	0.000050	0.00025	0	120	30	150	0.00027	10.5	25	
Endosulfan sulfate	0.00019	0.000050	0.00025	0	76	30	150	0.00019	0	25	
Endrin	0.00035	0.000050	0.00025	0	140	30	150	0.00035	0	25	
Endrin aldehyde	0.00025	0.000050	0.00025	0	100	30	150	0.00025	0	25	

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
LCSD-103853-PEST	**ZZZZZ**	**LCSD**	**mg/L**	**SW8081B**	**10/9/2017**	**10/10/2017**	**GC-ECD_171010A**	**3798551**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Endrin ketone	0.00029	0.000050	0.00025	0	116	30	150	0.00028	3.51	25	
gamma-BHC	0.00023	0.000050	0.00025	0	92	30	150	0.00023	0	25	
gamma-Chlordane	0.0003	0.000050	0.00025	0	120	30	150	0.0003	0	25	
Heptachlor	0.00025	0.000050	0.00025	0	100	30	150	0.00026	3.92	25	
Heptachlor epoxide	0.00029	0.000050	0.00025	0	116	30	150	0.00029	0	25	
Methoxychlor	0.00032	0.000050	0.00025	0	128	30	150	0.00031	3.17	25	

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100226-003BMST	**ZZZZZ**	**MS**	**mg/L**	**SW8081B**	**10/9/2017**	**10/10/2017**	**GC-ECD_171010A**	**3798553**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
4,4´-DDD	0.00056	0.000050	0.0005	0	112	30	150	0	0		
4,4´-DDE	0.00058	0.000050	0.0005	0	116	30	150	0	0		
4,4´-DDT	0.00053	0.000050	0.0005	0	106	30	150	0	0		
Aldrin	0.00048	0.000050	0.0005	0	96	30	150	0	0		
alpha-BHC	0.00042	0.000050	0.0005	0	84	30	150	0	0		
alpha-Chlordane	0.00054	0.000050	0.0005	0	108	30	150	0	0		
beta-BHC	0.00052	0.000050	0.0005	0	104	30	150	0	0		
delta-BHC	0.0004	0.000050	0.0005	0	80	30	150	0	0		
Dieldrin	0.00058	0.000050	0.0005	0	116	30	150	0	0		
Endosulfan I	0.00051	0.000050	0.0005	0	102	30	150	0	0		
Endosulfan II	0.00046	0.000050	0.0005	0	92	30	150	0	0		
Endosulfan sulfate	0.00036	0.000050	0.0005	0	72	30	150	0	0		
Endrin	0.0007	0.000050	0.0005	0	140	30	150	0	0		
Endrin aldehyde	0.00049	0.000050	0.0005	0	98	30	150	0	0		
Endrin ketone	0.00056	0.000050	0.0005	0	112	30	150	0	0		
gamma-BHC	0.00045	0.000050	0.0005	0	90	30	150	0	0		
gamma-Chlordane	0.00058	0.000050	0.0005	0	116	30	150	0	0		
Heptachlor	0.0005	0.000050	0.0005	0	100	30	150	0	0		
Heptachlor epoxide	0.00057	0.000050	0.0005	0	114	30	150	0	0		
Methoxychlor	0.00063	0.000050	0.0005	0	126	30	150	0	0		

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100228-003BMST	**ZZZZZ**	**MS**	**mg/L**	**SW8081B**	**10/10/2017**	**10/13/2017**	**GC-ECD_171013A**	**3802642**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
4,4´-DDD	0.00055	0.000050	0.0005	0	110	30	150	0	0		H
4,4´-DDE	0.00056	0.000050	0.0005	0	112	30	150	0	0		H
4,4´-DDT	0.0005	0.000050	0.0005	0	100	30	150	0	0		H
Aldrin	0.00046	0.000050	0.0005	0	92	30	150	0	0		H
alpha-BHC	0.00044	0.000050	0.0005	0	88	30	150	0	0		H
alpha-Chlordane	0.00055	0.000050	0.0005	0	110	30	150	0	0		H
beta-BHC	0.00057	0.000050	0.0005	0	114	30	150	0	0		H
delta-BHC	0.00041	0.000050	0.0005	0	82	30	150	0	0		H
Dieldrin	0.00059	0.000050	0.0005	0	118	30	150	0	0		H
Endosulfan I	0.00053	0.000050	0.0005	0	106	30	150	0	0		H
Endosulfan II	0.00047	0.000050	0.0005	0	94	30	150	0	0		H
Endosulfan sulfate	0.00035	0.000050	0.0005	0	70	30	150	0	0		H
Endrin	0.0007	0.000050	0.0005	0	140	30	150	0	0		H
Endrin aldehyde	0.00046	0.000050	0.0005	0	92	30	150	0	0		H

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL

ANALYTICAL QC SUMMARY REPORT

GC Semivolatiles

BatchID: 103853

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100228-003BMST	**ZZZZZ**	**MS**	**mg/L**	**SW8081B**	**10/10/2017**	**10/13/2017**	**GC-ECD_171013A**	**3802642**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Endrin ketone	0.00056	0.000050	0.0005	0	112	30	150	0	0		H
gamma-BHC	0.00047	0.000050	0.0005	0	94	30	150	0	0		H
gamma-Chlordane	0.00057	0.000050	0.0005	0	114	30	150	0	0		H
Heptachlor	0.00052	0.000050	0.0005	0	104	30	150	0	0		H
Heptachlor epoxide	0.00058	0.000050	0.0005	0	116	30	150	0	0		H
Methoxychlor	0.00061	0.000050	0.0005	0	122	30	150	0	0		H

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100226-003BMSDT	**ZZZZZ**	**MSD**	**mg/L**	**SW8081B**	**10/9/2017**	**10/10/2017**	**GC-ECD_171010A**	**3798554**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
4,4´-DDD	0.0005	0.000050	0.0005	0	100	30	150	0.00056	11.3	25	
4,4´-DDE	0.00053	0.000050	0.0005	0	106	30	150	0.00058	9.01	25	
4,4´-DDT	0.00047	0.000050	0.0005	0	94	30	150	0.00053	12.0	25	
Aldrin	0.0005	0.000050	0.0005	0	100	30	150	0.00048	4.08	25	
alpha-BHC	0.00036	0.000050	0.0005	0	72	30	150	0.00042	15.4	25	
alpha-Chlordane	0.00049	0.000050	0.0005	0	98	30	150	0.00054	9.71	25	
beta-BHC	0.00047	0.000050	0.0005	0	94	30	150	0.00052	10.1	25	
delta-BHC	0.00039	0.000050	0.0005	0	78	30	150	0.0004	2.53	25	
Dieldrin	0.00053	0.000050	0.0005	0	106	30	150	0.00058	9.01	25	
Endosulfan I	0.00047	0.000050	0.0005	0	94	30	150	0.00051	8.16	25	
Endosulfan II	0.0004	0.000050	0.0005	0	80	30	150	0.00046	14.0	25	
Endosulfan sulfate	0.00032	0.000050	0.0005	0	64	30	150	0.00036	11.8	25	
Endrin	0.00062	0.000050	0.0005	0	124	30	150	0.0007	12.1	25	
Endrin aldehyde	0.00042	0.000050	0.0005	0	84	30	150	0.00049	15.4	25	
Endrin ketone	0.0005	0.000050	0.0005	0	100	30	150	0.00056	11.3	25	
gamma-BHC	0.00041	0.000050	0.0005	0	82	30	150	0.00045	9.30	25	
gamma-Chlordane	0.00053	0.000050	0.0005	0	106	30	150	0.00058	9.01	25	
Heptachlor	0.00049	0.000050	0.0005	0	98	30	150	0.0005	2.02	25	
Heptachlor epoxide	0.0005	0.000050	0.0005	0	100	30	150	0.00057	13.1	25	
Methoxychlor	0.00057	0.000050	0.0005	0	114	30	150	0.00063	10.0	25	

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100228-003BMSDT	**ZZZZZ**	**MSD**	**mg/L**	**SW8081B**	**10/10/2017**	**10/13/2017**	**GC-ECD_171013A**	**3802644**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
4,4´-DDD	0.00052	0.000050	0.0005	0	104	30	150	0.00055	5.61	25	H
4,4´-DDE	0.00055	0.000050	0.0005	0	110	30	150	0.00056	1.80	25	H
4,4´-DDT	0.00049	0.000050	0.0005	0	98	30	150	0.0005	2.02	25	H
Aldrin	0.00044	0.000050	0.0005	0	88	30	150	0.00046	4.44	25	H
alpha-BHC	0.00042	0.000050	0.0005	0	84	30	150	0.00044	4.65	25	H
alpha-Chlordane	0.00051	0.000050	0.0005	0	102	30	150	0.00055	7.55	25	H
beta-BHC	0.00054	0.000050	0.0005	0	108	30	150	0.00057	5.41	25	H
delta-BHC	0.00039	0.000050	0.0005	0	78	30	150	0.00041	5.00	25	H
Dieldrin	0.00056	0.000050	0.0005	0	112	30	150	0.00059	5.22	25	H
Endosulfan I	0.0005	0.000050	0.0005	0	100	30	150	0.00053	5.83	25	H
Endosulfan II	0.00045	0.000050	0.0005	0	90	30	150	0.00047	4.35	25	H
Endosulfan sulfate	0.00033	0.000050	0.0005	0	66	30	150	0.00035	5.88	25	H
Endrin	0.00065	0.000050	0.0005	0	130	30	150	0.0007	7.41	25	H
Endrin aldehyde	0.00043	0.000050	0.0005	0	86	30	150	0.00046	6.74	25	H

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
* - Non Accredited Parameter
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
H/HT - Holding Time Exceeded
B - Analyte detected in the associated Method Blank
E - Value above quantitation range

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL

ANALYTICAL QC SUMMARY REPORT

GC Semivolatiles

BatchID: 103853

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100228-003BMSDT	**ZZZZZ**	**MSD**	**mg/L**	**SW8081B**	**10/10/2017**	**10/13/2017**	**GC-ECD_171013A**	**3802644**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Endrin ketone	0.00053	0.000050	0.0005	0	106	30	150	0.00056	5.50	25	H
gamma-BHC	0.00044	0.000050	0.0005	0	88	30	150	0.00047	6.59	25	H
gamma-Chlordane	0.00054	0.000050	0.0005	0	108	30	150	0.00057	5.41	25	H
Heptachlor	0.0005	0.000050	0.0005	0	100	30	150	0.00052	3.92	25	H
Heptachlor epoxide	0.00054	0.000050	0.0005	0	108	30	150	0.00058	7.14	25	H
Methoxychlor	0.00058	0.000050	0.0005	0	116	30	150	0.00061	5.04	25	H

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
* - Non Accredited Parameter
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
H/HT - Holding Time Exceeded
B - Analyte detected in the associated Method Blank
E - Value above quantitation range

STAT Analysis Corporation

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL
Test No: SW8082A **Matrix:** O

QC SUMMARY REPORT
SURROGATE RECOVERIES

Sample ID	CL10BZ2	XYL2456CLM						
MB-103780-PCB	73.0	82.0						
LCS-103780-PCB	77.0	82.0						
17100131-001AMS	80.0	40.0						
17100131-001AMSD	70.0	40.0						
17100145-001A	93.0	37.0						

Acronym		Surrogate	QC Limits
CL10BZ2	=	Decachlorobiphenyl	30-150
XYL2456CLM	=	Tetrachloro-m-xylene	30-150

*** Surrogate recovery outside acceptance limits**

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL

ANALYTICAL QC SUMMARY REPORT
GC Semivolatiles
BatchID: 103780

PREP BATCH SUMMARY

Sample ID	Matrix	pH	SampAmt	Sol Added	Sol Recov	Fin Vol	factor	PrepStart	PrepEnd
MB-103780-PCB			0.001	0	0	10	10000.000	10/5/2017	10/5/2017
LCS-103780-PCB			0.001	0	0	10	10000.000	10/5/2017	10/5/2017
17100130-025A	Solid		0.00102	0	0	10	9803.922	10/5/2017	10/5/2017
17100131-001A	Oil		0.00103	0	0	10	9708.738	10/5/2017	10/5/2017
17100131-002A	Oil		0.00105	0	0	10	9523.810	10/5/2017	10/5/2017
17100134-001A	Solid		0.00142	0	0	10	7042.254	10/5/2017	10/5/2017
17100135-002A	Solid		0.00102	0	0	10	9803.922	10/5/2017	10/5/2017
17100136-002A	Solid		0.00113	0	0	10	8849.558	10/5/2017	10/5/2017
17100145-001A	Soil		0.00116	0	0	10	8620.690	10/5/2017	10/5/2017
17100131-001AMS	Oil		0.00103	0	0	10	9708.738	10/5/2017	10/5/2017
17100131-001AMSD	Oil		0.00103	0	0	10	9708.738	10/5/2017	10/5/2017
17100152-001A	Oil		0.00104	0	0	10	9615.385	10/5/2017	10/5/2017
17100171-001A	Oil		0.00105	0	0	10	9523.810	10/5/2017	10/5/2017
17100184-002A	Solid		0.00102	0	0	10	9803.922	10/6/2017	10/6/2017
17100185-001A	Oil		0.00115	0	0	10	8695.652	10/6/2017	10/6/2017
17100185-002A	Oil		0.00112	0	0	10	8928.571	10/6/2017	10/6/2017
17100186-001A	Solids		0.00106	0	0	10	9433.962	10/6/2017	10/6/2017
17100188-001A	Oil		0.00102	0	0	10	9803.922	10/6/2017	10/6/2017
17100189-001A	Oil		0.00115	0	0	10	8695.652	10/6/2017	10/6/2017
17100190-001A	Oil		0.00102	0	0	10	9803.922	10/6/2017	10/6/2017

QC SUMMARY

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
MB-103780-PCB	**ZZZZZ**	**MBLK**	**mg/Kg**	**SW8082A**	**10/5/2017**	**10/5/2017**	**GC-ECD3_171003A**	**3806620**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Aroclor 1016	ND	1.0									
Aroclor 1221	ND	1.0									
Aroclor 1232	ND	1.0									
Aroclor 1242	ND	1.0									
Aroclor 1248	ND	1.0									
Aroclor 1254	ND	1.0									
Aroclor 1260	ND	1.0									

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
LCS-103780-PCB	**ZZZZZ**	**LCS**	**mg/Kg**	**SW8082A**	**10/5/2017**	**10/5/2017**	**GC-ECD3_171003A**	**3806621**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Aroclor 1016	8.85	1.0	10	0	88.5	30	150	0	0		
Aroclor 1260	9.13	1.0	10	0	91.3	30	150	0	0		

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100131-001AMS	**ZZZZZ**	**MS**	**mg/Kg**	**SW8082A**	**10/5/2017**	**10/5/2017**	**GC-ECD3_171003A**	**3806623**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Aroclor 1260	8.608	0.97	9.709	0	88.7	30	150	0	0		

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
* - Non Accredited Parameter
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
H/HT - Holding Time Exceeded
B - Analyte detected in the associated Method Blank
E - Value above quantitation range

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL

ANALYTICAL QC SUMMARY REPORT

GC Semivolatiles

BatchID: 103780

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100131-001AMSD	**ZZZZZ**	**MSD**	**mg/Kg**	**SW8082A**	**10/5/2017**	**10/5/2017**	**GC-ECD3_171003A**	**3806624**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Aroclor 1260	9.45	0.97	9.709	0	97.3	30	150	8.608	9.32	25	

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
* - Non Accredited Parameter
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
H/HT - Holding Time Exceeded
B - Analyte detected in the associated Method Blank
E - Value above quantitation range

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL
Test No: SW1311/8321B **Matrix:** W

QC SUMMARY REPORT
SURROGATE RECOVERIES

Sample ID	DCPA							
17100226-003BMS	89.4							
17100226-003BMSD	91.7							
MB-103856	86.5							
LCS-103856	82.1							
LCSD-103856	89.6							
17100145-001A	124							
MB-103856-TCLP	87.4							

Acronym		Surrogate	QC Limits
DCPA	=	2,4-Dichlorophenylacetic Acid	50-150

*** Surrogate recovery outside acceptance limits**

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL

ANALYTICAL QC SUMMARY REPORT
HPLC
BatchID: 103856

PREP BATCH SUMMARY

Sample ID	Matrix	pH	SampAmt	Sol Added	Sol Recov	Fin Vol	factor	PrepStart	PrepEnd
MB-103856			1	0	0	1	1.000	10/9/2017	10/9/2017
LCS-103856			1	0	0	1	1.000	10/9/2017	10/9/2017
LCSD-103856			1	0	0	1	1.000	10/9/2017	10/9/2017
MB-103856-TCLP			0.5	0	0	1	2.000	10/9/2017	10/9/2017
17100145-001A	Oil		0.05	0	0	1	20.000	10/9/2017	10/9/2017
17100192-004A	Soil		0.05	0	0	0.5	10.000	10/9/2017	10/9/2017
17100226-001B	Aqueous		0.5	0	0	0.5	1.000	10/9/2017	10/9/2017
17100226-002B	Aqueous		0.5	0	0	0.5	1.000	10/9/2017	10/9/2017
17100226-003B	Aqueous		0.5	0	0	0.5	1.000	10/9/2017	10/9/2017
17100226-003BMS	Aqueous		0.5	0	0	0.5	1.000	10/9/2017	10/9/2017
17100226-003BMSD	Aqueous		0.5	0	0	0.5	1.000	10/9/2017	10/9/2017
17100266-001A	Aqueous		0.5	0	0	0.5	1.000	10/10/2017	10/10/2017

QC SUMMARY

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
MB-103856	**ZZZZZ**	**MBLK**	**mg/L**	**SW8321B**	**10/9/2017**	**10/10/2017**	**HPLC-1_171010A**	**3798297**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
2,4,5-TP (Silvex)	ND	0.00010									
2,4-D	ND	0.00020									

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
MB-103856-TCLP	**ZZZZZ**	**MBLK**	**mg/L**	**SW8321B**	**10/9/2017**	**10/11/2017**	**HPLC-1_171011A**	**3799237**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
2,4,5-TP (Silvex)	ND	0.00020									
2,4-D	ND	0.00040									

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
LCS-103856	**ZZZZZ**	**LCS**	**mg/L**	**SW8321B**	**10/9/2017**	**10/10/2017**	**HPLC-1_171010A**	**3798298**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
2,4,5-TP (Silvex)	0.000842	0.00010	0.001	0	84.2	50	150	0	0		
2,4-D	0.000791	0.00020	0.001	0	79.1	50	150	0	0		

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
LCSD-103856	**ZZZZZ**	**LCSD**	**mg/L**	**SW8321B**	**10/9/2017**	**10/10/2017**	**HPLC-1_171010A**	**3798299**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
2,4,5-TP (Silvex)	0.000863	0.00010	0.001	0	86.3	50	150	0.00084	2.46	25	
2,4-D	0.000775	0.00020	0.001	0	77.5	50	150	0.00079	2.04	25	

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100226-003BMS	**ZZZZZ**	**MS**	**mg/L**	**SW8321B**	**10/9/2017**	**10/10/2017**	**HPLC-1_171010A**	**3798033**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
2,4,5-TP (Silvex)	0.001547	0.00010	0.002	0	77.4	50	150	0	0		
2,4-D	0.001837	0.00020	0.002	0	91.8	50	150	0	0		

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
* - Non Accredited Parameter
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
H/HT - Holding Time Exceeded
B - Analyte detected in the associated Method Blank
E - Value above quantitation range

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL

ANALYTICAL QC SUMMARY REPORT
HPLC
BatchID: 103856

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100226-003BMSD	**ZZZZZ**	**MSD**	**mg/L**	**SW8321B**	**10/9/2017**	**10/10/2017**	**HPLC-1_171010A**	**3798035**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
2,4,5-TP (Silvex)	0.001573	0.00010	0.002	0	78.6	50	150	0.00155	1.67	25	
2,4-D	0.001761	0.00020	0.002	0	88	50	150	0.00184	4.22	25	

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
* - Non Accredited Parameter
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
H/HT - Holding Time Exceeded
B - Analyte detected in the associated Method Blank
E - Value above quantitation range

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL

ANALYTICAL QC SUMMARY REPORT
GC Semivolatiles
BatchID: 103746

PREP BATCH SUMMARY

Sample ID	Matrix	pH	SampAmt	Sol Added	Sol Recov	Fin Vol	factor	PrepStart	PrepEnd
MB-103746-TPH			0.005	0	0	5	1000.000	10/4/2017	10/4/2017
LCS-103746-TPH			0.005	0	0	5	1000.000	10/4/2017	10/4/2017
17100078-001B	Soil		0.00536	0	0	5	932.836	10/4/2017	10/4/2017
17100078-002B	Soil		0.00515	0	0	5	970.874	10/4/2017	10/4/2017
17100078-003B	Soil		0.00508	0	0	5	984.252	10/4/2017	10/4/2017
17100078-004B	Soil		0.00513	0	0	5	974.659	10/4/2017	10/4/2017
17100078-005B	Soil		0.00528	0	0	5	946.970	10/4/2017	10/4/2017
17100078-006B	Soil		0.00506	0	0	5	988.142	10/4/2017	10/4/2017
17100078-004BMS	Soil		0.00512	0	0	5	976.562	10/4/2017	10/4/2017
17100078-004BMSD	Soil		0.00512	0	0	5	976.562	10/4/2017	10/4/2017
17100137-001B	Soil		0.00506	0	0	5	988.142	10/5/2017	10/5/2017
17100137-003B	Soil		0.00525	0	0	5	952.381	10/5/2017	10/5/2017
17100137-006B	Soil		0.00553	0	0	5	904.159	10/5/2017	10/5/2017
17100137-007B	Soil		0.0051	0	0	5	980.392	10/5/2017	10/5/2017
17100137-009B	Soil		0.00524	0	0	5	954.198	10/5/2017	10/5/2017
17100145-001A	Soil		0.00507	0	0	5	986.193	10/5/2017	10/5/2017

QC SUMMARY

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
MB-103746-TPH	**ZZZZZ**	**MBLK**	**mg/Kg**	**SW8015M**	**10/4/2017**	**10/4/2017**	**GC-FID-2_171004A**	**3795094**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
TPH (GRO)	9.963	20									J
TPH (DRO)	3.412	20									J
TPH (ERO)	ND	20									*

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
LCS-103746-TPH	**ZZZZZ**	**LCS**	**mg/Kg**	**SW8015M**	**10/4/2017**	**10/4/2017**	**GC-FID-2_171004A**	**3795087**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
TPH (GRO)	363.3	20	200	9.963	177	30	150	0	0		S
TPH (DRO)	278.8	20	200	3.412	138	30	150	0	0		
TPH (ERO)	211.3	20	200	0	106	30	150	0	0		*

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100078-004BMS	**ZZZZZ**	**MS**	**mg/Kg-dry**	**SW8015M**	**10/4/2017**	**10/4/2017**	**GC-FID-2_171004A**	**3795083**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
TPH (GRO)	1575	23	230.3	352.9	530	30	150	0	0		S
TPH (DRO)	507	23	230.3	59.14	194	30	150	0	0		S
TPH (ERO)	291.9	23	230.3	0	127	30	150	0	0		*

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100078-004BMSD	**ZZZZZ**	**MSD**	**mg/Kg-dry**	**SW8015M**	**10/4/2017**	**10/4/2017**	**GC-FID-2_171004A**	**3795084**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
TPH (GRO)	1328	23	230.3	352.9	423	30	150	1575	17.0	25	S
TPH (DRO)	461.9	23	230.3	59.14	175	30	150	507	9.31	25	S
TPH (ERO)	267.4	23	230.3	0	116	30	150	291.9	8.77	25	*

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
* - Non Accredited Parameter
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
H/HT - Holding Time Exceeded
B - Analyte detected in the associated Method Blank
E - Value above quantitation range

PREP BATCH SUMMARY

Sample ID	Matrix	pH	SampAmt	Sol Added	Sol Recov	Fin Vol	factor	PrepStart	PrepEnd
IMBW1 10/9/17			50	0	0	50	1.000	10/9/2017	10/9/2017
ILCSW1 10/9/17			50	0	0	50	1.000	10/9/2017	10/9/2017
IMBTA1 10/6/17			50	0	0	50	1.000	10/9/2017	10/9/2017
17100192-004A	Soil		50	0	0	50	1.000	10/9/2017	10/9/2017
17100210-001B	Soil		50	0	0	50	1.000	10/9/2017	10/9/2017
17100210-001BMS	Soil		50	0	0	50	1.000	10/9/2017	10/9/2017
17100210-001BMSD	Soil		50	0	0	50	1.000	10/9/2017	10/9/2017
17100177-001B	Soil		50	0	0	50	1.000	10/9/2017	10/9/2017
17100177-002B	Soil		50	0	0	50	1.000	10/9/2017	10/9/2017
17100177-003B	Soil		50	0	0	50	1.000	10/9/2017	10/9/2017
17100088-030A	Soil		50	0	0	50	1.000	10/9/2017	10/9/2017
17100213-001B	Soil		50	0	0	50	1.000	10/9/2017	10/9/2017
17100191-001A	Soil		50	0	0	50	1.000	10/9/2017	10/9/2017
17100191-002A	Soil		50	0	0	50	1.000	10/9/2017	10/9/2017
17100223-001A	Solid		50	0	0	50	1.000	10/9/2017	10/9/2017
17100224-001A	Solid		50	0	0	50	1.000	10/9/2017	10/9/2017
17100145-001A	Oil		50	0	0	50	1.000	10/9/2017	10/9/2017
IMBTB 10/6/17			50	0	0	50	1.000	10/9/2017	10/9/2017
17100221-001A	Solid		50	0	0	50	1.000	10/9/2017	10/9/2017
17100221-001AMS	Solid		50	0	0	50	1.000	10/9/2017	10/9/2017
IMBTA1 10/9/17			50	0	0	50	1.000	10/10/2017	10/10/2017
17100240-001A	Soil		50	0	0	50	1.000	10/10/2017	10/10/2017
17100262-006B	Soil		50	0	0	50	1.000	10/10/2017	10/10/2017
17100262-006BMS	Soil		50	0	0	50	1.000	10/10/2017	10/10/2017

QC SUMMARY

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
IMBTA1 10/6/17	**ZZZZZ**	**MBLK**	**mg/L**	**SW1311/6020A**	**10/9/2017**	**10/9/2017**	**ICPMS_171009B**	**3797792**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Silver	ND	0.010									

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
IMBTA1 10/6/17	**ZZZZZ**	**MBLK**	**mg/L**	**SW1311/6020A**	**10/9/2017**	**10/9/2017**	**ICPMS_171009A**	**3797972**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Arsenic	ND	0.010									
Barium	0.1679	0.050									
Cadmium	ND	0.0050									
Chromium	0.0043	0.010									J
Lead	0.00218	0.0050									J
Selenium	ND	0.010									

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100210-001BMS	**ZZZZZ**	**MS**	**mg/L**	**SW1311/6020A**	**10/9/2017**	**10/10/2017**	**ICPMS_171009B**	**3797799**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Arsenic	0.5188	0.010	0.5	0	104	75	125	0	0		
Barium	1.857	0.050	0.5	1.266	118	75	125	0	0		
Cadmium	0.492	0.0050	0.5	0	98.4	75	125	0	0		

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100210-001BMS	**ZZZZZ**	**MS**	**mg/L**	**SW1311/6020A**	**10/9/2017**	**10/10/2017**	**ICPMS_171009B**	**3797799**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Chromium	0.527	0.010	0.5	0.00288	105	75	125	0	0		
Selenium	0.4955	0.010	0.5	0	99.1	75	125	0	0		
Silver	0.1988	0.010	0.2	0	99.4	75	125	0	0		

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100210-001BMS	**ZZZZZ**	**MS**	**mg/L**	**SW1311/6020A**	**10/9/2017**	**10/10/2017**	**ICPMS_171010A**	**3798379**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Lead	0.5625	0.0050	0.5	0	112	75	125	0	0		

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100210-001BMSD	**ZZZZZ**	**MSD**	**mg/L**	**SW1311/6020A**	**10/9/2017**	**10/10/2017**	**ICPMS_171009B**	**3797800**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Arsenic	0.5085	0.010	0.5	0	102	75	125	0.5188	2.01	20	
Barium	1.838	0.050	0.5	1.266	114	75	125	1.857	1.03	20	
Cadmium	0.4647	0.0050	0.5	0	92.9	75	125	0.492	5.71	20	
Chromium	0.5159	0.010	0.5	0.00288	103	75	125	0.527	2.13	20	
Selenium	0.4961	0.010	0.5	0	99.2	75	125	0.4955	0.121	20	
Silver	0.1898	0.010	0.2	0	94.9	75	125	0.1988	4.63	20	

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100210-001BMSD	**ZZZZZ**	**MSD**	**mg/L**	**SW1311/6020A**	**10/9/2017**	**10/10/2017**	**ICPMS_171010A**	**3798380**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Lead	0.5416	0.0050	0.5	0	108	75	125	0.5625	3.79	20	

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
IMBW1 10/9/17	**ZZZZZ**	**MBLK**	**mg/L**	**SW6020A**	**10/9/2017**	**10/9/2017**	**ICPMS_171009B**	**3797790**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Silver	0.00044	0.0040									J

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
IMBW1 10/9/17	**ZZZZZ**	**MBLK**	**mg/L**	**SW6020A**	**10/9/2017**	**10/9/2017**	**ICPMS_171009A**	**3797970**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Arsenic	0.00066	0.0040									J
Barium	ND	0.0040									
Cadmium	ND	0.0020									
Chromium	0.00083	0.0040									J
Lead	0.00066	0.0020									J
Selenium	0.00378	0.0040									J

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
ILCSW1 10/9/17	**ZZZZZ**	**LCS**	**mg/L**	**SW6020A**	**10/9/2017**	**10/9/2017**	**ICPMS_171009B**	**3797791**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Silver	0.2073	0.0040	0.2	0.00044	103	80	120	0	0		

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL

ANALYTICAL QC SUMMARY REPORT
Metals
BatchID: 103842

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
ILCSW1 10/9/17	**ZZZZZ**	**LCS**	**mg/L**	**SW6020A**	**10/9/2017**	**10/9/2017**	**ICPMS_171009A**	**3797971**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Arsenic	0.4786	0.0040	0.5	0.00066	95.6	80	120	0	0		
Barium	0.5471	0.0040	0.5	0	109	80	120	0	0		
Cadmium	0.4927	0.0020	0.5	0	98.5	80	120	0	0		
Chromium	0.4581	0.0040	0.5	0.00083	91.5	80	120	0	0		
Lead	0.4978	0.0020	0.5	0.00066	99.4	80	120	0	0		
Selenium	0.4591	0.0040	0.5	0.00378	91.1	80	120	0	0		

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
* - Non Accredited Parameter
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
H/HT - Holding Time Exceeded
B - Analyte detected in the associated Method Blank
E - Value above quantitation range

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL

ANALYTICAL QC SUMMARY REPORT
Metals
BatchID: 103889

PREP BATCH SUMMARY

Sample ID	Matrix	pH	SampAmt	Sol Added	Sol Recov	Fin Vol	factor	PrepStart	PrepEnd
HGMBW1 10/10/17			30	0	0	30	1.000	10/10/2017	10/10/2017
HGLCSW1 10/10/17			30	0	0	30	1.000	10/10/2017	10/10/2017
HGMBTA1 10/9/17			30	0	0	30	1.000	10/10/2017	10/10/2017
17100254-001B	Soil		30	0	0	30	1.000	10/10/2017	10/10/2017
17100255-001A	Soil		30	0	0	30	1.000	10/10/2017	10/10/2017
17100255-002A	Soil		30	0	0	30	1.000	10/10/2017	10/10/2017
17100255-003A	Soil		30	0	0	30	1.000	10/10/2017	10/10/2017
17100255-004A	Soil		30	0	0	30	1.000	10/10/2017	10/10/2017
17100255-005A	Soil		30	0	0	30	1.000	10/10/2017	10/10/2017
17100255-006A	Soil		30	0	0	30	1.000	10/10/2017	10/10/2017
17100255-007A	Soil		30	0	0	30	1.000	10/10/2017	10/10/2017
17100255-008A	Soil		30	0	0	30	1.000	10/10/2017	10/10/2017
17100255-003AMS	Soil		30	0	0	30	1.000	10/10/2017	10/10/2017
17100255-003AMSD	Soil		30	0	0	30	1.000	10/10/2017	10/10/2017
HGMBTA1 10/6/17			30	0	0	30	1.000	10/10/2017	10/10/2017
17100145-001A	Oil		30	0	0	30	1.000	10/10/2017	10/10/2017
17100145-001AMS	Oil		30	0	0	30	1.000	10/10/2017	10/10/2017
17100262-001B	Soil		30	0	0	30	1.000	10/10/2017	10/10/2017
17100262-003B	Soil		30	0	0	30	1.000	10/10/2017	10/10/2017
17100262-006B	Soil		30	0	0	30	1.000	10/10/2017	10/10/2017

QC SUMMARY

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
HGMBTA1 10/6/17	**ZZZZZ**	**MBLK**	**mg/L**	**SW1311/7470A**	**10/10/2017**	**10/10/2017**	**CETAC 2_171010A**	**3798854**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Mercury	ND	0.00020									

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100145-001AMS	**100317006**	**MS**	**mg/L**	**SW1311/7470A**	**10/10/2017**	**10/10/2017**	**CETAC 2_171010A**	**3798856**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Mercury	0.0024	0.00020	0.0025	0	96	75	125	0	0		

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100255-003AMS	**ZZZZZ**	**MS**	**mg/L**	**SW1311/7470A**	**10/10/2017**	**10/10/2017**	**CETAC 2_171010A**	**3798866**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Mercury	0.0024	0.00020	0.0025	0	96	75	125	0	0		

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100255-003AMSD	**ZZZZZ**	**MSD**	**mg/L**	**SW1311/7470A**	**10/10/2017**	**10/10/2017**	**CETAC 2_171010A**	**3798867**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Mercury	0.0024	0.00020	0.0025	0	96	75	125	0.0024	0	20	

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
HGMBW1 10/10/17	**ZZZZZ**	**MBLK**	**mg/L**	**SW7470A**	**10/10/2017**	**10/10/2017**	**CETAC 2_171010A**	**3798845**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Mercury	ND	0.00020									

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
* - Non Accredited Parameter
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
H/HT - Holding Time Exceeded
B - Analyte detected in the associated Method Blank
E - Value above quantitation range

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL

ANALYTICAL QC SUMMARY REPORT
Metals
BatchID: 103889

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
HGLCSW1 10/10/17	**ZZZZZ**	**LCS**	**mg/L**	**SW7470A**	**10/10/2017**	**10/10/2017**	**CETAC 2_171010A**	**3798846**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Mercury	0.0025	0.00020	0.0025	0	100	85	115	0	0		

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
* - Non Accredited Parameter
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
H/HT - Holding Time Exceeded
B - Analyte detected in the associated Method Blank
E - Value above quantitation range

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL

ANALYTICAL QC SUMMARY REPORT
Wet Chemistry
BatchID: 103790

PREP BATCH SUMMARY

Sample ID	Matrix	pH	SampAmt	Sol Added	Sol Recov	Fin Vol	factor	PrepStart	PrepEnd
RCNMBS1 100517			1	0	0	50	50.000	10/5/2017	10/5/2017
RCNLCSS1 100517			1	0	0	50	50.000	10/5/2017	10/5/2017
17100145-001A	Oil		1	0	0	50	50.000	10/5/2017	10/5/2017
17100046-001A	Soil		1	0	0	50	50.000	10/5/2017	10/5/2017
17100046-001AMS	Soil		1	0	0	50	50.000	10/5/2017	10/5/2017
17100046-001AMSD	Soil		1	0	0	50	50.000	10/5/2017	10/5/2017

QC SUMMARY

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
RCNMBS1 100517	**ZZZZZ**	**MBLK**	**mg/Kg**	**SW7.3.3.2**	**10/5/2017**	**10/5/2017**	**LACHAT-2_171005B**	**3793388**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Reactive Cyanide	ND	1.0									

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
RCNLCSS1 100517	**ZZZZZ**	**LCS**	**mg/Kg**	**SW7.3.3.2**	**10/5/2017**	**10/5/2017**	**LACHAT-2_171005B**	**3793389**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Reactive Cyanide	7.486	1.0	10	0	74.9	50	150	0	0		

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100046-001AMS	**ZZZZZ**	**MS**	**mg/Kg**	**SW7.3.3.2**	**10/5/2017**	**10/5/2017**	**LACHAT-2_171005B**	**3793391**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Reactive Cyanide	6.289	1.0	10	0	62.9	50	150	0	0		

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100046-001AMSD	**ZZZZZ**	**MSD**	**mg/Kg**	**SW7.3.3.2**	**10/5/2017**	**10/5/2017**	**LACHAT-2_171005B**	**3793392**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Reactive Cyanide	5.952	1.0	10	0	59.5	50	150	6.289	5.50	30	

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
* - Non Accredited Parameter
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
H/HT - Holding Time Exceeded
B - Analyte detected in the associated Method Blank
E - Value above quantitation range

CLIENT: Natural Resource Technology, Inc.
Work Order: 17100145
Project: 1983, South Plant Former MGP, Waukegan, IL

ANALYTICAL QC SUMMARY REPORT
Wet Chemistry
BatchID: 103789

PREP BATCH SUMMARY

Sample ID	Matrix	pH	SampAmt	Sol Added	Sol Recov	Fin Vol	factor	PrepStart	PrepEnd
RSMBS1 100517			1	0	0	50	50.000	10/5/2017	10/5/2017
RSLCSS1 100517			1	0	0	50	50.000	10/5/2017	10/5/2017
17100046-001A	Soil		1	0	0	50	50.000	10/5/2017	10/5/2017
17100046-001AMS	Soil		1	0	0	50	50.000	10/5/2017	10/5/2017
17100046-001AMSD	Soil		1	0	0	50	50.000	10/5/2017	10/5/2017
17090893-001A	Soil		1	0	0	50	50.000	10/5/2017	10/5/2017
17090908-001A	Soil		1	0	0	50	50.000	10/5/2017	10/5/2017
17100145-001A	Oil		1	0	0	50	50.000	10/5/2017	10/5/2017

QC SUMMARY

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
RSMBS1 100517	**ZZZZZ**	**MBLK**	**mg/Kg**	**SW7.3.4.2**	**10/5/2017**	**10/5/2017**	**LACHAT-2_171005A**	**3793293**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Reactive Sulfide	ND	10									

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
RSLCSS1 100517	**ZZZZZ**	**LCS**	**mg/Kg**	**SW7.3.4.2**	**10/5/2017**	**10/5/2017**	**LACHAT-2_171005A**	**3793294**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Reactive Sulfide	444.4	10	500	0	88.9	50	150	0	0		

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100046-001AMS	**ZZZZZ**	**MS**	**mg/Kg**	**SW7.3.4.2**	**10/5/2017**	**10/5/2017**	**LACHAT-2_171005A**	**3793287**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Reactive Sulfide	421.1	10	500	0	84.2	40	120	0	0		

Sample ID:	Customer ID:	SampType:	Units:	TestNo:	Prep Date:	Analysis Date:	Run ID:	SeqNo:
17100046-001AMSD	**ZZZZZ**	**MSD**	**mg/Kg**	**SW7.3.4.2**	**10/5/2017**	**10/5/2017**	**LACHAT-2_171005A**	**3793297**

Analyte	Result	PQL	SPK value	SPK Ref Val	% REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Reactive Sulfide	330.9	10	500	0	66.2	40	120	421.1	24.0	30	

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
* - Non Accredited Parameter
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
H/HT - Holding Time Exceeded
B - Analyte detected in the associated Method Blank
E - Value above quantitation range

Appendix L

Material Compatibility Testing Results

Corrosion Testing Laboratories, Inc.

CTL REF #34182

January 16, 2018

Marcus Byker, PE
Environmental Engineer
Natural Resource Technology, Inc.
300 S. Wacker Drive, Suite 2050
Chicago, IL 60606

Re: Materials Testing in Coal Tar

Dear Mr. Byker:

Presented in this report are the results of compatibility/corrosion tests of various materials of construction in a sample identified as a coal tar dense non-aqueous phase liquid sample. The testing was authorized under Natural Resource Technology, Inc. (NRT) Service Order No.: 1983-11.1-5.

TEST SOLUTION
NRT provided four (4) bottles (overall, approximately 4 liters total volume of sample) of a liquid sample identified as follows:

- Liquid: Site 1983; Client Sample 100317005; Collected 10-3-17; Time: 14:50

NRT provided additional characterization of the sample as a "coal tar dense non-aqueous phase liquid sample." The sample will be referred to as Coal Tar for the purposes of this report.

TEST PROCEDURE
The following materials of construction were tested by full immersion of test specimens in the Coal Tar solution at room temperature:

- Type 304L stainless steel
- Type 316L stainless steel
- HDPE
- PTFE
- PVDF
- Viton®

The original test plan called for a 60 day exposure; however, due to unforeseen circumstances the tests ran for 79 days.

The stainless steel test specimens were 2" long x 1" wide x 0.125" thick and were provided with a standard 120 grit finish on all surfaces. Duplicate test specimens of each alloy were tested.

General test specimen preparation was in conformance with ASTM G1 and test procedures were in conformance with ASTM G31.

The HDPE, PTFE and PVDF test specimens were 3" long x 1" wide; the HDPE and PTFE test specimens were $^1/_8$" thick, and the PVDF test specimens were ¼" thick. Triplicate test specimens of each material were tested. General test procedures followed the guidelines of ASTM D543, Practice A, Procedure I. In addition, based on NRT's information that the Coal Tar solution contains a surfactant, HDPE was tested according to ASTM D1693 for resistance to environmental stress cracking. (HDPE is susceptible to stress cracking in some surfactants.)

The Viton® test specimens were 2" long x 1" wide x $^1/_8$" thick. Triplicate test specimens of Viton® were tested. General test procedures followed the guidelines of ASTM D471.

After exposure, the test specimens were cleaned. The stainless steel test specimens were evaluated for mass loss and for localized corrosion (pitting) at 20X magnification. The non-metallic materials were evaluated for changes in mass, dimensions, Durometer hardness and appearance; the evaluations were performed immediately after cleaning and 24 hours after the end of testing.

RESULTS

Stainless Steel

No mass loss (measured to 0.1 mg) was detected and no corrosion was observed on the stainless steel test specimens. Photographs of the test specimens before and after testing are presented in **Figure 1**.

HDPE

All test specimens were stained a yellow color due to absorbance of the Coal Tar solution. No blistering, tackiness, cracking or other visual/tactile indications of incompatibility of HDPE with the Coal Tar solution were observed. Dimensional, mass and Durometer D hardness changes are presented in **Tables 1 and 2**.

Table 1
HDPE Dimensional, Mass and Durometer D Changes – Immediately After Cleaning

Sample	Δ Length (mm) [% Δ Length]	Δ Width (mm) [% Δ Width]	Δ Thickness (mm) [% Δ Thickness]	Δ Mass (g) [% Δ mass]	Δ Hardness (Durometer D)
1	0.88 [1.12]	0.57 [2.03]	0.05 [1.49]	0.3388 [4.83]	No change (NC) (Note 1)
2	0.87 [1.13]	0.55 [2.01]	0.05 [1.49]	0.3221 [4.86]	NC
3	0.89 [1.16]	0.53 [1.99]	0.04 [1.19]	0.3136 [4.87]	NC

Notes:
1. Pre-test and Post-test hardness were within ±2 Durometer D units.

Table 2
HDPE Dimensional, Mass and Durometer D Changes – 24 Hours After Cleaning

Sample	Δ Length (mm) [% Δ Length]	Δ Width (mm) [% Δ Width]	Δ Thickness (mm) [% Δ Thickness]	Δ Mass (g) [% Δ mass]	Δ Hardness (Durometer D)
1	0.85 [1.08]	0.58 [2.06]	0.05 [1.49]	0.3173 [4.53]	No change (NC) (Note 1)
2	0.79 [1.03]	0.49 [1.79]	0.06 [1.79]	0.3012 [4.54]	NC
3	0.81 [1.06]	0.48 [1.80]	0.05 [1.49]	0.2940 [4.57]	NC

Notes:
1. Pre-test and Post-test hardness were within ±2 Durometer D units.

Photographs of the test specimens before and after testing are presented in **Figure 2**.

No cracking or other indications of incompatibility of the stressed HDPE test specimens was observed **(Figure 3)**, although, as with the immersion test specimens, the stressed specimens were stained from absorbing the Coal Tar solution.

PTFE

All test specimens retained their initial white color. No blistering, tackiness, cracking or other visual/tactile indications of incompatibility of PTFE with the Coal Tar solution were observed. Dimensional, mass and Durometer D hardness changes are presented in **Tables 3 and 4**.

Table 3
PTFE Dimensional, Mass and Durometer D Changes – Immediately After Cleaning

Sample	Δ Length (mm) [% Δ Length]	Δ Width (mm) [% Δ Width]	Δ Thickness (mm) [% Δ Thickness]	Δ Mass (g) [% Δ mass]	Δ Hardness (Durometer D)
1	NC (Note 1)	NC	NC	0.0013 [0.01]	No change (NC) (Note 2)
2	NC	NC	NC	0.0019 [0.01]	NC
3	NC	NC	NC	0.0032 [0.02]	NC

Notes:
1. Pre-test and Post-test measurements were within ±0.03 mm.
2. Pre-test and Post-test hardness were within ±2 Durometer D units.

Table 4
PTFE Dimensional, Mass and Durometer D Changes – 24 Hours After Cleaning

Sample	Δ Length (mm) [% Δ Length]	Δ Width (mm) [% Δ Width]	Δ Thickness (mm) [% Δ Thickness]	Δ Mass (g) [% Δ mass]	Δ Hardness (Durometer D)
1	NC (Note 1)	NC	NC	0.0010 [<0.01]	No change (NC) (Note 2)
2	NC	NC	NC	0.0009 [<0.01]	NC
3	NC	NC	NC	0.0010 [<0.01]	NC

Notes:
1. Pre-test and Post-test measurements were within ±0.03 mm.
2. Pre-test and Post-test hardness were within ±2 Durometer D units.

Photographs of the test specimens before and after testing are presented in **Figure 4**.

PVDF

All test specimens retained their initial white color. No blistering, tackiness, cracking or other visual/tactile indications of incompatibility of PVDF with the Coal Tar solution were observed. Dimensional, mass and Durometer D hardness changes are presented in **Tables 5 and 6**.

Table 5
PVDF Dimensional, Mass and Durometer D Changes – Immediately After Cleaning

Sample	Δ Length (mm) [% Δ Length]	Δ Width (mm) [% Δ Width]	Δ Thickness (mm) [% Δ Thickness]	Δ Mass (g) [% Δ mass]	Δ Hardness (Durometer D)
1	NC (Note 1)	NC	NC	0.0086 [0.03]	No change (NC) (Note 2)
2	NC	NC	NC	0.0088 [0.04]	NC
3	NC	NC	NC	0.0090 [0.04]	NC

Notes:
1. Pre-test and Post-test measurements were within ±0.03 mm.
2. Pre-test and Post-test hardness were within ±2 Durometer D units.

Table 6
PVDF Dimensional, Mass and Durometer D Changes – 24 Hours After Cleaning

Sample	Δ Length (mm) [% Δ Length]	Δ Width (mm) [% Δ Width]	Δ Thickness (mm) [% Δ Thickness]	Δ Mass (g) [% Δ mass]	Δ Hardness (Durometer D)
1	NC (Note 1)	NC	NC	0.0073 [0.03]	No change (NC) (Note 2)
2	NC	NC	NC	0.0069 [0.03]	NC
3	NC	NC	NC	0.0072 [0.03]	NC

Notes:
1. Pre-test and Post-test measurements were within ±0.03 mm.
2. Pre-test and Post-test hardness were within ±2 Durometer D units.

Photographs of the test specimens before and after testing are presented in **Figure 5**.

Viton®
All test specimens retained their initial black color. No blistering, tackiness, cracking or other visual/tactile indications of incompatibility of PVDF with the Coal Tar solution were observed. Dimensional, mass and Durometer A hardness changes are presented in **Tables 7 and 8**.

Table 7
Viton® Dimensional, Mass and Durometer D Changes – Immediately After Cleaning

Sample	Δ Length (mm) [% Δ Length]	Δ Width (mm) [% Δ Width]	Δ Thickness (mm) [% Δ Thickness]	Δ Mass (g) [% Δ mass]	Δ Hardness (Durometer A)
1	0.25 [0.49]	0.04 [0.15]	0.07 [2.93]	0.0958 [1.66]	No change (NC) (Note 1)
2	0.45 [0.89]	0.12 [0.46]	0.06 [2.53]	0.0940 [1.67]	NC
3	0.15 [0.29]	0.11 [0.40]	0.03 [1.28]	0.0992 [1.70]	NC

Notes:
1. Pre-test and Post-test hardness were within ±2 Durometer A units.

Table 8
Viton® Dimensional, Mass and Durometer D Changes – 24 Hours After Cleaning

Sample	Δ Length (mm) [% Δ Length]	Δ Width (mm) [% Δ Width]	Δ Thickness (mm) [% Δ Thickness]	Δ Mass (g) [% Δ mass]	Δ Hardness (Durometer A)
1	0.27 [0.53]	0.01 [0.04]	0.06 [2.51]	0.0772 [1.34]	No change (NC) (Note 2)
2	0.24 [0.47]	0.12 [0.46]	0.05 [2.11]	0.0768 [1.37]	NC
3	0.17 [0.33]	0.08 [0.29]	0.04 [1.70]	0.0803 [1.38]	NC

Notes:
1. Pre-test and Post-test hardness were within ±2 Durometer A units.

Photographs of the test specimens before and after testing are presented in **Figure 6**.

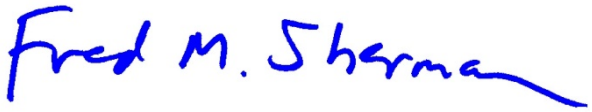
DISCUSSION
Under the test conditions Types 304L and 316L stainless steel, PTFE and PVDF were compatible with the Coal Tar solution, showing negligible or no effect from the exposure.

Performance of HDPE in the Coal Tar solution was consistent with the literature for coal tar: generally resistant with discoloration at ambient temperature. Absorbance of the solution could indicate a tendency toward permeation as well as definite contamination issues with containers, liners, etc. According to the literature for HDPE, handling of coal tar at higher temperatures, as, for example during the summer handling would not be recommended.

Performance of Viton® in the Coal Tar solution was consistent with the literature for coal tar showing satisfactory performance.

We appreciate the opportunity to assist you in this investigation. If you have any questions or comments, please do not hesitate to contact us.

Principal Investigator:



Fred M. Sherman
Senior Materials Analyst

Reviewed and Approved:

Bradley D. Krantz
Vice-President of Laboratory Services

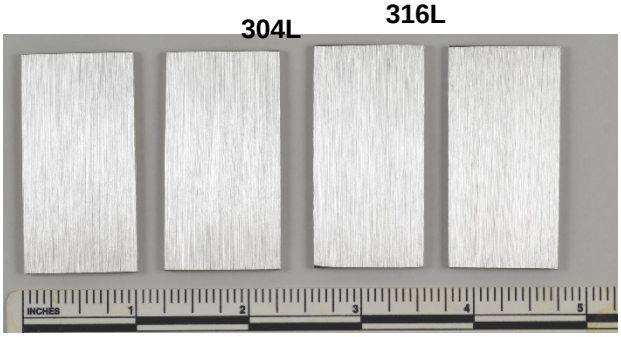
Policy Statement

This study was performed and this report was prepared based upon specific samples and/or information provided to Corrosion Testing Laboratories, Inc. (CTL) by Natural Resource Technology, Inc. The information contained in this report represents only the materials tested or evaluated. Such work was performed in accordance with CTL's Quality Assurance Manual, Revision 13, issued 22 June 2009. The conclusions and opinions provided were developed within a reasonable degree of scientific certainty and are based upon materials and information provided to date. Should additional information become available (e.g., on further continued review of the material received or submission of additional samples for examination), we reserve the right to adjust our professional opinions.

CTL assumes no responsibility for variations in sample or data quality (composition, appearance, performance, etc.) or any other feature of similar subject matter produced (measured, manufactured, fabricated, etc.) by persons or under conditions over which we have no control. This report may not be altered, added to or subtracted from and, if this does occur, CTL does not accept responsibility for such alterations, additions, or deletions. This report shall not be reproduced, except in full, without the written approval of CTL. All material that was received by CTL will be discarded six (6) months after this report has been issued, unless other arrangements have been agreed upon. All liquid, soil and gaseous samples that are received by CTL shall not be stored for more than thirty (30) days and shall be disposed of in accordance with applicable rules and regulations.

Pre-Test, Front

Post-Test, Front



Pre-Test, Back

Post-Test, Back

Figure 1. Stainless steel test specimens

Pre-Test, Front

Post-Test, Front

Pre-Test, Back

Post-Test, Back

Figure 2. HDPE test specimens

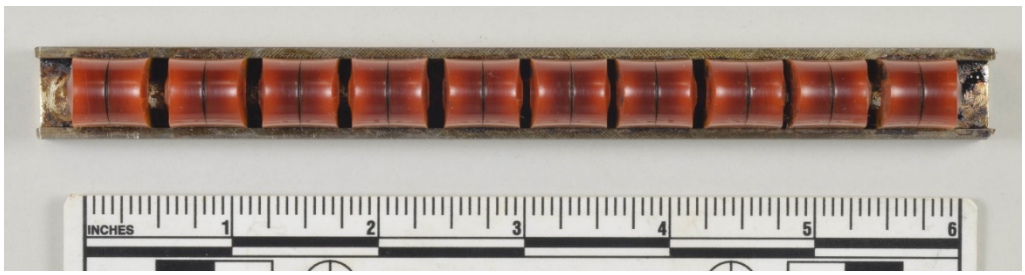
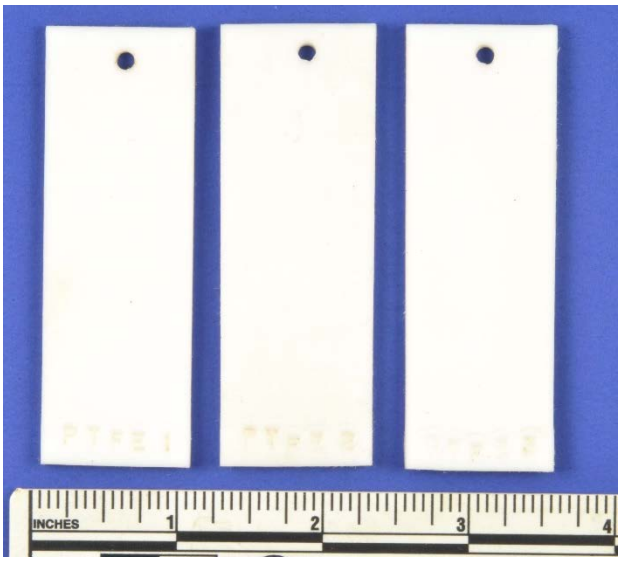


Figure 3. Post-test appearance of stressed HDPE test specimens. No cracking was observed on the test specimens. The reason for red discoloration in the stressed area, as opposed to the yellow discoloration of the flat panels, is not known. (The same lot of HDPE was used to prepare all test specimens.)

Pre-Test, Front



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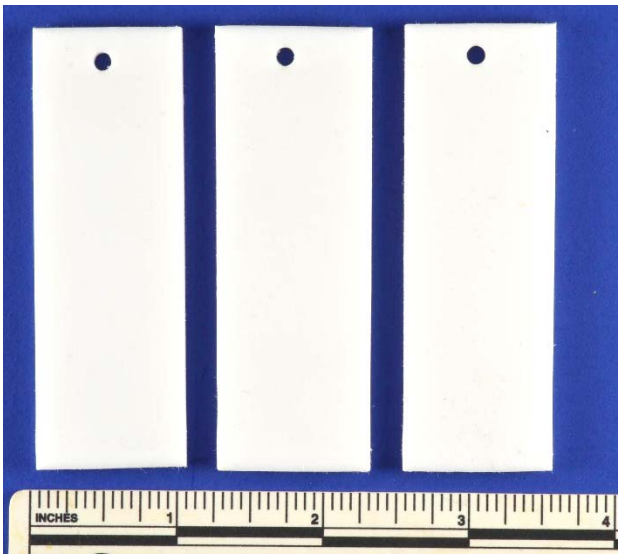
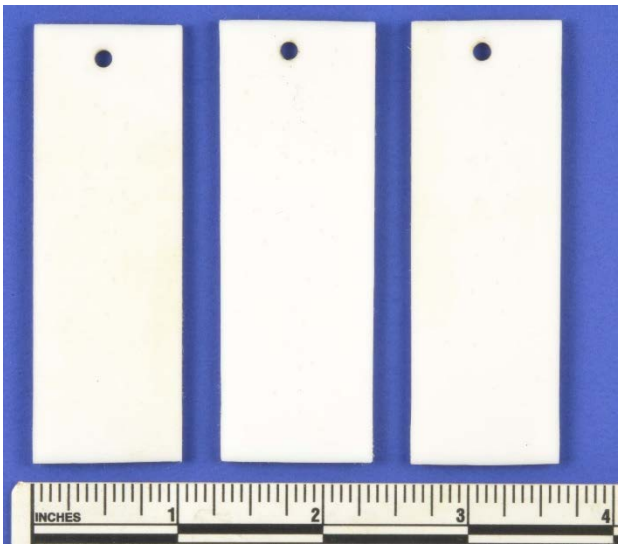
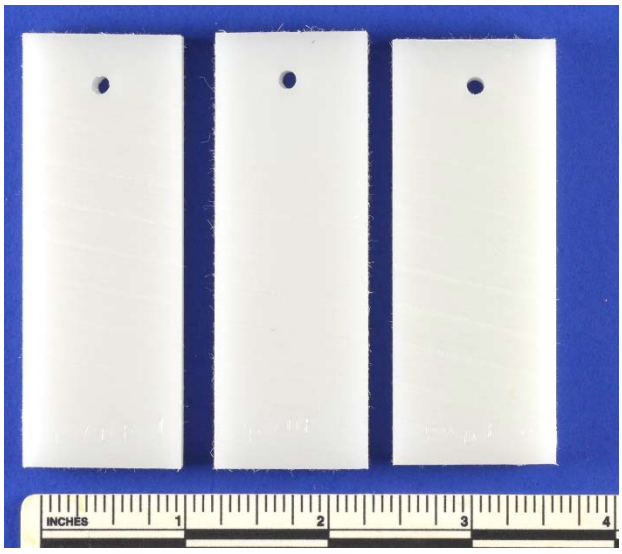


Pre-Test, Back



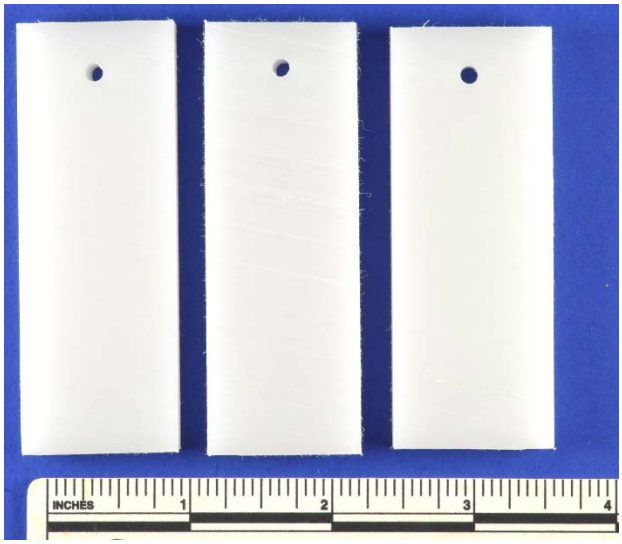
Post-Test, Back

Figure 4. PTFE test specimens



Pre-Test, Front

Post-Test, Front



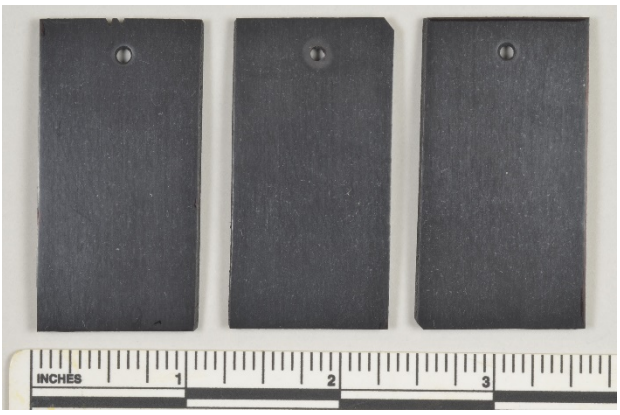
Pre-Test, Back

Post-Test, Back

Figure 5. PVDF test specimens

Pre-Test, Front

Post-Test, Front



Pre-Test, Back

Post-Test, Back

Figure 6. PVDF test specimens

Appendix M

DNAPL Pump Evaluation

DNAPL PUMP EVALUATION

An evaluation of four potential DNAPL extraction pumps was conducted from October 2 to October 6, 2017 as part of the Pre-Design Investigation (PDI) at the North Shore Gas Former South Plant Manufactured Gas Plant Site (Site). The evaluation included the following four pump styles that were previously identified during a desktop study as potentially effective at removing DNAPL: large diameter peristaltic, double diaphragm, pneumatic displacement, and rotary. Each pump was evaluated by extracting DNAPL from one of the recovery wells located on Site. After the extraction process, the pump was disassembled and cleaned to assess ease of maintenance and any current or potential future damage. A summary of the observations from each pump are as follows:

Pump Style	Installation Approach	Advantages	Disadvantages
Large Diameter Peristaltic	▪ Drop Pipe Down into Well ▪ Pump at ground surface	▪ Simplest pump in trial, no springs or check valves ▪ Easiest to clean/maintain ▪ Steady pumping rate ▪ When coupled with VFD, pumping rate can be adjusted ▪ Self-priming	▪ Tubing can become worn, requiring regular replacement ▪ Comparatively higher power requirements ▪ Comparatively limited discharge pressure
Double Diaphragm	▪ Drop Pipe Down into Well ▪ Pump at ground surface	▪ Air or electric operated, simplifying well value configuration ▪ Low energy consumption ▪ Self-priming ▪ Pumping rate controlled through air pressure/flowrate	▪ 4 internal check valves have potential to become fouled and are challenging to clean ▪ Nature of pump design results in pulsed pumping rate
Pneumatic Displacement	▪ Pump itself is inserted into well	▪ Comparatively easy pump to clean due to minimal parts ▪ Air operated, simplifying well value configuration ▪ Pumping rate controlled through air pressure/flowrate	▪ 2 internal check valves have potential to clog ▪ Must be inserted fully into the well resulting in higher probability for corrosion ▪ Nature of pump cycle will mix water and NAPL if NAPL thickness in the sump is less than ~2.5 feet
Rotary	▪ Drop Pipe Down into Well ▪ Pump at ground surface	▪ Most consistent pumping rate ▪ No check valves and minimal internal components make it easy to clean and maintain ▪ When coupled with VFD, pumping rate can be adjusted	▪ Highest power/motor size requirements ▪ Model in trial required pump to be fully primed, which would be impractical for full-scale

All four of the pumps successfully extracted DNAPL from the recovery wells. Of the pumps that rely on suction lift rather than insertion into the well, the large diameter peristaltic and double diaphragm pumps were most successful at obtaining sufficient suction lift and extracting DNAPL. While the rotary pump had the steadiest pumping rate and an easily maintainable system, it required that the system be fully primed upon start-up which would be impractical during full-scale operations with the potential to turn pumps on and off as DNAPL

accumulation fluctuates. Although the pneumatic displacement model has some disadvantages in terms of the thickness of DNAPL required for operation, this model did successfully extract DNAPL and may warrant further consideration if the suction lift capacity of other preferred models is insufficient for successful operation.

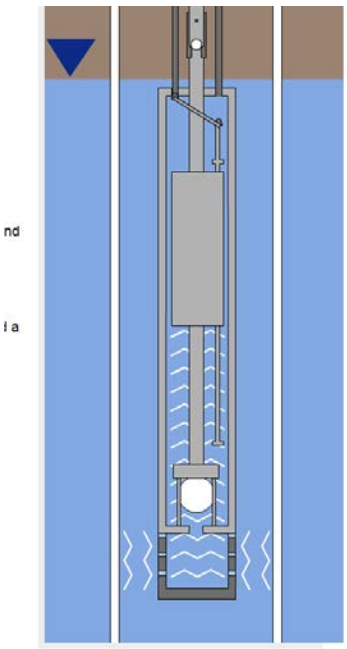
ATTACHMENTS

Attachment 1 Pump Photographs

Attachment 2 Pump Specifications

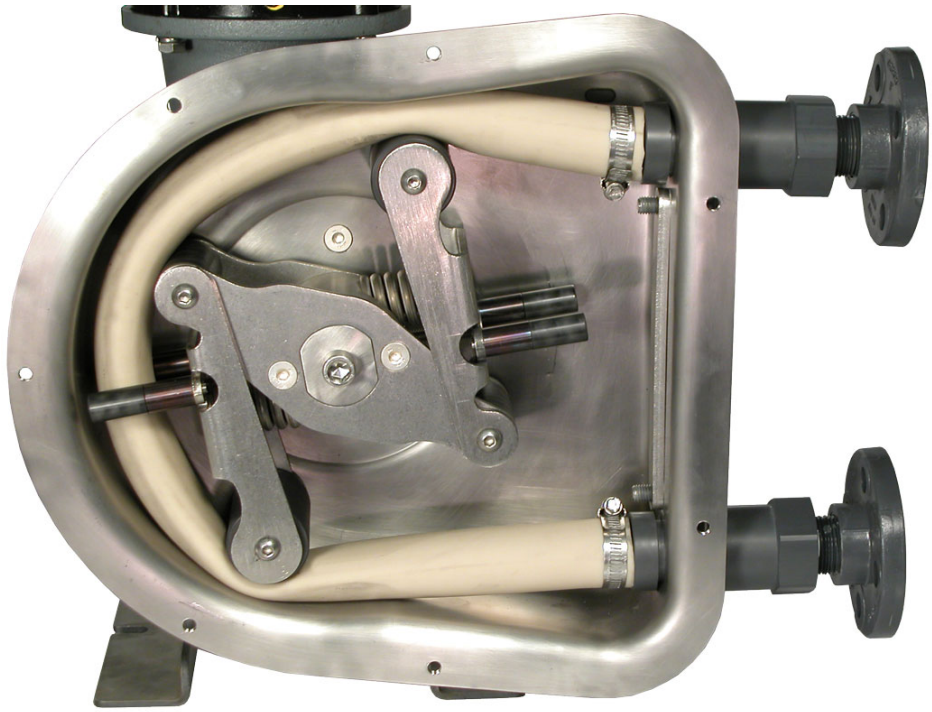
ATTACHMENT A – PUMP PHOTOGRAPHS

PNEUMATIC DISPLACMENT: QED AUTOPUMP 4+ LONG BOTTOM INLET



DOUBLE DIAPHRAGM: SAND PIPER S05B2TP2TPNS000

LARGE DIAMETER PERISTALTIC: MASTERFLEX 7585-30



ROTARY PUMP: DAYTON 1” INTERMEDIATE-DUTY 316 STAINLESS STEEL ROTARY GEAR PUMP

ATTACHMENT B – PUMP SPECIFICATIONS

PNEUMATIC DISPLACMENT: QED AUTOPUMP 4+ LONG BOTTOM INLET

AP4+B Bottom Inlet, Long

Max. Flow	14 gpm (53 lpm)
O.D.	3.6 in (91 mm)
Length	51.4 in. (131cm)

Description

The AP4+ Bottom Inlet Long AutoPump provides maximum capabilities and flow in a bottom inlet pump for 4" (100 mm) diameter and larger wells with shorter water columns and/or the need to pump down to lower water levels, compared to full-length pumps. It is offered in optional versions to handle even the most severe remediation and landfill pumping applications, and delivers flow rates up to 14 gpm (49 lpm)*. The AP4+ Long Bottom Inlet AutoPump is complemented by the most comprehensive selection of accessories to provide a complete system to meet site specific requirements. Call QED for prompt, no-obligation assistance on your pumping project needs.

The AutoPump Heritage

The AP4+ Bottom Inlet Long AutoPump is part of the famous AutoPump family of original automatic air-powered pumps, developed in the mid 1980s specifically to handle unique pumping needs at remediation and landfill sites. Over the years they've proven their durability at thousands of sites worldwide. AutoPumps are designed to handle difficult pumping challenges that other pumps can't, such as hydrocarbons, solvents, suspended solids, corrosives, temperature extremes, viscous fluids and frequent start/stop cycles. Beyond just the pump, AutoPump systems offer the most complete range of tubing, hose, connectors, wellhead caps and accessories to help your installation go smoothly. This superior pumping heritage, application experience and support back up every AutoPump you put to work on your project.

Advantages

1. **The original automatic air-powered well pump, proven worldwide over 18 years**
2. **The highest flow rates and deepest pumping capabilities in the industry**
3. **Patented, proven design for superior reliability and durability, even in severe applications**
4. **Handles solids, solvents, hydrocarbons corrosive conditions, viscous fluids and high temperatures beyond the limits of electric pumps**
5. **Five-year warranty**

***Consult QED for higher flow requirements**

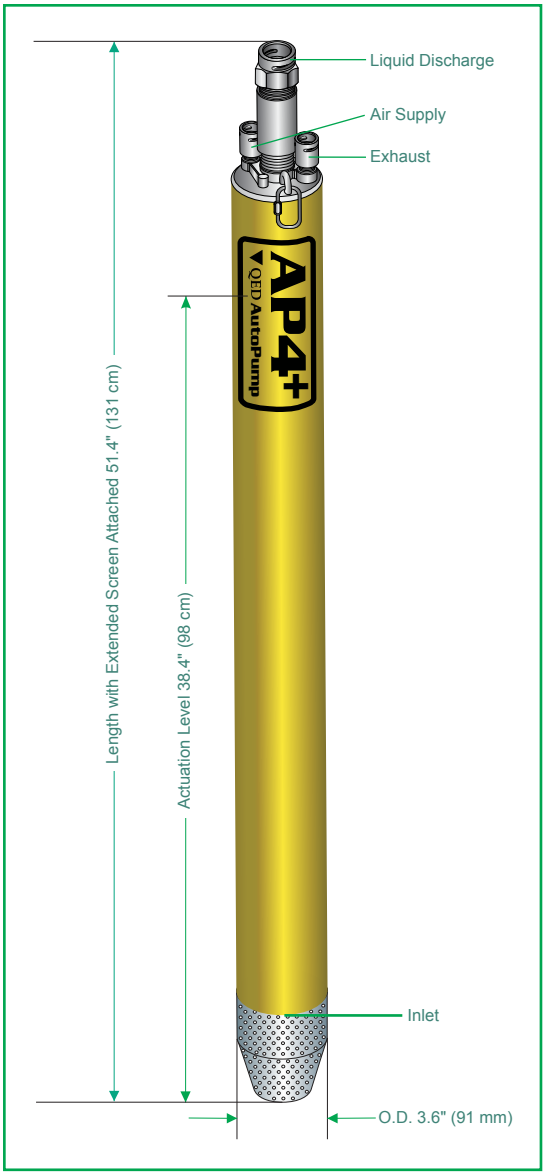
QED Environmental Systems

AP4+ AutoPump®

Bottom Inlet, Long

AP4+B

Pump Dimensions



Specifications & Operating Requirements

Model	**4" - Long AP4+ Bottom Inlet**
Liquid Inlet Location	Bottom
O.D.	3.6 in. (91 mm)
Overall Length With Extended Screen	51.4 in. (131 cm)
Weight	16.7 lbs. (7.6 kg)
Maximum Flow Rate	14 gpm (53 lpm)* - See Flow Rate Chart
Pump Volume/Cycle	0.58 - 0.78 gal (2.2 - 3L)
Minimum Accuation Level	38.4 in. (98 cm)
Standard Pump	
Maximum Depth	250 ft. (76 m)
Air Pressure	5 - 120 psi (0.4 - 8.4 kg/cm2)
Air Usage	0.4 - 1.1 scf / gal. (3.0 - 8.5 liter of air / fluid liter) - See air usage chart
High Pressure Pump	
Maximum Depth	425 ft. (130 m)
Air Pressure	5 - 200 psi (0.4 - 14.1 kg/cm2)
Minimum Liquid Density	0.7 SpG (0.7 g/cm3)
Standard Construction Materials[1]	
Pump Body	Fiberglass or Stainless Steel
Pump Ends	Stainless Steel
Internal Components	Stainless Steel, Viton, PVDF[3], Hastelloy-C
Tube & Hose Fittings	Brass or Stainless Steel
Fitting Type	Barbs, Quick Connects or Easy Fittings
Tube & Hose Options	
Tubing Materials[2]	Nylon
Sizes - Liquid Discharge	1 in. (25 mm) or 1-1/4 in. (32 mm) OD
Pump Air Supply	1/2 in. (13 mm) OD
Air Exhaust	5/8 in. (16 mm) OD
Hose Material	Nitrile
Sizes - Liquid Discharge	3/4 in. (19 mm) or 1 in. (25 mm) ID
Pump Air Supply	3/8 in. (9.5 mm) ID
Air Exhaust	1/2 in. (13 mm) ID

[1] Material upgrades available
[2] Applies to QED supplied tubing; other tubing sources may not conform to QED fittings.

Application Limits (Base model)

AP4+ AutoPumps are designed to handle the application ranges described below. For applications outside these ranges, consult QED about AP4+ upgrades.

Maximum Temperature: 180°F (82°C)
pH Range: 4-9
Solvents and Fuels: diesel, gasoline, JP1-JP6,#2 heating oils, BTEX, MTBE, landfill liquids

***Consult QED for higher flow requirements**

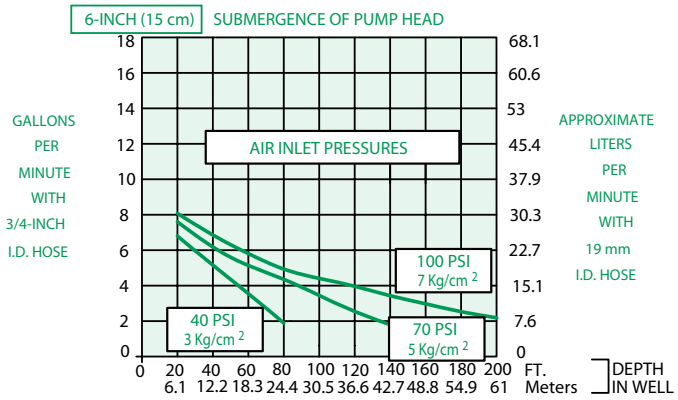
Long and short AP4+ AutoPumps are warranted for five(5) years: Low-Drawdown AP4+ AutoPumps are warranted for one (1) year.

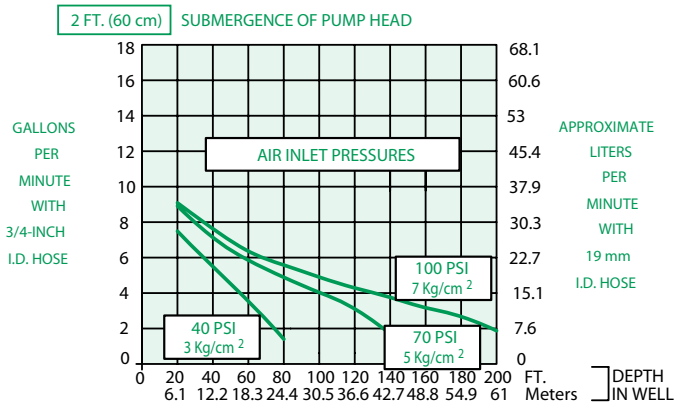
P.O. Box 3726 Ann Arbor, MI 48106-3726 USA **1.800.624.2026** **F 1.734.995.1170** info@qedenv.com www.qedenv.com

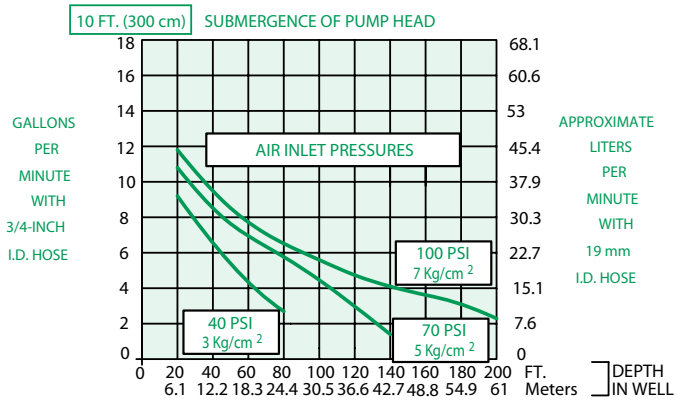
AP4 +B Bottom Inlet, Long

Flow Rates[1]

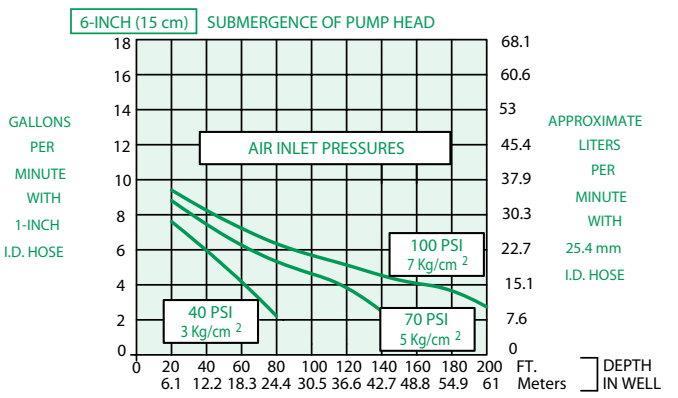
3/4 inch (19 mm) Inside Diameter Discharge Hose
(Equivalent to 1-Inch O.D. Tubing)

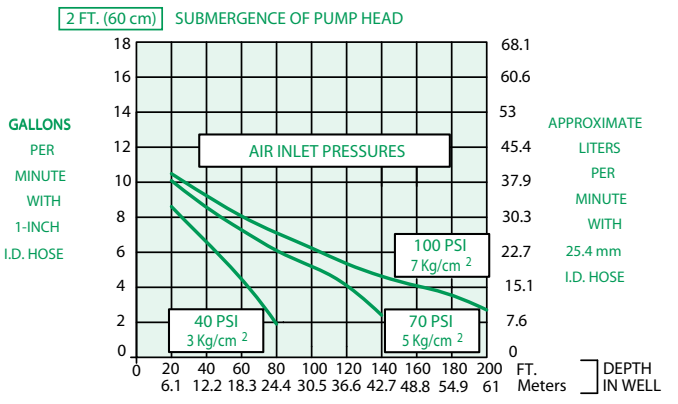


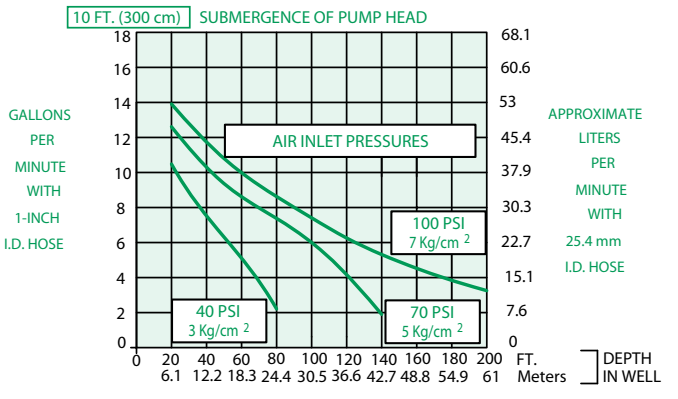




1 inch (25.4 mm) Inside Diameter Discharge Hose
(Equivalent to 1.25-Inch O.D. Tubing)





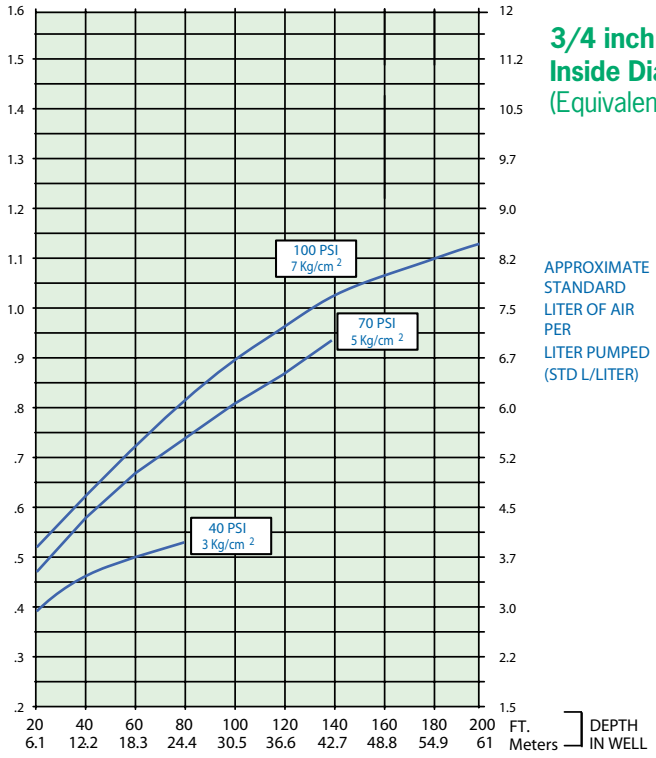


[1]FLOW RATES MAY VARY WITH SITE CONDITIONS. CALL QED FOR TECHNICAL ASSISTANCE.

Bottom Inlet, Long

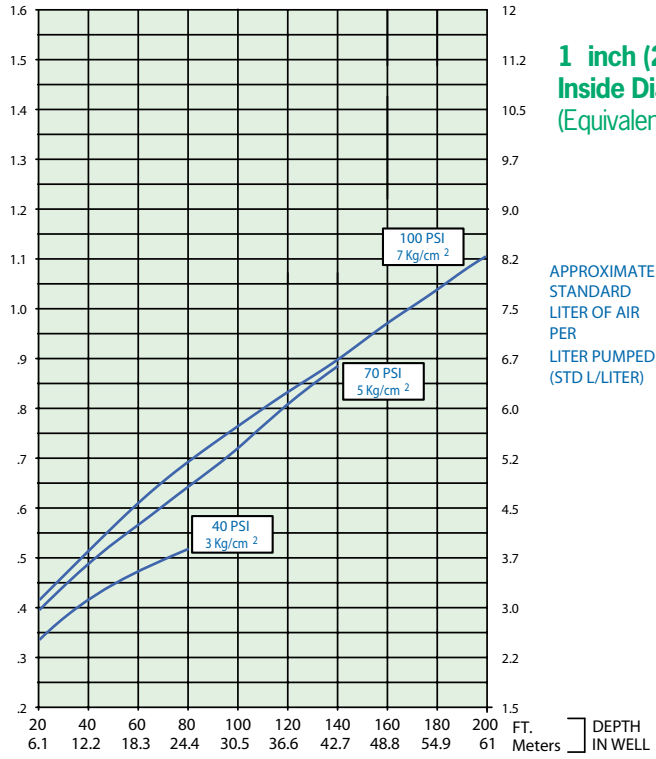
AP4+B

Air Consumption



3/4 inch (19 mm) Inside Diameter Discharge Hose

(Equivalent to 1-Inch O.D. Tubing)



1 inch (25.4 mm) Inside Diameter Discharge Hose

(Equivalent to 1.25-Inch O.D. Tubing)

P.O. Box 3726 Ann Arbor, MI 48106-3726 USA **1.800.624.2026** **F 1.734.995.1170** info@qedenv.com www.qedenv.com

DOUBLE DIAPHRAGM: SAND PIPER S05B2TP2TPNS000

Sandpiper SO5B2P2TPNS000 Air-Powered Double-Diaphragm PP Pump, PTFE; 14 GPM

Specifications & Description

- Max Flow Rate (GPM)14
- Max Flow Rate (LPM)53
- Suction Lift Wet (in H_2O)120
- Suction Lift Wet (mm of H_2O)3100
- Suction Lift Wet (in Hg)8.8
- Suction Lift Wet (mm Hg)537
- Power (Air)Yes
- Air Consumption (SCFM)16
- Air Consumption (m^3/hr)27.2
- Air Inlet Connection (NPT(F))1/4
- Max Air Inlet Pressure (PSI)100
- Max Air Inlet Pressure (bar)6.9
- Wetted MaterialsPolypropylene, PTFE
- Inlet Connection (NPT(F))1/2
- Outlet Connection (NPT(F))1/2
- Particulates, Max size dia (in)0.125
- Run DryYes
- Max Particulates Size Diameter (cm)3.2
- Max Temperature (° F)150
- Max Temperature (° C)66
- Viscosity, Max (cP)11000
- Duty Cycle ContinuousYes
- Length (in)10.125
- Height (in)7.0625
- Width (in)11.3125
- Length (cm)25.72
- Height (cm)17.94
- Width (cm)28.73
- DescriptionAir-Powered Double-Diaphragm PP Pump, PTFE; 14 GPM

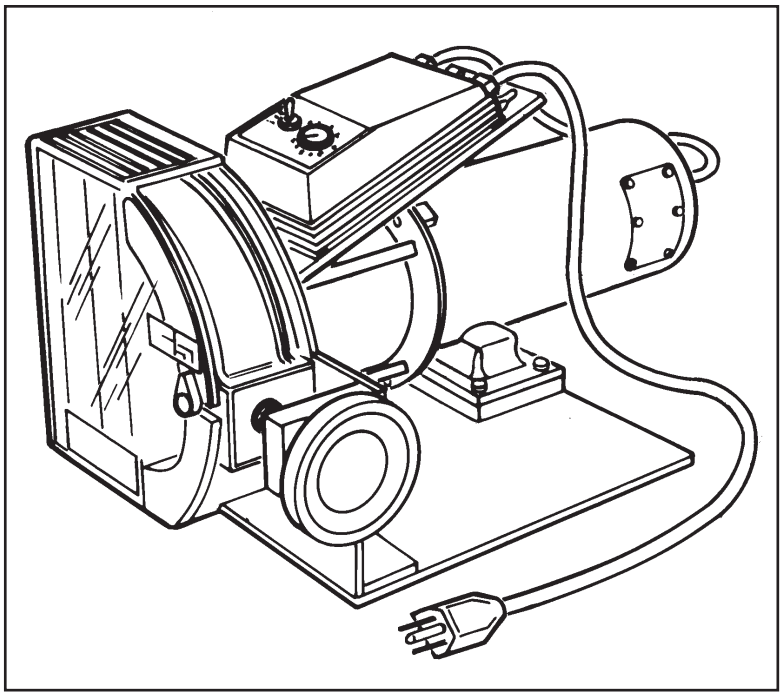
5 YEAR Warranty

MORE ABOUT THIS ITEM

These pumps can move high-viscosity fluids such as paint, sludge, and sewage. However, flow rate and pressure depends on the application. If you have questions about the compatibility of your high-viscosity fluid, call our Application Specialists for more information.

Order air filters/regulators to remove impurities from your air line and to help regulate working pressure. Combination air filter/regulators feature polypropylene filter, 0- to 160-psi gauge, and a polycarbonate bowl. Temperature range is 0 to 125°F (17 to 51°C).

LARGE DIAMETER PERISTALTIC: MASTERFLEX 7585-30



Masterflex® B/T® pump 07585-30

OPERATING MANUAL:

B/T® RAPID-LOAD DIRECT DRIVE PERISTALTIC PUMP AND DRIVES

Model Numbers

07585-30
07585-35
07585-50
07585-55

Cole-Parmer Instrument Co.
1-800-MASTERFLEX (627-8373) (U.S. and Canada only)
11 (847) 549-7600 (Outside U.S.) • (847) 549-7600 (Local) • www.masterflex.com

ISO9001 SUPPLIER CERTIFIED

Barnant Company
1-800-637-3739 (U.S. and Canada only)
11 (847) 381-7050 (Outside U.S.) • (847) 381-7050 (Local) • www.barnant.com

ISO9001 REGISTERED SUPPLIER

A-1299-0835
Edition 03

INTRODUCTION

This manual provides information for installing, operating and servicing the following models of Masterflex® B/T® RAPID-LOAD® Direct-Drive Variable-Occlusion Peristaltic Pumps and Drives.

MODEL	TYPE
07585-30	Pump with variable speed washdown motor and NEMA 4 controller, 115V AC system.
07585-35	Pump with variable speed washdown motor and NEMA 4 controller, 230V AC system.
07585-50	Pump with 5:1 gear head to accommodate NEMA Type 56C frame motors (no motor, no controller).
07585-55	Pump with 5:1 gear head to accommodate an IEC-72, Frame number 71, flange number F130, foot mounted, 0.37 kW motor (71-14F130) (no motor, no controller).

The unique design of these peristaltic pumps provides a greatly simplified means for rapid loading and changing of tubing. In addition, the following features are incorporated:

- Pumps up to 12 GPM.
- Uses continuous tubing to ensure a sanitary and non-contaminating -system.
- Fluid contacts only the tubing.
- Handles wide range of viscosities.
- Several different size tubing and formulations can be used.
- 5:1 gear head eliminates need for belt and pulley.
- Washdown motor and NEMA 4 controller provided on some models.

APPLICATION DATA

The gentle peristaltic action of these pumps is ideal for pumping highly viscous and shear-sensitive liquids. These pumps are also ideally suited for use where sterile conditions and purity are required. Toxic and hazardous fluids can be pumped with the proper selection of Masterflex® B/T® tubing since the fluid contacts only the tubing and not the pump.

WARNING: ***Tubing breakage may result in fluid being sprayed from pump. Use appropriate measures to protect operator and equipment.***

GENERAL DESCRIPTION

The RAPID-LOAD® B/T® peristaltic pump (see Figure 1) is mounted on a base and attached to a NEMA 56C frame motor or IEC-72 71-14F130 frame motor (with foot mountings) through a 5:1 gear head and adapter. Depending on the model, the motor is either supplied or customer furnished and is attached to the adapter by four bolts and to the base by an additional four bolts. The controller is mounted on a bracket above the gear head. The bracket and controller can be removed and hung by two bolts at a location up to 10 ft. away. The controller incorporates a REV-OFF-FWD switch and a speed control.

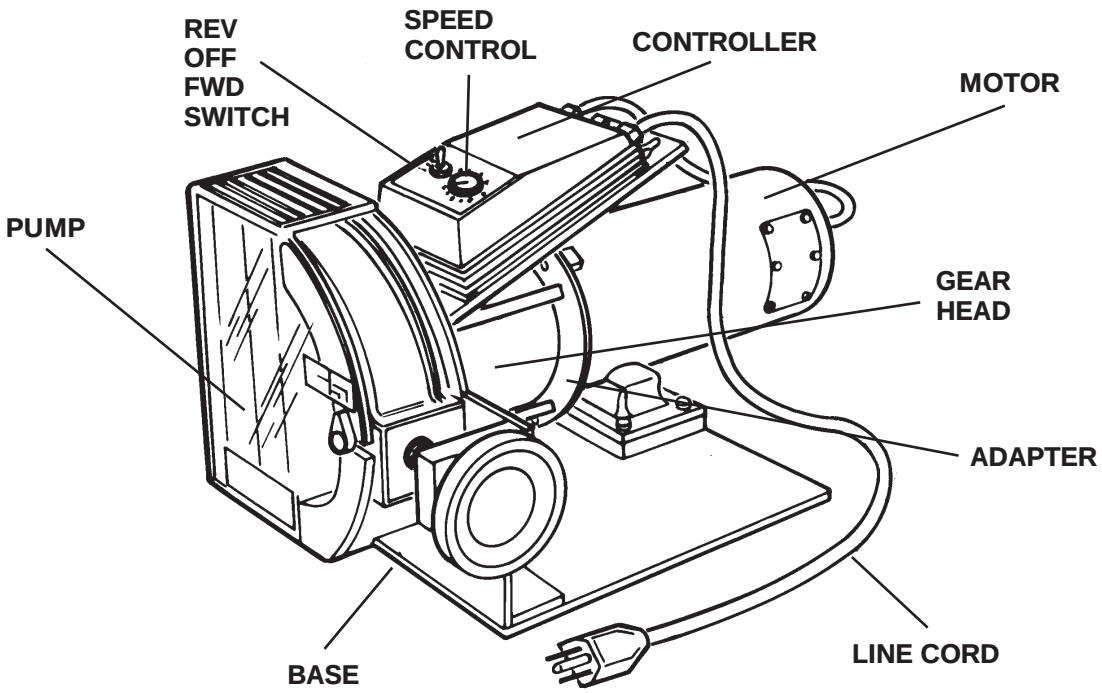


Figure 1. TYPICAL RAPID-LOAD PUMP AND DRIVE

Due to its unique design, several different Masterflex® B/T® tubing sizes can be accommodated by this RAPID-LOAD® peristaltic pump. The adjusting knob (see Figure 2) allows the user to load tubing quickly and consistently and is used to set the nominal occlusion (amount of squeeze on the tubing) for each size tubing. The indicator pointer can be aligned with index marks for the different tube sizes, thus simplifying the setting of nominal occlusion. Occlusion is adjusted by turning the occlusion ring adjusting knob clockwise to increase occlusion or counterclockwise to decrease occlusion until the desired performance is obtained. When maximum flow is not required, reduction in the occlusion can greatly increase tubing life. Increased occlusion provides improved vacuum and pressure performance.

The maximum recommended rotor speed is 350 rpm. A tachometer access port is provided to allow monitoring of pump rotation speed. The pump rotor can turn either clockwise or counterclockwise. When turning clockwise (FWD) the top connection is for suction and the bottom connection is for discharge. The 350 rpm speed is obtained from the standard 1725 rpm fractional horsepower motor through the 5:1 gear reduction. Faster speeds will increase flow, but will also considerably shorten average tubing life. (We cannot be responsible for pump performance when operated at speeds higher than 350 rpm.)

If the pump is to be operated with back-pressure on the discharge line greater than 5 PSIG, hose clamps or screw-type band clamps are recommended on the tubing connections on the discharge side of the pump. Silicone or C-FLEX® tubing, because of their highly elastic natures, can expand very quickly if back-pressure is present and could create leakage at the fittings if not securely retained. It is this same elastic nature, however, that makes them such excellent materials for this peristaltic type pump. Norprene® tubing yields longer life, especially under pressure. Do not attempt to use other materials in lieu of these, as pump performance could be severely compromised with possible damage to the pump. Refer to Table 1 for tubing recommendations.

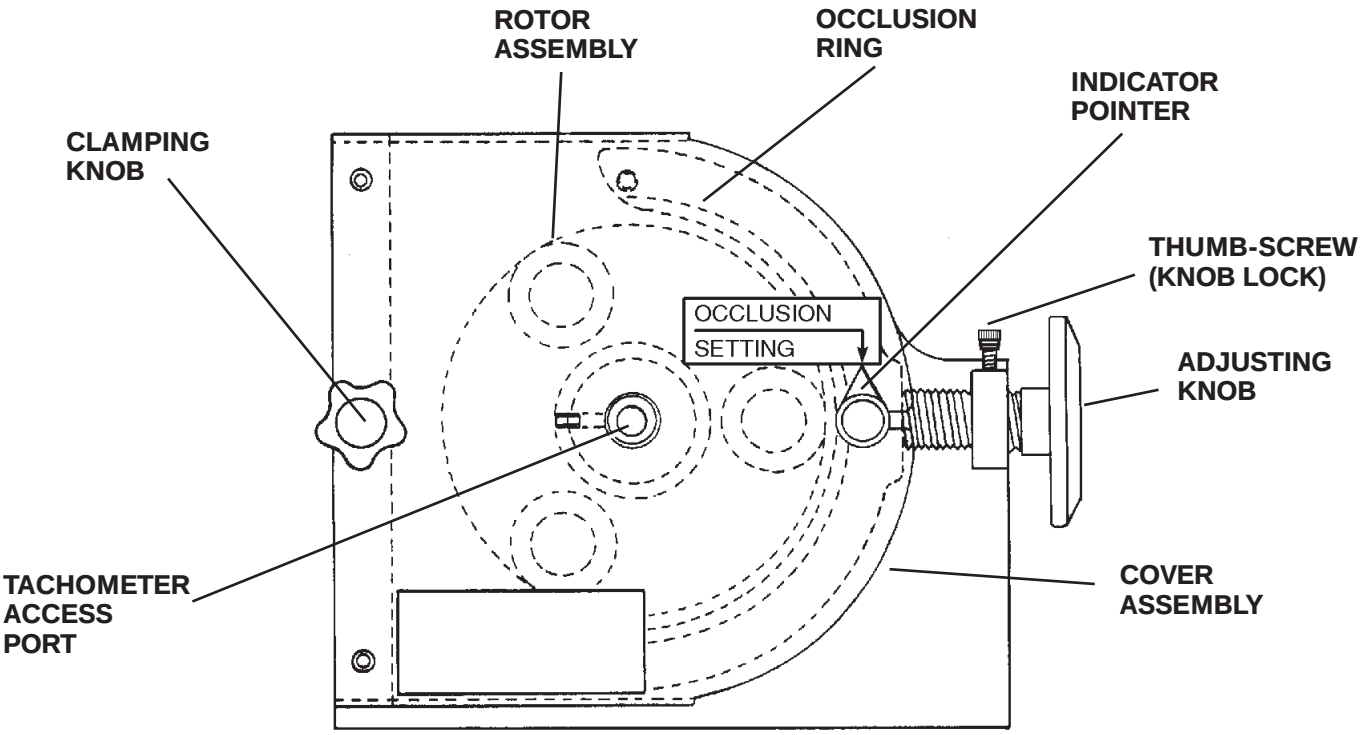


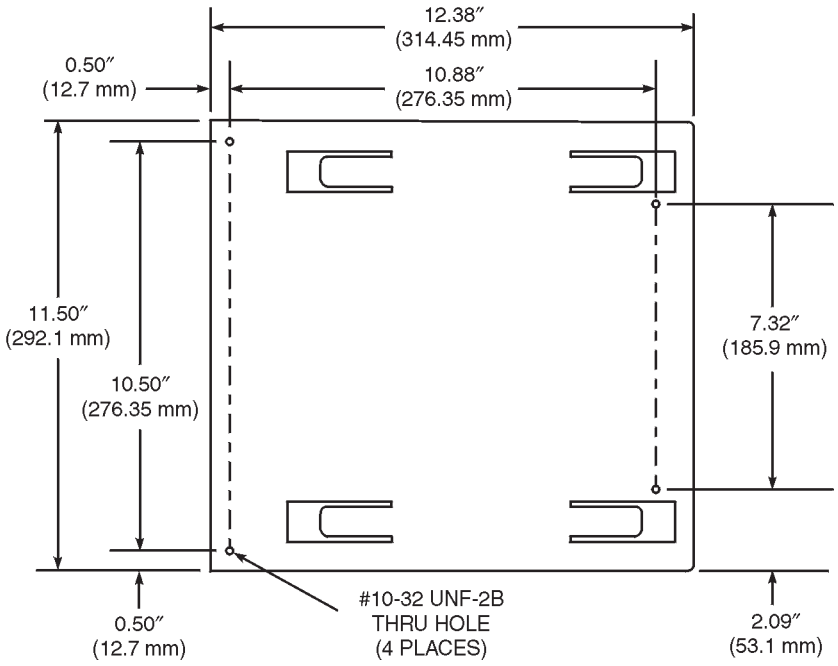
Figure 2. RAPID-LOAD PUMP ASSEMBLY

INSTALLATION AND SETUP

These units should be placed on a flat surface such as a floor, bench or table and should be near an electrical power source. Be sure to check data plate for proper voltage rating(s). See Appendix for Model 07585-50 and Model 07585-55 motor mounting instructions.

Note: For those models with a controller, the controller and bracket can be removed and located up to 10 feet away. Secure the bracket using two bolts inserted through the keyhole slots.

Pump Mounting Dimensions



Dimensions are in inches (mm)

MODEL NOS. 7585-30, -35, -50, -55

TUBING TYPES

Use only Masterflex® B/T® precision tubing with Masterflex® pumps to ensure optimum performance. Use of other tubing may void applicable warranties.

Note: Use Masterflex® B/T® tubing. These pumps are designed to use B/T® tubing sizes 86, 88, 90 and 92 only. The tubing sizes refer to the last two digits of the Masterflex® B/T® tubing model number.

The following chart provides information for the various sizes of tubing.

Table 1. Tubing Data

Characteristic	Tubing Size			
	B/T® 86	B/T® 88	B/T® 90	B/T® 92
Inside Dia. in (mm)	0.37 (9.5)	0.5 (12.7)	0.75 (19.0)	1 (25.4)
Outside Dia. in (mm)	0.87 (22.2)	0.87 (22.2)	1.25 (31.8)	1.37 (35)
Hose barb size in (mm)	3/8 (9.5)	1/2 (12.7)	3/4 (19.0)	1 (25.4)
Flow Range (with 12–350 rpm drive)	0.3–7.5 liter/min (0.07–2 GPM)	0.5–15 liter/min (0.15–4.0 GPM)	1–30 liter/min (0.3–8 GPM)	1.5–45 liter/min (0.4–12 GPM)
Nominal Flow Per Revolution	21 mL	42 mL	84 mL	126 mL
Maximum Vacuum	26 in Hg	26 in Hg	26 in Hg	26 in Hg
Maximum; Outlet Pressure	20 psig (1.4 bar)	20 psig (1.4 bar)	20 psig (1.4 bar)	20 psig (1.4 bar)
Flow ranges are approximate—calculated under the following conditions: 0 psi at inlet, 0.5 psig at outlet and water circulant at 22°C (72°F).				

Cleaning

Keep the drive enclosure clean with mild detergents. Never immerse nor use excessive fluid.

ACCESSORIES

All Masterflex® tubing in sizes B/T® 86, B/T® 88, B/T® 90 and B/T® 92 can be used with this pump. Be sure tubing material matches application.

Description	Part Number
Retaining Ring Tool	07585-06

SPECIFICATIONS

Output:

Pump Speed: 12 to 350 rpm

Torque output, maximum: 1440 oz-in (104 kg-cm)

Tubing compatibility: Sizes 86, 88, 90 or 92

Flow Range: Up to 12 GPM

Input:

Supply voltage limits:

Model 7585-30 90 to 130 Vrms @ 50/60 Hz
Model 7585-35 200 to 260 Vrms @ 50 Hz

Current, max:

Model 7585-30 6.5A
Model 7585-35 3.3A

Installation Category:

Installation Category II per IEC 664 (Local level—appliances, portable equipment, etc.)

Motor Drive:

Requirement (motor not supplied):

Model 7585-50 NEMA Type 56C; 1800 rpm and

0.5 Hp max.

Model 7585-55 IEC-72 71-14F130; 1800 rpm and

0.5 Hp max.

SPECIFICATIONS (cont.)

Construction:

Dimensions:

Model 7585-30 16.5 in W x 14 in H x 22 in D
(41.9 cm W x 35.6 cm H x 55.9 cm D)

Model 7585-35 16.5 in W x 14 in H x 22 in D
(41.9 cm W x 35.6 cm H x 55.9 cm D)

Model 7585-50 16.5 in W x 14 in H x 9 in D
(41.9 cm W x 35.6 cm H x 22.9 cm D)

Model 7585-55 16.5 in W x 14 in H x 9 in D
(41.9 cm W x 35.6 cm H x 22.9 cm D)

Weight:

Model 7585-30 89 lbs (40.4 kg)
Model 7585-35 89 lbs (40.4 kg)
Model 7585-50 30 lbs (13.6 kg)
Model 7585-55 30 lbs (13.6 kg)

Enclosure Rating:

Model 7585-30 IP56 (NEMA 4) per IEC 529
Model 7585-35 IP56 (NEMA 4) per IEC 529

Environment:

Temperature, Operating:	0°C to 40°C (32°F to 104°F)
Storage Temperature:	–20°C to 60°C (–4°F to 140°F)
Humidity (non-condensing):	10% to 90%
Altitude:	Less than 2000 m
Pollution Degree:	Pollution Degree 3 per IEC 664 (Sheltered locations)
Chemical Resistance:	Exposed material is painted aluminum, plastic and vinyl

Compliance: Units are designed to meet UL 778

ROTARY PUMP: DAYTON 1” INTERMEDIATE-DUTY 316 STAINLESS STEEL ROTARY GEAR PUMP

DAYTON **1" Intermediate-Duty 316 Stainless Steel Rotary Gear Pump Head, Pedestal Design, 125 psi**
Item # **4KHP3**
Mfr. Model # **4KHP3**

Product Details

Dayton heavy duty gear pumps feature self priming, bidirectional, positive displacement, designed to operate with nearly pulseless flow. They are used in a wide variety of applications including industrial, agricultural, marine, domestic, and commercial apartments. The pumps can be directly mounted to NEMA frame Total Enclosed Fan Cooled (TEFC) motors. Made of stainless steel, these pumps are ideal for handling viscous based fluids.

Technical Specifications

Item #	4KHP3
Mfr. Model #	4KHP3
UNSPSC #	40151551
Catalog Page	2687
Shipping Weight	17.1 lbs
Country of Origin	India *
Item	Rotary Gear Pump Head
Duty Rating	Intermediate
Design	Pedestal
Pump Body Material	316 Stainless Steel
Port Size	1"
Pump RPM	1725
Temp. Range	32 Degrees to 280 Degrees F
Max. Pressure	125 psi
Max. Viscosity	550 SSU
Gear	Fortron PPS Spur
Length	11-3/8"
Width	4-1/2"
Height	5-3/8"

O-Ring Material	Viton
Relief Valve	Without
Seal	Mechanical With Stainless Steel, Viton, Carbon/Ceramic
Shaft Dia.	0.750"
Shaft Height	3-15/16"
Shaft Material	316 Stainless Steel
GPM @ Freeflow	24
HP @ Free Flow	1
GPM @ Freeflow @ 1725 RPM	24.8
HP @ Free Flow @ 1725 RPM	1-1/2
GPM @ 25 PSI	23.4
HP @ 25 PSI	1-1/2
GPM @ 50 PSI	22.3
HP @ 50 PSI	2
GPM @ 75 PSI	21.5
HP @ 75 PSI	2
GPM @ 100 PSI	20.5
HP @ 100 PSI	3
GPM @ 125 PSI	3
HP @ 125 PSI	3
GPM @ 125 PSI @ 1725 RPM	19.5
HP @ 125 PSI @ 1725 RPM	3
Suction Lift	17 ft.
Suction Lift @ 1725 RPM	19.5 ft.

Appendix N

Design Calculations

N1 - Compressed Air to Recovery Well Pumps Memo
N2 - DNAPL AODD Pumps Memo
N3 - DNAPL QED PULSE Pumps Memo
N4 - Groundwater AODD Pumps Memo
N5 - Horizontal Well Screen Design
N6 - Solids Treatability Study

MEMORANDUM

TO:	File	cc:	M. Byker
FROM:	T.L. Snyder		T. Komar
RE:	NSG Recovery Well Pumps		
FILE:	31060/67860		
DATE:	October 12, 2018		

See the attached preliminary Pipe-Flo model results for the compressed air supply to the Groundwater and DNPL Recovery Well Pumps and a conceptual Compressed Air Flow Diagram including the compressor, refrigerated and dessicant air dryers, and air receivers. Assumptions used to prepare the Pipe-Flo model are as follows:

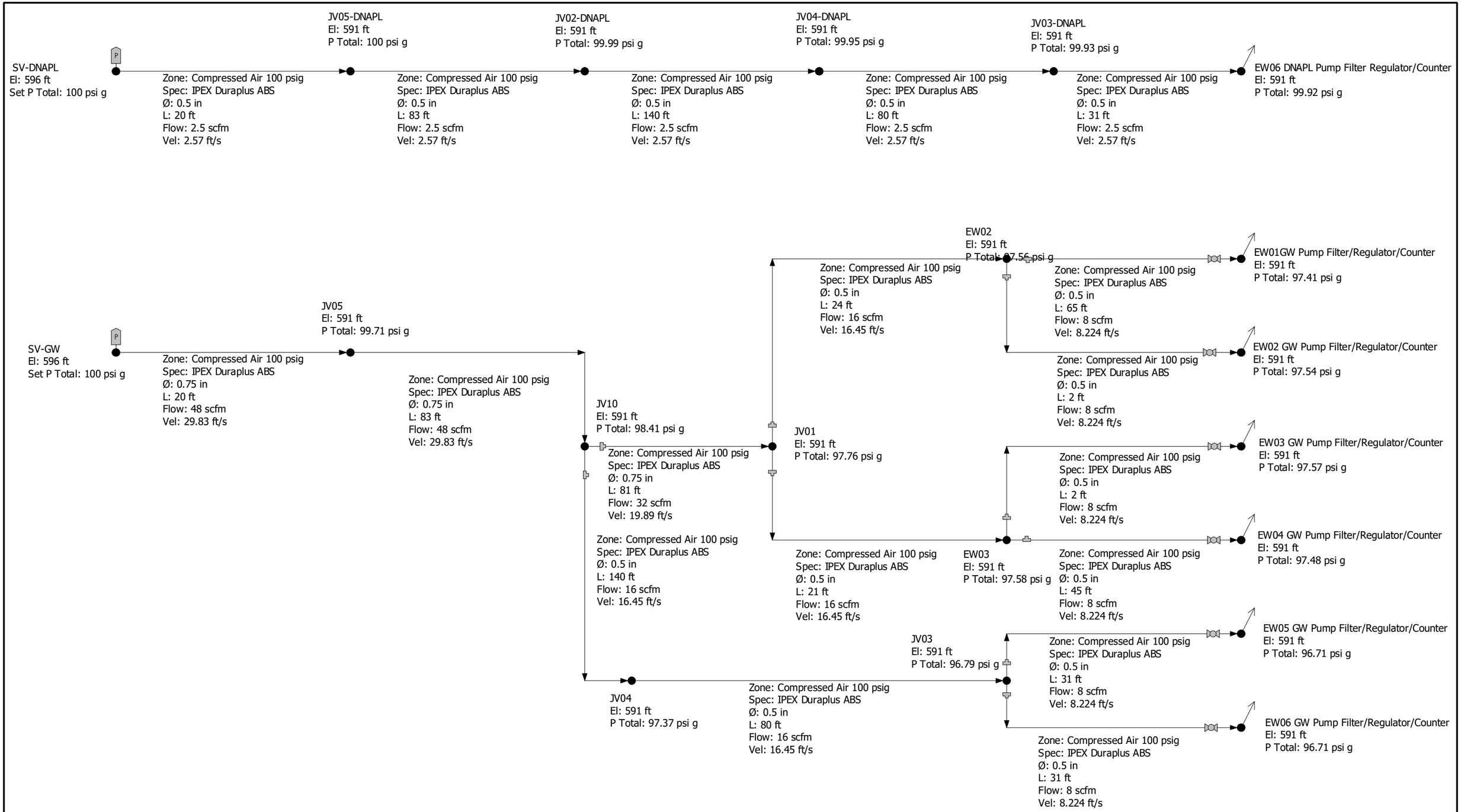
The Pipe-Flo model calculates the available air pressure to the recovery well pumps using a compressed air supply pressure of 100 psig from the manifold to be located in or near the treatment facility. Six Ground Water Recovery Well Pumps will operate concurrently to provide a total flow of 20 gpm (3.34 gpm/pump) groundwater to the treatment facility. Each pump requires 8 cfm (free air).

Six DNAPL Recovery Well pumps will each have their own dedicated compressed air supply and will operate infrequently. When operating, each pump will require 2.5 or less cfm (free air). Three AODD Pumps will have a filter/regulator and counter at the pump and a solenoid valve at the manifold. Three QED Pulse pumps will have a solenoid valve, filter regulator, and pulse counter at the manifold. The compressed air supply to EW06 only was modelled, the available air pressure to the other DNAPL recovery well pumps should be equal or greater.

Compressed air piping is IPEX DuraPlus ABS with sizes as shown.

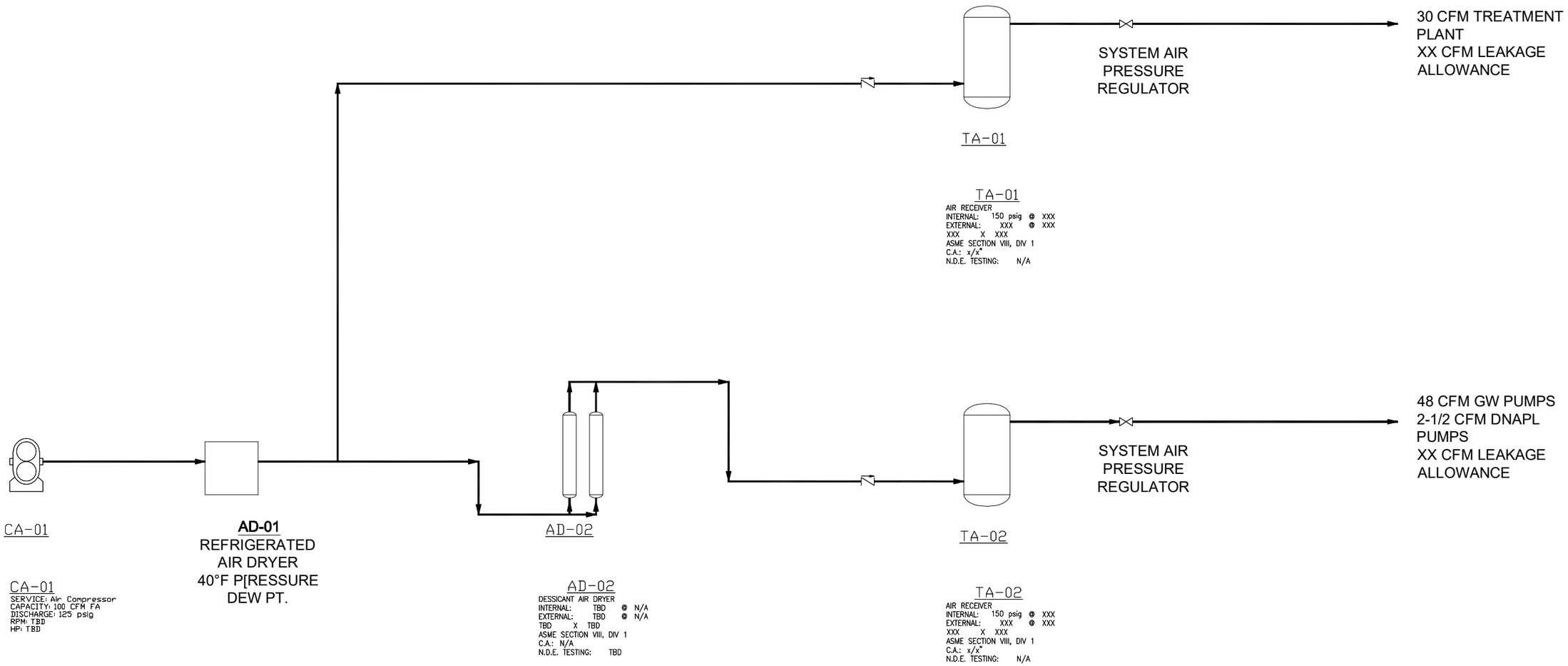
A pressure dew point requirement of -40°F will be required for the compressed air to the recovery well pumps along with coalescing (oil removal) and particulate filters. A pressure dew point of 40°F to the treatment facility along with coalescing and particulate filters is suitable.

The compressor should be equipped with an auto load/unload feature at a minimum. Rotary screw compressors are preferred.



	PIPE-FLO Professional	Units Used				Project Information
	Program Version: 16.1.41643	**Flow rate:** scfm		**Power:**		**Company:** OBG
	Calculation Method: Darcy-Weisbach	**Velocity:** ft/s		**Temperature:** °F		**Project:** 67860.1983-WBS - NSG
	Maximum Iterations: 100	**Pressure:** psi g		**Density:** lb/ft³		**Drawn by:** T.L. Snyder
	Iteration Tolerance: 0.01	**Elevation:** ft		**Viscosity:** cP		**File Name:** 67860 - Compressed Air_2018.10.11.pipe
	Laminar Cutoff Re: 2100	**Length:** ft		**Atmospheric Pressure:** 14.38	psi a	**Lineup:** <Design Case>
		Size: in				**Print Date:** Friday, October 12, 2018 01:41 PM

SAVED: 10/11/18 8:59 AM



PRELIMINARY
NOT FOR
CONSTRUCTION
DATE: ##########

IN CHARGE OF ###
DESIGNED BY ###
CHECKED BY ###
DRAWN BY ###

NO.	DATE	REVISION	INT.
####	####	#	#
####	####	####	#
#####	#####	#####	#####
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O'BRIEN & GERE ENGINEERS, INC
####

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FILE NO.
###.#####

DATE
##########

######

\\SERVER27-01\PROJECTS\WBS.3106067860.1983-WBS - NSG\DOCS\DWG\PILOT STUDY\66760.COMPRESSED AIR PFD.DWG

MEMORANDUM

TO:	File	cc:	M. Byker
FROM:	T.L. Snyder		T. Komar
RE:	NSG Recovery Well DNAPL AODD Pumps		
FILE:	31060/67860		
DATE:	October 11, 2018		

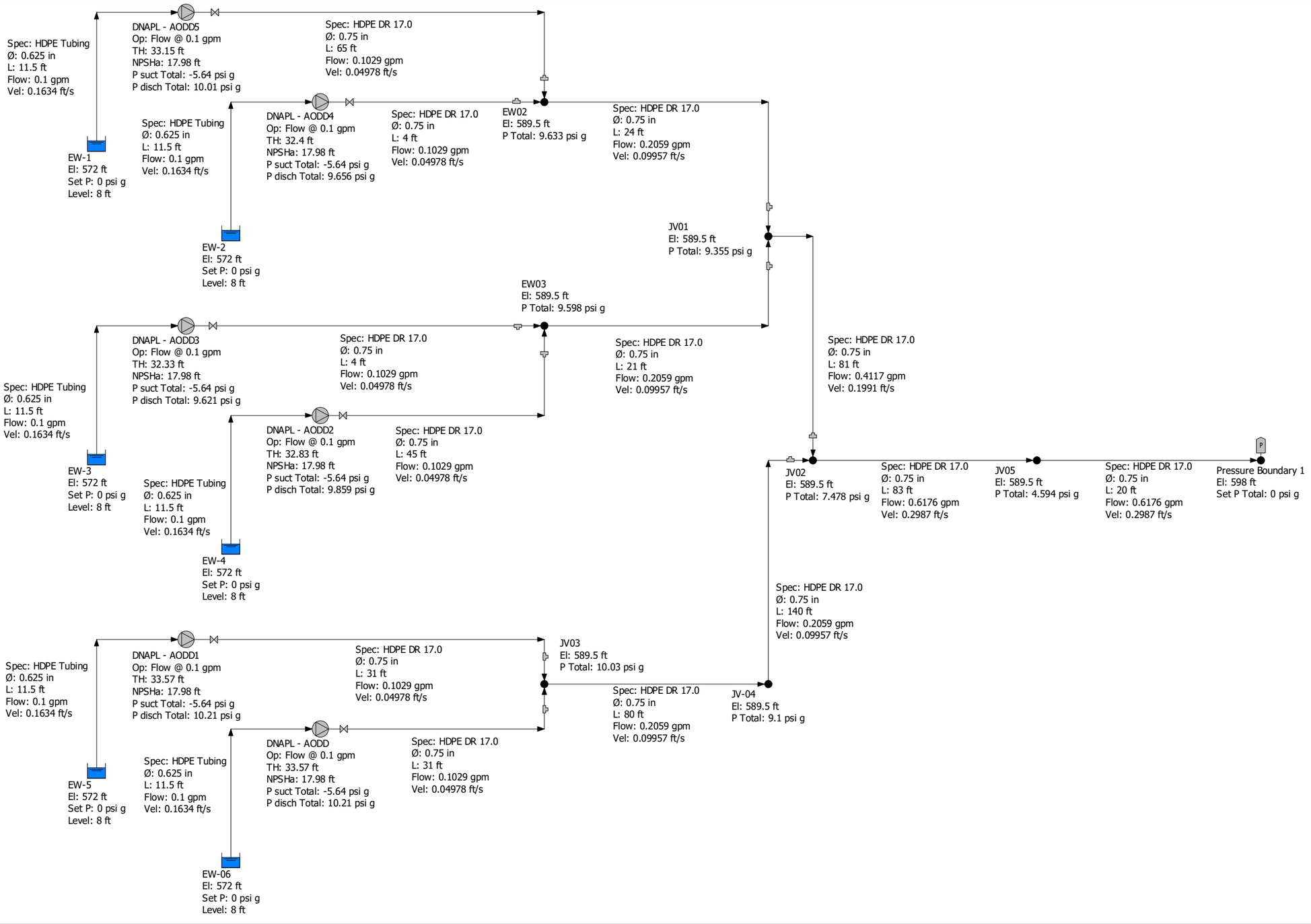
See the attached preliminary Pipe-Flo model results for the DNAPL AODD Recovery Well Pumps. Assumptions used are as follows:

Ground Surface Elevation; 592.0 ft
Pump Inlet/Discharge Elevation; 589.5 ft.
Static Water Surface Elevation; 584.0 ft.
Drawdown During Pumping; 4 ft.
DNAPL Suction Inlet; 578.0 ft.
DNAPL AODD Pump Suction Piping; 5/8" nom. dia. HDPE ttubing, 1/2" I.D.
DNAPL AODD Pump Discharge Piping; ¾" nom. dia. HDPE DR17.0 (IPS), 0.919" I.D.

DNAPL Fluid Properties (Pump Discharge):
Temperature; 70°F
Pressure; O psig
Atmosperic Pressure; 14.38 psia @ 592.0 ft.
Density; 66.05 lb/ft3 (Specific Gravity; 1.06)
Viscosity; 147 cP (71.9 cSt)
Specific Heat Capacity; 1.013 BTU/lb°F (water)
Rel. Molecular Mass; 18 (water)
Vapor Pressure; 0.3633 psia (water – I used this because it's higher than below and more conservative)
Critical Pressure: 3199 psia (water)

DNAPL Fluid Properties (Pump Suction):
Temperature; 60°F
Pressure; O psig
Atmospheric Pressure; 14.38 psia @ 592.0 ft.
Density; 67.98 lb/ft^3 (Specific Gravity; 1.06)
Viscosity; 230 cP (109 cSt)
Specific Heat Capacity; 1.013 BTU/lb°F (water)
Rel. Molecular Mass; 18 (water)
Vapor Pressure; 0.2564 psia (water – I used this because it's higher than below and more conservative)
Critical Pressure: 3199 psia (water)

Elevations used were provided by TRK and have not been adjusted for individual wells at this time.



	PIPE-FLO Professional	Units Used	Project Information
	Program Version: 16.1.41643 **Calculation Method:** Darcy-Weisbach **Maximum Iterations:** 100 **Iteration Tolerance:** 0.01 **Laminar Cutoff Re:** 2100	**Flow rate:** gpm **Velocity:** ft/s **Pressure:** psi g **Elevation:** ft **Length:** ft **Size:** in **Power:** **Temperature:** °F **Density:** lb/ft³ **Viscosity:** cP **Atmospheric Pressure:** 14.38 psi a	**Company:** OBG **Project:** 67860.1983-WBS - NSG **Drawn by:** T.L. Snyder **File Name:** 67860.DNAPL-AODD_2018.10.11.pipe **Lineup:** <Design Case> **Print Date:** Thursday, October 11, 2018 04:50 PM

MEMORANDUM

TO:	File	cc:	M. Byker
FROM:	T.L. Snyder		T. Komar
RE:	NSG Recovery Well DNAPL QED PULSE Pumps		
FILE:	31060/67860		
DATE:	October 11, 2018		

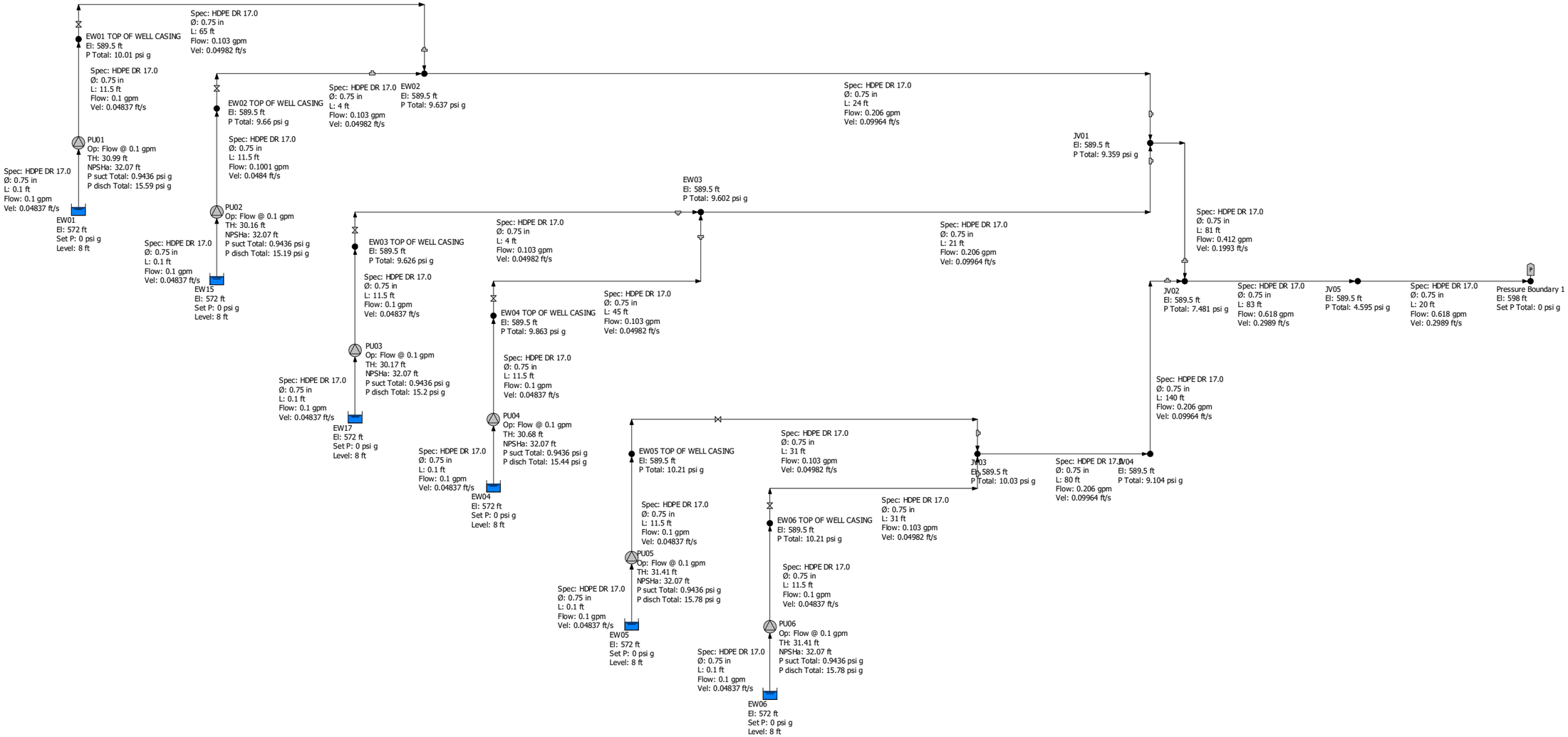
See the attached preliminary Pipe-Flo model results for the DNAPL QED PULSE Recovery Well Pumps. Assumptions used are as follows:

Ground Surface Elevation; 592.0 ft
Pump Inlet/Discharge Elevation; 589.5 ft.
Static Water Surface Elevation; 584.0 ft.
Drawdown During Pumping; 4 ft.
DNAPL QED PULSE Pump Inlet; 578.0 ft.
DNAPL QED PULSE Pump Discharge Piping; ¾" nom. dia. HDPE DR17.0 (IPS), 0.919" I.D.

DNAPL Fluid Properties (Pump Discharge to Top of Well Casing):
Temperature; 50°F
Pressure; O psig
Atmospheric Pressure; 14.38 psia @ 592.0 ft.
Density; 68.03 lb/ft^3 (Specific Gravity; 1.09)
Viscosity; 317 cP (150 cSt)
Specific Heat Capacity; 1.013 BTU/lb°F (water)
Rel. Molecular Mass; 18 (water)
Vapor Pressure; 0.2564 psia (water – I used this because it's higher than below and more conservative)
Critical Pressure: 3199 psia (water)

DNAPL Fluid Properties (Top of Well Casing to Treatment Facility):
Temperature; 70°F
Pressure; O psig
Atmosperic Pressure; 14.38 psia @ 592.0 ft.
Density; 66.05 lb/ft3 (Specific Gravity; 1.06)
Viscosity; 147 cP (71.9 cSt)
Specific Heat Capacity; 1.013 BTU/lb°F (water)
Rel. Molecular Mass; 18 (water)
Vapor Pressure; 0.3633 psia (water – I used this because it's higher than below and more conservative)
Critical Pressure: 3199 psia (water)

Elevations used were provided by TRK and have not been adjusted for individual wells at this time.



		PIPE-FLO Professional	Units Used				Project Information
		Program Version: 16.1.41643	**Flow rate:**		**Power:**		**Company:** OBG
		Calculation Method: Darcy-Weisbach	**Velocity:** ft/s		**Temperature:** °F		**Project:** 67860.1983-WBS - NSG
		Maximum Iterations: 100	**Pressure:** psi g		**Density:** lb/ft³		**Drawn by:** T.L. Snyder
		Iteration Tolerance: 0.01	**Elevation:**		**Viscosity:** cP		**File Name:** 67860.DNAPL-QED PULSE_2018.10.11.pipe
		Laminar Cutoff Re: 2100	**Length:**		**Atmospheric Pressure:** 14.38	psi a	**Lineup:** <Design Case>
			Size:				**Print Date:** Friday, October 12, 2018 11:38 AM

MEMORANDUM

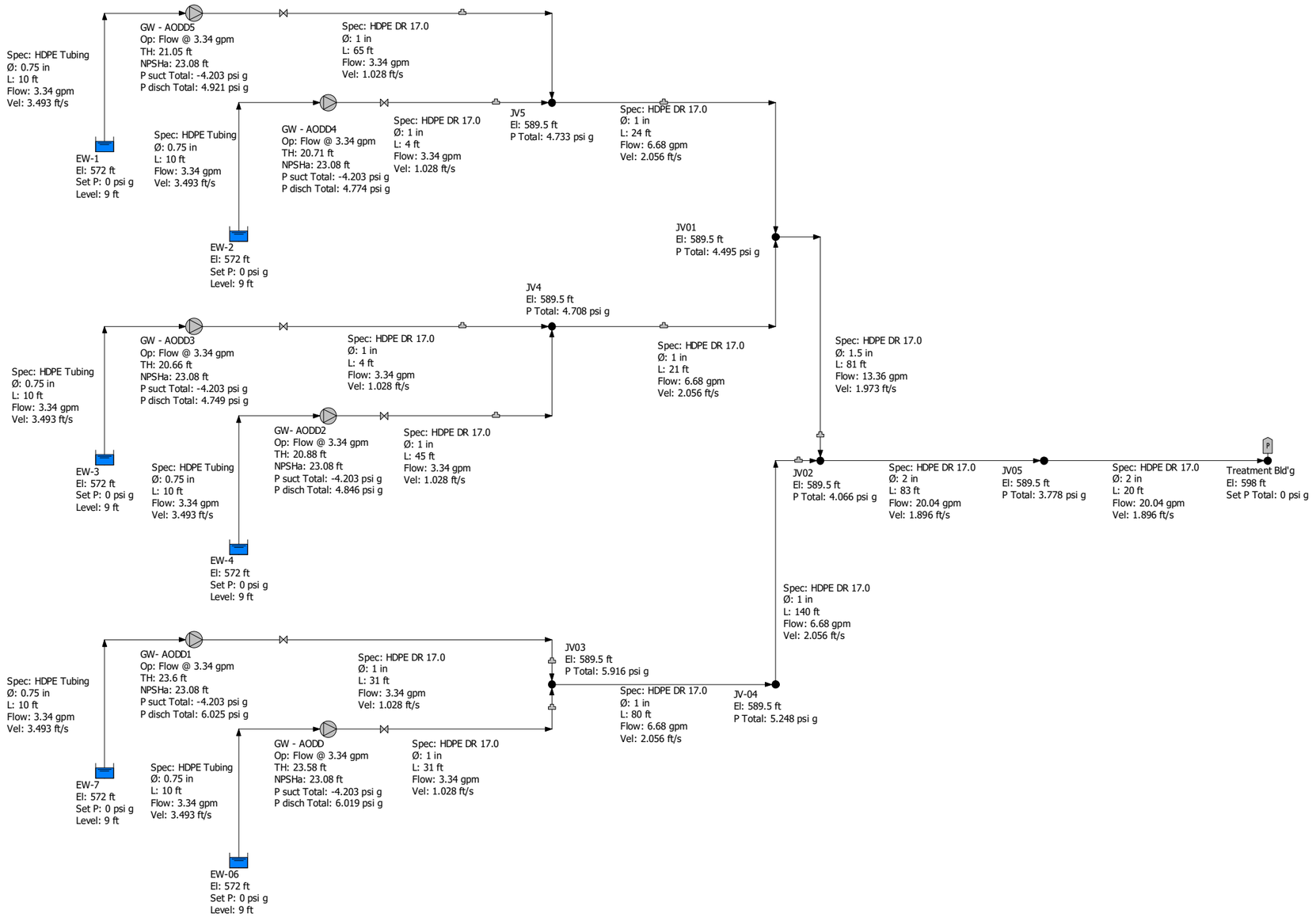
TO:	File	cc:	M. Byker
FROM:	T.L. Snyder		T. Komar
RE:	NSG GW Recovery Well Pumps		
FILE:	31060/67860		
DATE:	October 11, 2018		

See the attached preliminary Pipe-Flo model results for the GW AODD Recovery Well Pumps. Assumptions used are as follows:

Ground Surface Elevation; 592.0 ft
Pump Inlet/Discharge Elevation; 589.5 ft.
Static Water Surface Elevation; 584.0 ft.
Drawdown During Pumping; 3 ft. (Adjusted due to GW inlet elevation)
GW Inlet; 581.0 ft. (from Recovery Well Section & Details)
Btm. of Recovery Well; 572.0 ft.
GW AODD Pump Inlet Piping; ¾" nom. dia. HDPE Tubing, 1/16" Wall Thickness, 5/8" I.D.
GW AODD Pump Discharge Piping; HDPE DR17.0 (IPS), size varies – see model results

GW Fluid Properties:
Waterlike
Temperature; 50°F
Pressure; 0 psig
Atmospheric Pressure; 14.38 psia @ 592.0 ft.

Elevations used were provided by TRK and have not been adjusted for individual wells at this time.



	PIPE-FLO Professional		Units Used			Project Information	
	Program Version:	16.1.41643	**Flow rate:**		**Power:**	**Company:**	OBG
	Calculation Method:	Darcy-Weisbach	**Velocity:**	ft/s	**Temperature:**	°F	**Project:** 67860.1983-WBS - NSG
	Maximum Iterations:	100	**Pressure:**	psi g	**Density:**	lb/ft³	**Drawn by:** T.L. Snyder
	Iteration Tolerance:	0.01	**Elevation:**		**Viscosity:**	cP	**File Name:** GW-AODD_2018.10.10.pipe
	Laminar Cutoff Re:	2100	**Length:**		**Atmospheric Pressure:**	14.38 psi a	**Lineup:** <Design Case>
			Size:				**Print Date:** Thursday, October 11, 2018 11:08 AM

OBG	CALCULATION SHEET	By: MDB		Date: 10/4/18	
		Chkd By: ANS		Date: 10/5/18	
		Revision:	*Data:*	*By:*	*App'd:*
Client: North Shore Gas					
OBG Project No.: 67860					

Slotted Pipe Open Area

Slotted pipe open area calculation for injection of treated groundwater through a horizontal well with approximately 185 linear feet (LF) of screen installed in a fine-grained sand formation with conductivities ranging from 30 to 50 feet per day (ft/d). Anticipated injection flow rates will range from 10 to 20 gallons per minute (gpm).

Background on Well Design Input Values

A slot width of 0.02 inches was selected as the minimum manufacturable width to match the surrounding formation, based on consultation with Albert Smith of Johnson Screens on September 27, 2018. A slot length of 1.5 inches was selected as the minimum manufacturable length. Geotechnical information is provided in Appendix O.

A design overpressure of 10 gpm was selected to match the minimum flow rate, translating to 0.43 pounds per square inch (psi) or 1 foot (ft) of water.

Calculation

Determine the flow rate per slot and the required number and configuration of slots for the horizontally screened injection well.

To determine the orifice (slot) flow rate:

$$Q_s = C_d * A * \sqrt{2g(\Delta h)} \qquad [1]$$

Where

C_d=	0.61		coefficient of discharge for a sharp edged orifice [1]
A=	0.00021	ft^2	slot width
g =	32.2	ft/s^2	gravitational acceleration constant
Δh =	1		Design overpressure of injection well

Therefore, the orifice flow rate per each slot is calculated as

Q_s =	0.00102	ft^3/second
Q_s =	0.00763	gallons/second
Q_s =	0.45770	gpm

To calculate the spacing of the slots when negating frictional losses for the piping run

$$Q_T = Q_s * n$$

Q_T =	10	gpm	total injection flow rate

Solving for N,

n =	22	slots

Therefore,

L=	185	feet	
Slot Spacing $_{Theoretical}$ =	8.47	feet between slots	

	CALCULATION SHEET	By: MDB		Date: 10/4/18	
		Chkd By: ANS		Date: 10/5/18	
		Revision:	*Data:*	*By:*	*App'd:*
Client: North Shore Gas					
OBG Project No.: 67860					

Verifying Over Pressure if Discharging at 20 gpm

Given that the number and size of the slots would not change from a 10 gpm discharge to a 20 gpm discharge, the orifice flow rate at each slot would double. Following the orifice equation, this would increase the change in head or overpressure, of the injection well to the squared ratio of the new flow rate to the old flow rate: $(20\ gpm/10\ gpm)^2 = 2^2 = 4$. The increase in overpressure from 1 ft. of water to 4 ft. of water is within the design specifications of the effluent pump and pipe.

Actual Slot Spacing Specification

OBG had well design calculations reviewed by Brian Younkin, PhD with Directional Technologies, Inc, a leading designer and installer of horizontal wells. Dr. Younkin indicated that there is a high probability that the slots will be negatively affected by siltation and fouling of well screen, clogging of slots, and formational backpressure during well installation and operations. Accordingly, Dr Younkin recommended that the space between slots be reduced by a factor of 3-5 times so that the actual discharge is similar to the theoretical discharge. Accordingly, the space between slots would be reduced to 1.7-2.8 feet. To account Dr Younkin's recommendation for a factor of safety while minimizing concerns with having slots spaced to promote uniform discharge along the entire well, slots at the bottom of the well screen will be spaced at every 5 feet. Slots along the top of the well screen will be spaced every 2.5 feet where water will be discharged once the entire pipe is pressurized.

Summary and Conclusions:

The pipe slot design consists of one 0.020-inch wide by 1.5-inch long slot per every 2.5 feet along the top and every 5 feet along the bottom of the 185 linear foot screened interval. The slots will be cut perpendicular to the pipe.

References

1 - Lindeburg, M. R. (2006). FE review manual: Rapid preparation for the general fundamentals of engineering exam (2nd ed.). Belmont, CA: Professional Publications. *pp25-4.*

IRON SOLUBILITY AND SOLIDS PRECIPITATION

Six aliquots of field composited water were used to determine the optimum pH for iron removal. The pH of the aliquots were adjusted to 8, 8.5, 9, 9.5, & 10 S.U. respectively, using 1N NaOH. After pH adjustment, each aliquot was allowed to settle for one hour to allow for solids to settle. After one hour, the samples were visually screened for best solids precipitation and the supernatant was decanted into a secondary container. A portion of the decanted sample was analyzed for TSS. The remaining sample was filtered through a 0.45 µm filter and analyzed for dissolved iron.

The results of the TSS testing were inconclusive due to the presence of LNAPL in the sample.

It was observed that the concentration of dissolved iron decreases as pH increases. The results of the testing showed that at pH 10, dissolved iron was undetected by the laboratory. It should be noted that the control sample tested had limited concentrations of iron and is not considered representative of expected groundwater conditions.

JAR TESTING

Small-scale jar testing was performed using 100 mL aliquots of pH adjusted field composited water. Alum, Aries-291 (coagulant), and Kemira A-130 (anionic flocculant) were visually screened to determine which chemical and dosage would achieve the greatest solids removal at a pH of 10. The optimum dosages were visually screened to be:

1. 1 mg/L of Kemira A-130
2. 20 mg/L of Aries-291 with 0.5 mg/L of Kemira A-130

Upon completion of the small-scale jar testing, two 1 L aliquots of pH adjusted field composited water was used to perform large-scale jar tests. Following chemical addition, each test aliquot was rapidly mixed for 30 seconds, followed by flocculation for 15 minutes and quiescent settling for 60 minutes. At the end of the settling period, a supernatant sample was collected from each aliquot and analyzed for TSS. The results of the testing showed that the combination of Aries-291 and Kemira A-130 reduced the TSS of the sample to an undetectable level.

TITRATIONS

Titrations were performed using 1N NaOH and 1N nitric acid to determine full scale chemical consumption. It was calculated that approximately 4.2 gallons of 50% NaOH would be required per 10,000 gallons of water to increase the pH to 10 S.U. It was also calculated that approximately 3.42 gallons of 68% nitric acid would be required to drop the pH of 10,000 gallons of water to 7 S.U.

Appendix O

Geotechnical Data

Table 1. Summary of Sieve Data

Appendix O - Geotechnical Data
Former South Plant Manufactured Gas Plant Site
Waukegan, IL
North Shore Gas, CERCLIS ID - ILD984809228

Sample No.	Boring Location	Surface Elevation	Depth Interval	Elevation Interval	Particle-Size Diameter With Respect to Percentage of Finer Material Within the Sample[1]			
		(ft NAVD88)	(ft bgs)	(ft NAVD88)	D_{50} (mm)	D_{60} (mm)	D_{70} (mm)	D_{85} (mm)
103017003	PDI-SB-05-A	587.8	15.0 - 17.0	572.8 - 570.8	0.2170	0.2400	0.2670	0.3000
103017004	PDI-SB-05-A	587.8	18.5 - 21.0	569.3 - 566.8	2.3600	3.3000	4.7500	8.2500
Slot Design Statistics				**Minimum =**	0.2170	0.2400	0.2670	0.3000
				Maximum =	2.3600	3.3000	4.7500	8.2500
				Average =	1.2885	1.7700	2.5085	4.2750
				Standard Deviation =	1.5153	2.1637	3.1700	5.6215
				Median =	1.2885	1.7700	2.5085	4.2750

Notes:

mm = milimeters

in = inches

1. All D values estimated from the sieve graphs included with the geotechnical analysis completed by GESTRA in November 2017.

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Test Results of
Specific Gravity of Fine Soil

Project Name:	Waukegan South Plant MGP	Date:	November 28, 2017
Project Number:	K13028-40	Client:	NRT
Project Location:	Waukegan, IL		
AASHTO Designation:	T100		

Sample Information

Type of Sample:	Bag	Sample Date:	11/1/2017
Boring #:		Sampled By:	Client
Sample ID#	103017003	Specification Reference:	USCS
Depth:	15'-17'	Soil Classification:	SP-SM

Basic Test Information

Pyconometer (flask) number	1
Weight of dry pycnometer,	96.38
Weight of distilled water & flask (g)	345.59
@ Temperature T1 (^{o}C)	21.8
Weight of deaired slurry & flask (g)	377.29
@ Temperature T2 (^{o}C)	20.6
Weight of oven-dried soil (g)	50.55

K table

Temp. (^{o}C)	Temp (^{o}F)	K
16	60.8	1.0007
17	62.6	1.0006
18	64.4	1.0004
19	66.2	1.0002
20	68.0	1.0000
21	69.8	0.9998
22	71.6	0.9996
23	73.4	0.9993
24	75.2	0.9991
25	77.0	0.9989
26	78.8	0.9986
27	80.6	0.9983
28	82.4	0.9980
29	84.2	0.9977
30	86.0	0.9974

Specific Gravity Calculation

Temp adjustment factor, K (at T1)	0.9998
Adjusted deaired water & flask weight (g)	345.5
Temp adjustment factor, K (at T2)	1.0000
Adjusted deaired slurry & flask weight (g)	377.3
Weight of oven dried sample(g)	50.6

Specific Gravity at 20 ^{o}C **2.69**

Comments

Performed by: JB

Reviewed by: J. Bruesewitz P.G.
GESTRA Engineering, Inc.

GESTRA Engineering
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Milwaukee, WI 53207
(414) 933-7444

Test Results of
Specific Gravity of Fine Soil

Project Name:	Waukegan South Plant MGP	Date:	November 28, 2017
Project Number:	K13028-40	Client:	NRT
Project Location:	Waukegan, IL		
AASHTO Designation:	T100		

Sample Information

Type of Sample:	Bag	Sample Date:	11/1/2017
Boring #:		Sampled By:	Client
Sample ID#	103017004	Specification Reference:	USCS
Depth:	18.5'-21'	Soil Classification:	SP-SM

Basic Test Information

Pyconometer (flask) number	4
Weight of dry pycnometer,	93.97
Weight of distilled water & flask (g)	342.99
@ Temperature T1 (^{o}C)	21.8
Weight of deaired slurry & flask (g)	375.42
@ Temperature T2 (^{o}C)	21.8
Weight of oven-dried soil (g)	51.58

K table

Temp. (^{o}C)	Temp (^{o}F)	K
16	60.8	1.0007
17	62.6	1.0006
18	64.4	1.0004
19	66.2	1.0002
20	68.0	1.0000
21	69.8	0.9998
22	71.6	0.9996
23	73.4	0.9993
24	75.2	0.9991
25	77.0	0.9989
26	78.8	0.9986
27	80.6	0.9983
28	82.4	0.9980
29	84.2	0.9977
30	86.0	0.9974

Specific Gravity Calculation

Temp adjustment factor, K (at T1)	0.9998
Adjusted deaired water & flask weight (g)	342.9
Temp adjustment factor, K (at T2)	0.9998
Adjusted deaired slurry & flask weight (g)	375.4
Weight of oven dried sample(g)	51.6

Specific Gravity at 20 ^{o}C **2.69**

Comments

Performed by: JB

Reviewed by: J. Bruesewitz P.G.
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Test Results of
Specific Gravity of Fine Soil

Project Name:	Waukegan South Plant MGP	Date:	November 28, 2017
Project Number:	K13028-40	Client:	NRT
Project Location:	Waukegan, IL		
AASHTO Designation:	T100		

Sample Information

Type of Sample:	Bag	Sample Date:	11/2/2017
Boring #:		Sampled By:	Client
Sample ID#	110117001	Specification Reference:	USCS
Depth:	28'-30'	Soil Classification:	ML

Basic Test Information

Pyconometer (flask) number	6
Weight of dry pycnometer,	93.10
Weight of distilled water & flask (g)	342.24
@ Temperature T1 (^{o}C)	21
Weight of deaired slurry & flask (g)	374.69
@ Temperature T2 (^{o}C)	20.2
Weight of oven-dried soil (g)	50.5

K table

Temp. (^{o}C)	Temp (^{o}F)	K
16	60.8	1.0007
17	62.6	1.0006
18	64.4	1.0004
19	66.2	1.0002
20	68.0	1.0000
21	69.8	0.9998
22	71.6	0.9996
23	73.4	0.9993
24	75.2	0.9991
25	77.0	0.9989
26	78.8	0.9986
27	80.6	0.9983
28	82.4	0.9980
29	84.2	0.9977
30	86.0	0.9974

Specific Gravity Calculation

Temp adjustment factor, K (at T1)	0.9998
Adjusted deaired water & flask weight (g)	342.2
Temp adjustment factor, K (at T2)	1.0000
Adjusted deaired slurry & flask weight (g)	374.7
Weight of oven dried sample(g)	50.5

Specific Gravity at 20 ^{o}C **2.81**

Comments

Performed by: JB

Reviewed by: J. Bruesewitz P.G.
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Test Results of
Specific Gravity of Fine Soil

Project Name:	Waukegan South Plant MGP	Date:	November 28, 2017
Project Number:	K13028-40	Client:	NRT
Project Location:	Waukegan, IL		
AASHTO Designation:	T100		

Sample Information

Type of Sample:	Bag	Sample Date:	11/1/2017
Boring #:		Sampled By:	Client
Sample ID#	103017005	Specification Reference:	USCS
Depth:	23'-25'	Soil Classification:	ML

Basic Test Information

Pyconometer (flask) number	2
Weight of dry pycnometer,	93.76
Weight of distilled water & flask (g)	342.71
@ Temperature T1 (^{o}C)	21.8
Weight of deaired slurry & flask (g)	375.01
@ Temperature T2 (^{o}C)	21.7
Weight of oven-dried soil (g)	50.41

K table

Temp. (^{o}C)	Temp (^{o}F)	K
16	60.8	1.0007
17	62.6	1.0006
18	64.4	1.0004
19	66.2	1.0002
20	68.0	1.0000
21	69.8	0.9998
22	71.6	0.9996
23	73.4	0.9993
24	75.2	0.9991
25	77.0	0.9989
26	78.8	0.9986
27	80.6	0.9983
28	82.4	0.9980
29	84.2	0.9977
30	86.0	0.9974

Specific Gravity Calculation

Temp adjustment factor, K (at T1)	0.9998
Adjusted deaired water & flask weight (g)	342.7
Temp adjustment factor, K (at T2)	0.9998
Adjusted deaired slurry & flask weight (g)	375.0
Weight of oven dried sample(g)	50.4

Specific Gravity at 20 ^{o}C **2.78**

Comments

Performed by: JB

Reviewed by: J. Bruesewitz P.G.
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Test Results of
Specific Gravity of Fine Soil

Project Name:	Waukegan South Plant MGP	Date:	November 28, 2017
Project Number:	K13028-40	Client:	NRT
Project Location:	Waukegan, IL		
AASHTO Designation:	T100		

Sample Information

Type of Sample:	Sonic Core	Sample Date:	11/1/2017
Boring #:		Sampled By:	Client
Sample ID#	110117003	Specification Reference:	USCS
Depth:	53.5'-55'	Soil Classification:	CL

Basic Test Information

Pyconometer (flask) number	5
Weight of dry pycnometer,	95.06
Weight of distilled water & flask (g)	344.21
@ Temperature T1 (^{o}C)	21.7
Weight of deaired slurry & flask (g)	376.5
@ Temperature T2 (^{o}C)	21.8
Weight of oven-dried soil (g)	50.69

K table

Temp. (^{o}C)	Temp (^{o}F)	K
16	60.8	1.0007
17	62.6	1.0006
18	64.4	1.0004
19	66.2	1.0002
20	68.0	1.0000
21	69.8	0.9998
22	71.6	0.9996
23	73.4	0.9993
24	75.2	0.9991
25	77.0	0.9989
26	78.8	0.9986
27	80.6	0.9983
28	82.4	0.9980
29	84.2	0.9977
30	86.0	0.9974

Specific Gravity Calculation

Temp adjustment factor, K (at T1)	0.9998
Adjusted deaired water & flask weight (g)	344.2
Temp adjustment factor, K (at T2)	0.9998
Adjusted deaired slurry & flask weight (g)	376.4
Weight of oven dried sample(g)	50.7

Specific Gravity at 20 ^{o}C **2.75**

Comments

Performed by: JB

Reviewed by: J. Bruesewitz P.G.
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Test Results of
Specific Gravity of Fine Soil

Project Name:	Waukegan South Plant MGP	Date:	November 28, 2017
Project Number:	K13028-40	Client:	NRT
Project Location:	Waukegan, IL		
AASHTO Designation:	T100		

Sample Information

Type of Sample:	Sonic Core	Sample Date:	11/2/2017
Boring #:		Sampled By:	Client
Sample ID#	110217003	Specification Reference:	USCS
Depth:	17.5'-18.5'	Soil Classification:	CL-ML

Basic Test Information

Pyconometer (flask) number	3
Weight of dry pycnometer,	94.07
Weight of distilled water & flask (g)	343.26
@ Temperature T1 (^{o}C)	22.2
Weight of deaired slurry & flask (g)	375.4
@ Temperature T2 (^{o}C)	21.4
Weight of oven-dried soil (g)	50.32

K table

Temp. (^{o}C)	Temp (^{o}F)	K
16	60.8	1.0007
17	62.6	1.0006
18	64.4	1.0004
19	66.2	1.0002
20	68.0	1.0000
21	69.8	0.9998
22	71.6	0.9996
23	73.4	0.9993
24	75.2	0.9991
25	77.0	0.9989
26	78.8	0.9986
27	80.6	0.9983
28	82.4	0.9980
29	84.2	0.9977
30	86.0	0.9974

Specific Gravity Calculation

Temp adjustment factor, K (at T1)	0.9996
Adjusted deaired water & flask weight (g)	343.2
Temp adjustment factor, K (at T2)	0.9998
Adjusted deaired slurry & flask weight (g)	375.3
Weight of oven dried sample(g)	50.3

Specific Gravity at 20 ^{o}C **2.77**

Comments

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Laboratory Test Results of Atterberg Limits of Soil

Project Name:	Waukegan South Plant MGP	Date:	November 29, 2017
Project Number:	K13028-40	Client:	Natural Resource Technology
Project Location:	Waukegan, IL		
ASTM Designation:	**D4318**		

Sample Information

Type of Sample	Bulk
Boring Number	
Sample Number	103017005
Depth of Sample	23'-25'

NOT PLASTIC

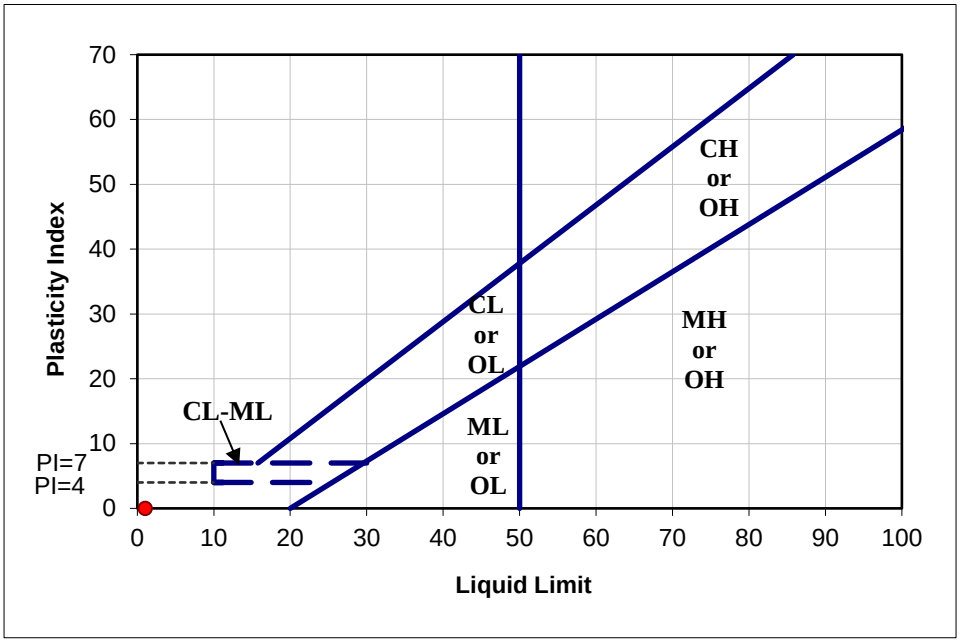
Determination of Liquid Limit

Cup Number			
Weight of Cup (g)			
Weight of Wet Soil and Cup (g)			
Weight of Dry Soil and Cup (g)			
Moisture Content (%)	#DIV/0!	#DIV/0!	#DIV/0!
Blow Counts			

Determination of Plastic Limit

Cup Number		
Weight of Cup (g)		
Weight of Wet Soil and Cup (g)		
Weight of Dry Soil and Cup (g)		
Moisture Content (%)	#DIV/0!	#DIV/0!

Compilation of Test Results



Liquid Limit	N/A
Plastic Limit	N/A
Plasticity Index	N/A
USCS Symbol	**NP**

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Laboratory Test Results of Atterberg Limits of Soil

Project Name:	Waukegan South Plant MGP	Date:	November 29, 2017
Project Number:	K13028-40	Client:	Natural Resource Technology
Project Location:	Waukegan, IL		
ASTM Designation:	**D4318**		

Sample Information

Type of Sample	Bulk
Boring Number	
Sample Number	110117001
Depth of Sample	28'-30'

NOT PLASTIC

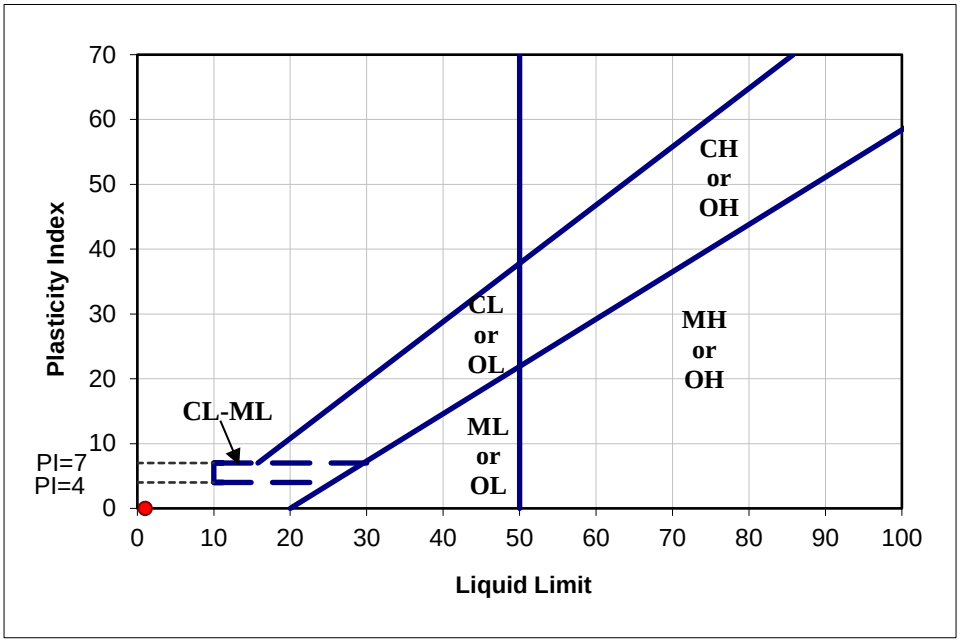
Determination of Liquid Limit

Cup Number			
Weight of Cup (g)			
Weight of Wet Soil and Cup (g)			
Weight of Dry Soil and Cup (g)			
Moisture Content (%)	#DIV/0!	#DIV/0!	#DIV/0!
Blow Counts			

Determination of Plastic Limit

Cup Number		
Weight of Cup (g)		
Weight of Wet Soil and Cup (g)		
Weight of Dry Soil and Cup (g)		
Moisture Content (%)	#DIV/0!	#DIV/0!

Compilation of Test Results



Liquid Limit	N/A
Plastic Limit	N/A
Plasticity Index	N/A
USCS Symbol	**NP**

Performed by: Bonnie Bills

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Laboratory Test Results of Atterberg Limits of Soil

Project Name:	Waukegan MGP	Date:	November 29, 2017
Project Number:	K 13028-40	Client:	Natural Resource Technology
Project Location:	Waukegan, IL		
ASTM Designation:	**D4318**		

Sample Information

Type of Sample	Bulk
Boring Number	
Sample Number	110117003
Depth of Sample	53.5'-55'

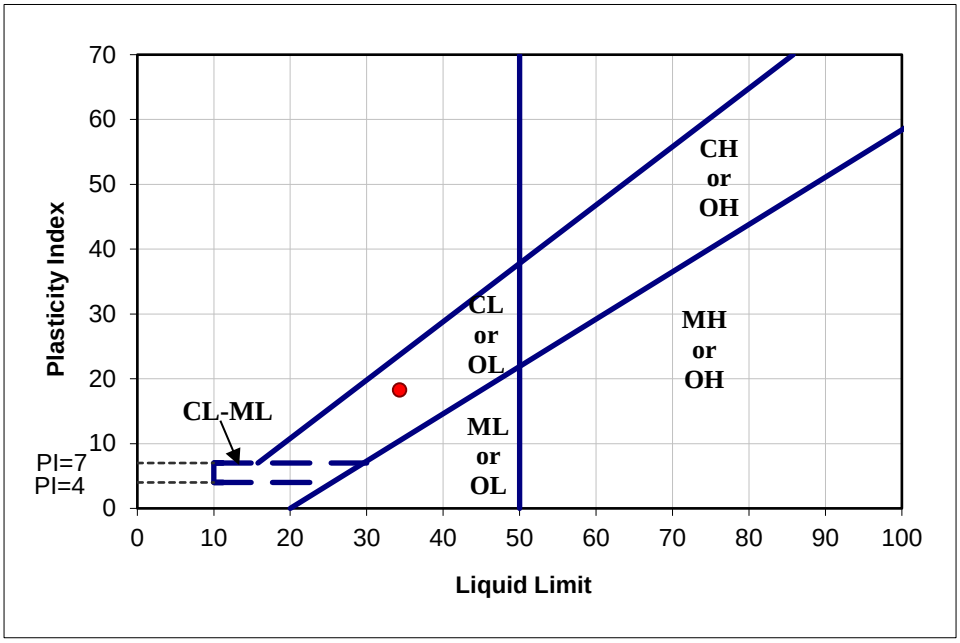
Determination of Liquid Limit

Cup Number	L10	D16	L13
Weight of Cup (g)	14.50	14.60	14.61
Weight of Wet Soil and Cup (g)	37.40	36.47	34.52
Weight of Dry Soil and Cup (g)	31.69	30.85	29.25
Moisture Content (%)	33.2	34.6	36.0
Blow Counts	32	22	15

Determination of Plastic Limit

Cup Number	B31	D2
Weight of Cup (g)	7.30	7.22
Weight of Wet Soil and Cup (g)	13.70	13.60
Weight of Dry Soil and Cup (g)	12.82	12.72
Moisture Content (%)	15.9	16.0

Compilation of Test Results



Liquid Limit	34
Plastic Limit	16
Plasticity Index	18
USCS Symbol	**CL**

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Laboratory Test Results of Atterberg Limits of Soil

Project Name:	Waukegan South Plant MGP	Date:	November 29, 2017
Project Number:	K13028-40	Client:	Natural Resource Technology
Project Location:	Waukegan, IL		
ASTM Designation:	**D4318**		

Sample Information

Type of Sample	Bulk
Boring Number	
Sample Number	110217003
Depth of Sample	17.5'-18.5'

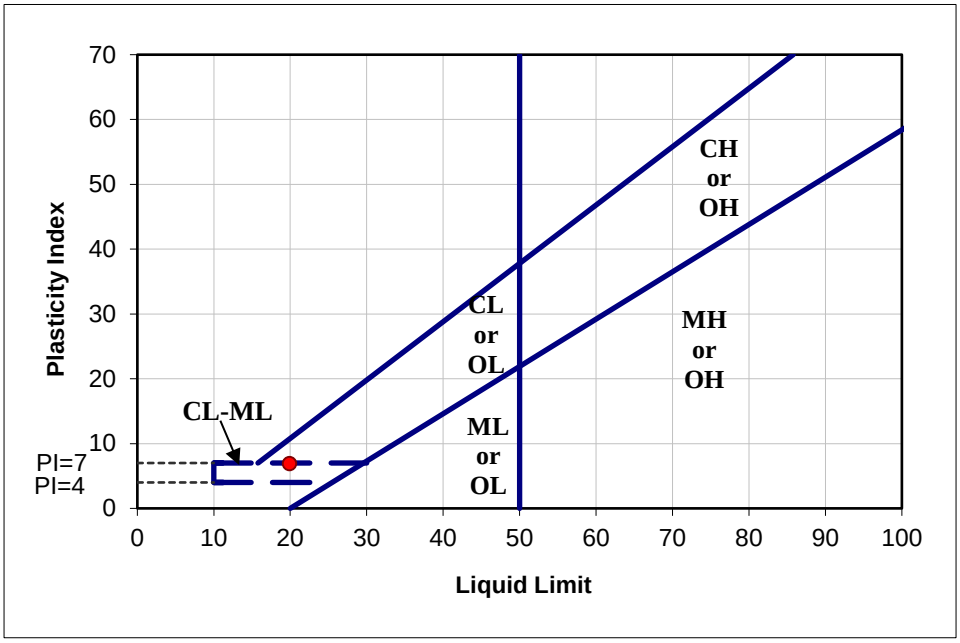
Determination of Liquid Limit

Cup Number	D8	L18	D19
Weight of Cup (g)	14.43	14.60	14.33
Weight of Wet Soil and Cup (g)	34.23	36.75	37.42
Weight of Dry Soil and Cup (g)	31.06	33.01	33.48
Moisture Content (%)	19.1	20.3	20.6
Blow Counts	35	20	17

Determination of Plastic Limit

Cup Number	L6	B19
Weight of Cup (g)	7.20	7.13
Weight of Wet Soil and Cup (g)	13.47	13.33
Weight of Dry Soil and Cup (g)	12.77	12.64
Moisture Content (%)	12.6	12.5

Compilation of Test Results



Liquid Limit	20
Plastic Limit	13
Plasticity Index	7
USCS Symbol	**CL-ML**

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Laboratory Test Results of Mechanical Analysis of Soil or Aggregate

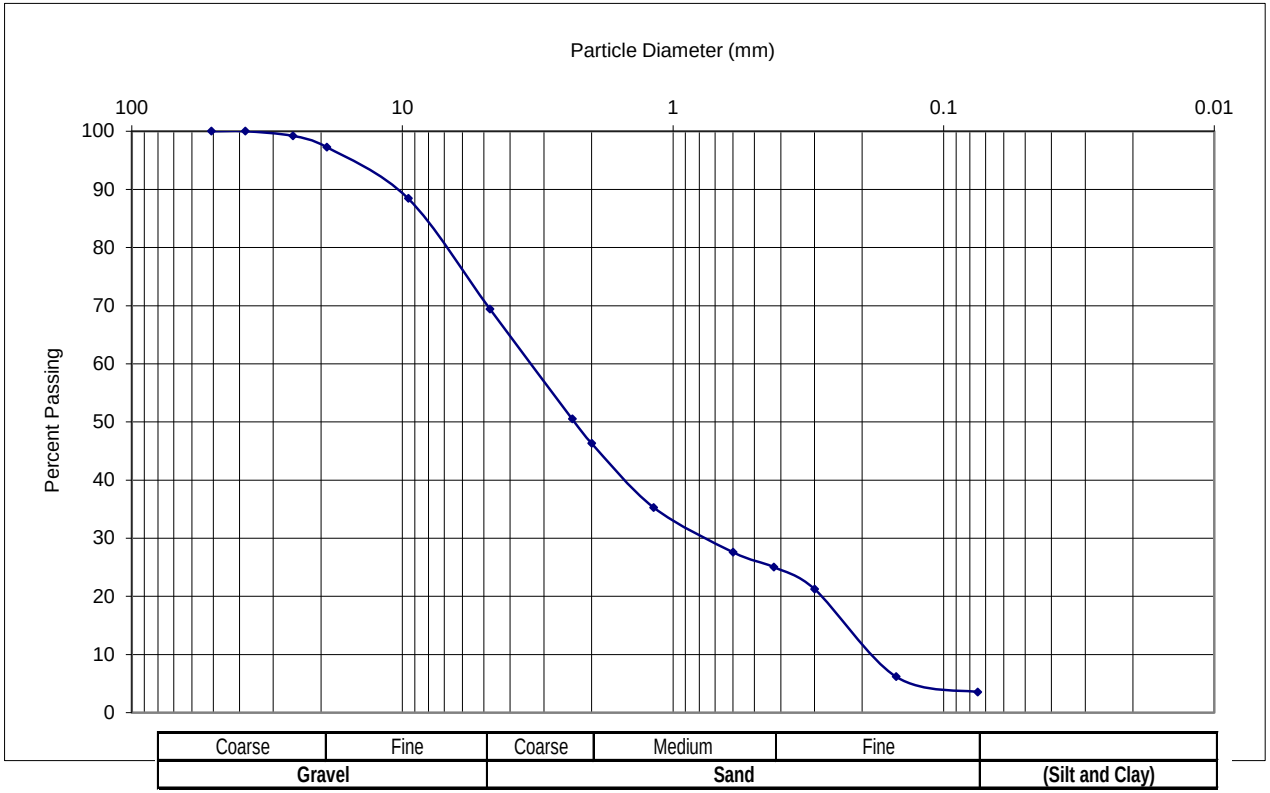
Project Name:	Waukegan South Plant MGP	Date:	November 22, 2017
Project Number:	K13028-40	Reported To:	Natural Resource Technology
Project Location:	Waukegan, IL		
ASTM Designation:	**C136, D422**		

Sample Information

Type of Sample:	Bag	Sample Number:	103017004
Boring Number:		Depth of Sample:	18.5'-21'

Mechanical Analysis Data

Sieve	Sieve Opening (mm)	Percent Passing (%)
2	50.8	100.0
1 1/2	38.1	100.0
1	25.4	99.2
3/4	19.05	97.3
3/8	9.525	88.4
#4	4.75	69.4
#8	2.36	50.5
#10	2	46.3
#16	1.18	35.3
#30	0.6	27.6
#40	0.425	25.0
#50	0.3	21.3
#100	0.15	6.2
#200	0.075	3.6



Moisture Content 8.7 %

Remarks: Gravel 30.6 % Sand 65.8 %
Passing #200 Sieve (Silt & Clay) 3.6 %

Performed by: Bonnie Bills

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Laboratory Test Results of Mechanical Analysis of Soil or Aggregate

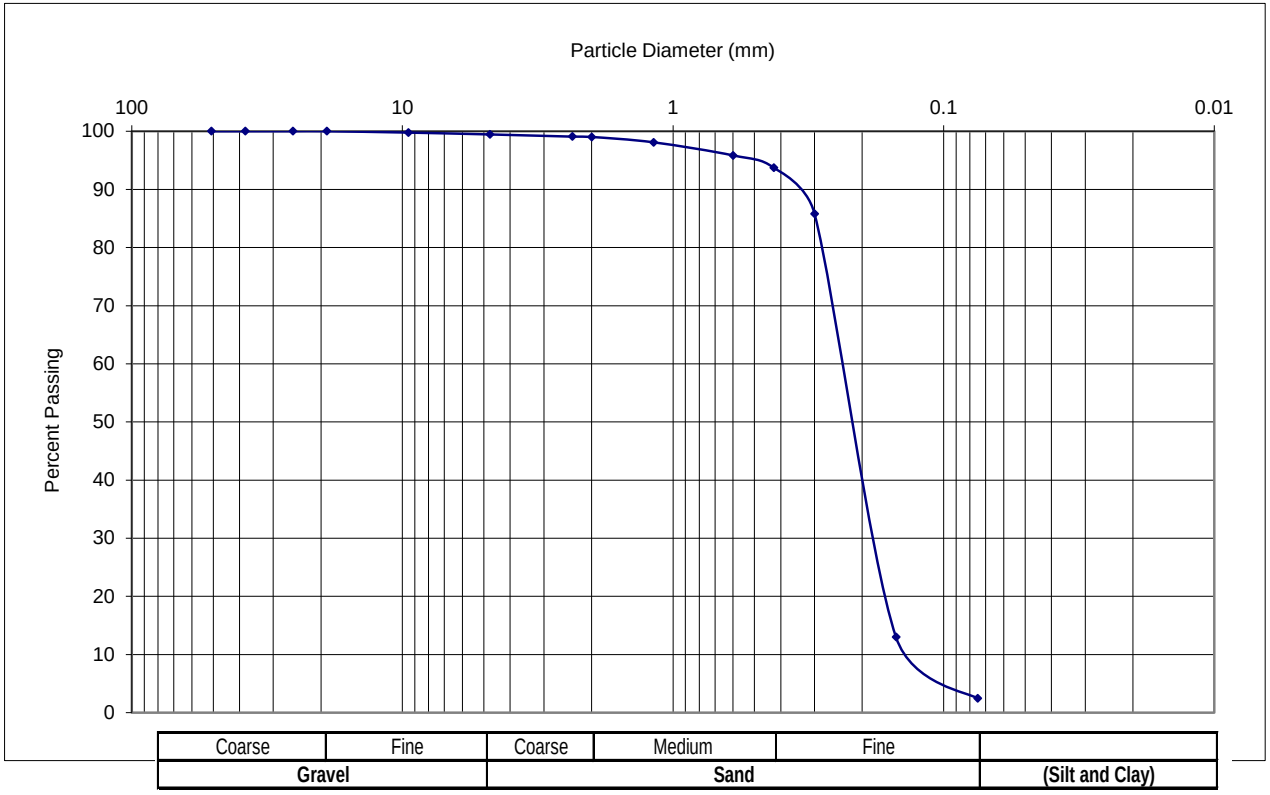
Project Name:	Waukegan South Plant MGP	Date:	November 22, 2017
Project Number:	K13028-40	Reported To:	Natural Resource Technology
Project Location:	Waukegan, IL		
ASTM Designation:	**C136, D422**		

Sample Information

Type of Sample:	Bag	Sample Number:	103017003
Boring Number:		Depth of Sample:	15'-17'

Mechanical Analysis Data

Sieve	Sieve Opening (mm)	Percent Passing (%)
2	50.8	100.0
1 1/2	38.1	100.0
1	25.4	100.0
3/4	19.05	100.0
3/8	9.525	99.8
#4	4.75	99.5
#8	2.36	99.1
#10	2	99.0
#16	1.18	98.1
#30	0.6	95.8
#40	0.425	93.7
#50	0.3	85.8
#100	0.15	13.0
#200	0.075	2.5



Moisture Content 21.3 %

Remarks: Gravel 0.5 % Sand 97.0 %
Passing #200 Sieve (Silt & Clay) 2.5 %

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Laboratory Test Results of
Mechanical Analysis & Hydrometer of Soil or Aggregate

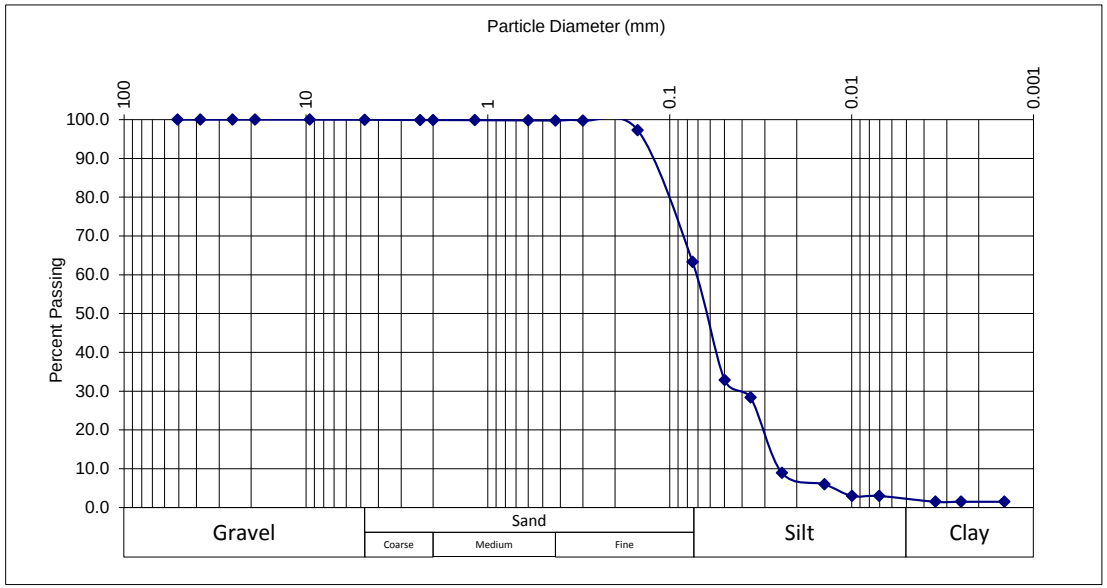
Project Name:	Waukegan South Plant MGP	Date:	November 22, 2017
Project Number:	K13028-40	Reported To:	Natural Resource Thechnology
Project Location:	Waukegan, IL		
ASTM Designation:	**D422**		

Sample Information

Type of Sample:	Bag	Sample Number:	103017005
Boring Number:		Depth of Sample:	23'-25'

Mechanical Analysis Data

Sieve	Sieve Opening (mm)	Percent Passing (%)
2 in.	50.800	100
1 1/2 in.	38.100	100
1 in.	25.400	100
3/4 in.	19.050	100
3/8 in.	9.525	100
#4	4.750	100
#8	2.360	99.9
#10	2.000	99.9
#16	1.180	99.9
#30	0.600	99.8
#40	0.425	99.8
#50	0.300	99.7
#100	0.150	97.3
#200	0.075	63.4



Remarks: Gravel 0.0 % Sand 36.6 %
Fines 63.4 %

Moisture Content: 18.1%

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Laboratory Test Results of
Mechanical Analysis & Hydrometer of Soil or Aggregate

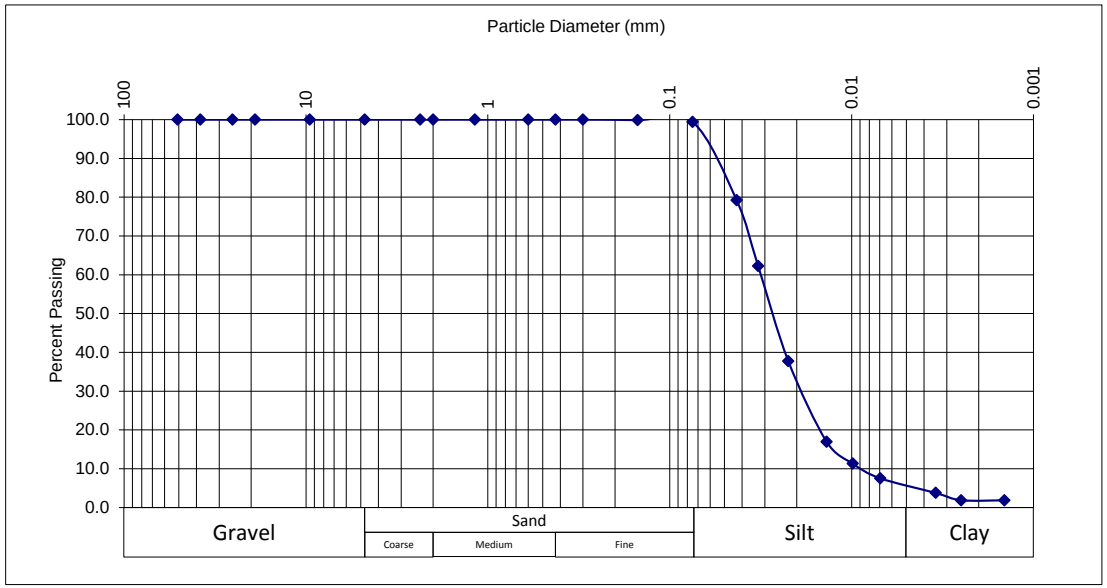
Project Name:	Waukegan South Plant MGP	Date:	November 22, 2017
Project Number:	K 13028-40	Reported To:	Natural Resource Technology
Project Location:	Waukegan, IL		
ASTM Designation:	**D422**		

Sample Information

Type of Sample:	Bag	Sample Number:	110117001
Boring Number:		Depth of Sample:	28'-30'

Mechanical Analysis Data

Sieve	Sieve Opening (mm)	Percent Passing (%)
2 in.	50.800	100
1 1/2 in.	38.100	100
1 in.	25.400	100
3/4 in.	19.050	100
3/8 in.	9.525	100.0
#4	4.750	100.0
#8	2.360	100.0
#10	2.000	100.0
#16	1.180	100.0
#30	0.600	100.0
#40	0.425	100.0
#50	0.300	100.0
#100	0.150	99.9
#200	0.075	99.4



Remarks: Gravel 0.0 % Sand 0.6 %
Fines 99.4 %

Moisture Content: 18.9%

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Laboratory Test Results of
Mechanical Analysis & Hydrometer of Soil or Aggregate

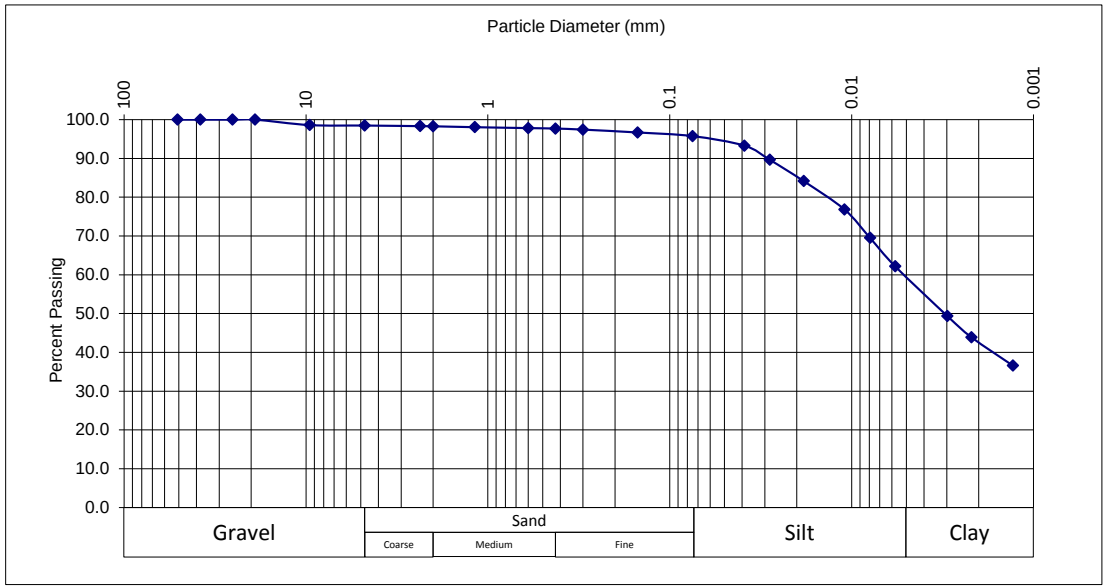
Project Name:	Waukegan South Plant MGP	Date:	November 27, 2017
Project Number:	K13028-40	Reported To:	Natural Resource Technology
Project Location:	Waukegan, IL		
ASTM Designation:	**D422**		

Sample Information

Type of Sample:	Sonic Core	Sample Number:	110117003
Boring Number:		Depth of Sample:	53.5-55'

Mechanical Analysis Data

Sieve	Sieve Opening (mm)	Percent Passing (%)
2 in.	50.800	100
1 1/2 in.	38.100	100
1 in.	25.400	100
3/4 in.	19.050	100
3/8 in.	9.525	98.6
#4	4.750	98.5
#8	2.360	98.3
#10	2.000	98.3
#16	1.180	98.1
#30	0.600	97.8
#40	0.425	97.7
#50	0.300	97.4
#100	0.150	96.7
#200	0.075	95.8



Remarks: Gravel 1.5 % Sand 2.7 %
Fines 95.8 %

Moisture Content: 17.8%

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Laboratory Test Results of
Mechanical Analysis & Hydrometer of Soil or Aggregate

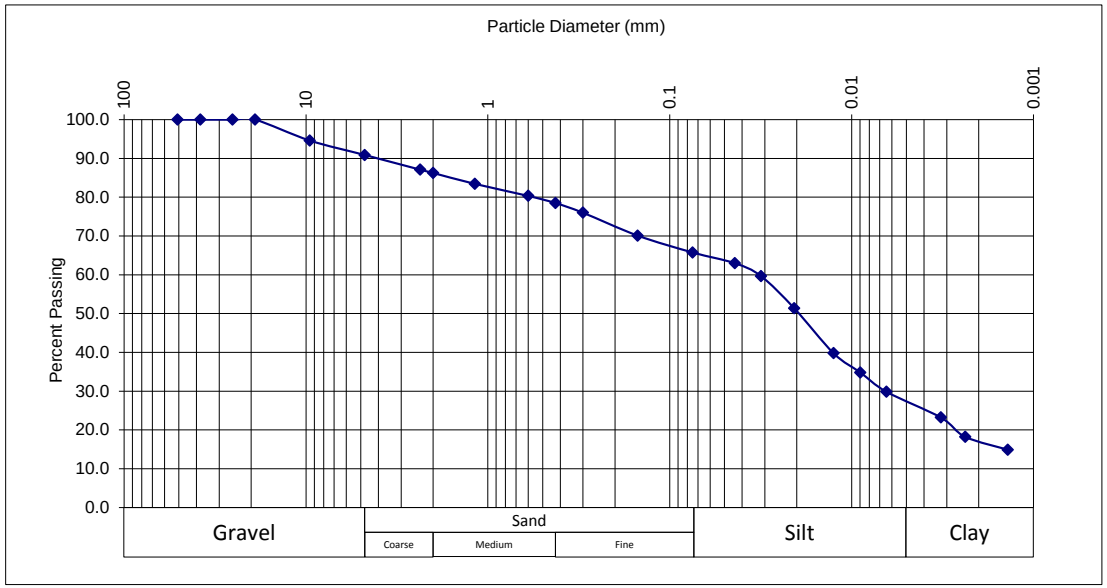
Project Name:	Waukegan South Plant MGP	Date:	November 17, 2017
Project Number:	K13028-40	Reported To:	Natural Resource Technology
Project Location:	Waukegan, IL		
ASTM Designation:	**D422**		

Sample Information

Type of Sample:	Sonic Core	Sample Number:	110217003
Boring Number:		Depth of Sample:	17.5'-18.5'

Mechanical Analysis Data

Sieve	Sieve Opening (mm)	Percent Passing (%)
2 in.	50.800	100
1 1/2 in.	38.100	100
1 in.	25.400	100
3/4 in.	19.050	100
3/8 in.	9.525	94.6
#4	4.750	90.9
#8	2.360	87.1
#10	2.000	86.3
#16	1.180	83.4
#30	0.600	80.3
#40	0.425	78.5
#50	0.300	76.0
#100	0.150	70.1
#200	0.075	65.8



Remarks: Gravel 9.1 % Sand 25.1 %
Fines 65.8 %

Moisture Content: 10.2%

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Laboratory Test Results of Unconfined Compressive Strength of Soil

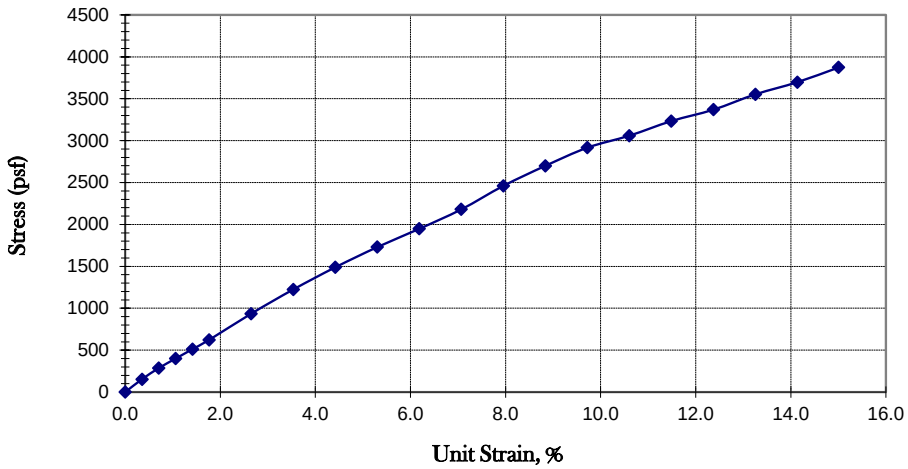
Project Name:	Waukegan South Plant MGP	Date:	November 17, 2017
Project Number:	K13028-40	Report To:	Natural Resource Technology
Project Location:	Waukegan, IL		Due Calibration: 06/2018
ASTM Designation:	**D2166**		Form Updated on 7/1/2016

Test Data

Deformation dial reading (0.001 in.)	Sample stress (psf)
0	0
20	153
40	286
60	399
80	512
100	623
150	936
200	1224
250	1488
300	1730
350	1948
400	2180
450	2460
500	2699
550	2916
600	3059
650	3233
700	3369
750	3552
800	3698
849	3873

Sample Information

Boring no.:		Diameter (in)	2.85
Sample no.:	110217003	Area (sq. in.):	6.38
Depth of Soil:	17.5'-18.5'	Height: (in.):	5.66
Description of Soil:	LEAN CLAY WITH GRAVEL, gray, moist		
Strain Rate (in/min):	0.050		



UC Strength, Q_u (tsf)	**1.94**
Wet Density (pcf)	144.8
Dry Density (pcf)	131.3
Moisture Content (%)	10.2

Remarks

Performed By: JB

Reviewed By: D. Born, EIT
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Laboratory Test Results of Unconfined Compressive Strength of Soil

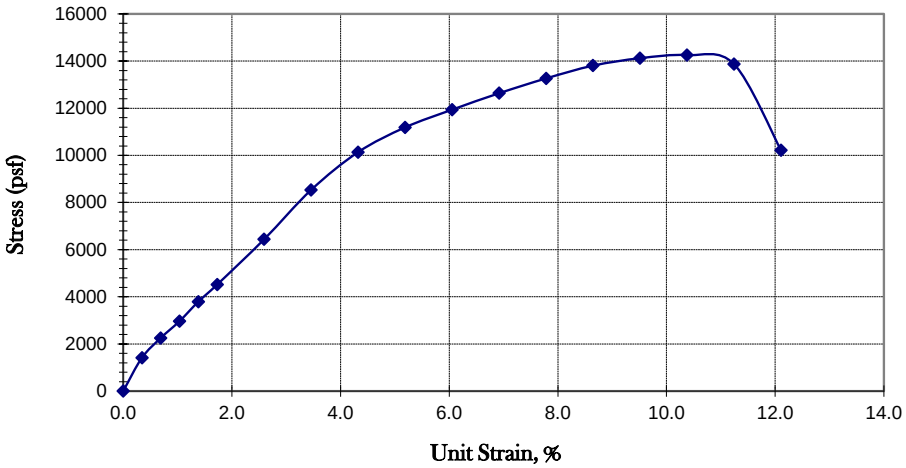
Project Name:	Waukegan South Plant MGP	Date:	November 17, 2017
Project Number:	K13028-40	Report To:	Natural Resource Technology
Project Location:	Waukegan, IL		Due Calibration: 06/2018
ASTM Designation:	**D2166**		Form Updated on 7/1/2016

Test Data

Deformation dial reading (0.001 in.)	Sample stress (psf)
0	0
20	1416
40	2253
60	2968
80	3794
100	4517
150	6438
200	8533
250	10137
300	11186
350	11937
400	12635
450	13263
500	13806
550	14122
600	14252
650	13869
700	10214

Sample Information

Boring no.:		Diameter (in)	2.81
Sample no.:	110117003	Area (sq. in.):	6.22
Depth of Soil:	53.5'-55'	Height: (in.):	5.78
Description of Soil:	LEAN CLAY, gray, moist		
Strain Rate (in/min):	0.042		



UC Strength, Q_u (tsf)	**7.13**
Wet Density (pcf)	136.2
Dry Density (pcf)	115.7
Moisture Content (%)	17.8

Remarks

Performed By: JB

Reviewed By: D. Born, EIT
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Appendix P

Influent Groundwater Characterization Data

Appendix P - Influent Composite Analytical Results Compared to the Groundwater Class I Remediation Objectives

Former South Plant Manufactured Gas Plant Site
Waukegan, IL
North Shore Gas, CERCLIS ID - ILD984809228

			BTEX	BTEX	BTEX	BTEX	VOC	VOC	VOC	VOC	VOC	VOC	VOC	PAH	PAH	PAH	PAH	PAH	PAH	PAH	PAH	PAH	PAH	PAH	PAH	PAH
9-digit Code	Station Name	Sample Date	Benzene	Ethylbenzene	Toluene	Xylene (Total)	1,1-Dichloroethene	1,2-Dichloroethane	Bromoform	Carbon tetrachloride	Chlorobenzene	Chloroform	cis-1,2-Dichloroethene	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene
Reporting Units:			µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Groundwater Remediation Objective, Class I [1]:			**5**	**700**	**1,000**	**10,000**	**7**	**5**	**1**	**5**	**100**	**0.2**	**70**	**490**	**28**	**420**	**210**	**2,100**	**0.13**	**0.2**	**0.18**	**210**	**0.17**	**1.5**	**0.3**	**280**	**280**
102717001	Influent Composite	10/27/2017	689	2,050	< 62.5 U	1,620	< 51.3 U	< 21.0 U	< 62.5 U	< 62.5 U	< 62.5 U	< 312 U	< 32.0 U	3,320	4,640	2,070	367	921	478	330	245	121	93.2	437	38.1	922	1,080
Removal Efficiency			99.3	65.9	--	--	--	--	--	--	--	--	--	85.2	99.4	79.7	42.8	--	100.0	99.9	99.9	--	99.8	99.7	99.2	69.6	74.1
Order of Magnitude Reduction			100	10	--	--	--	--	--	--	--	--	--	10	100	10	1	--	1000	1000	1000	--	100	100	100	0	10

Notes
1. Screening levels (objectives) used are presented in the Illinois Tiered Approach to Corrective Action Objectives (TACO); Title 35, Ch. I, SubCh.f, Sec. 742, Tier 1,Appendix B Tier 1, Table E Groundwater Remediation Objectives for the Groundwater Component of the Groundwater Ingestion Route. They are supplemented, as needed, with the "Non-TACO Class I and Class II groundwater objectives" for chemicals not contained in the TACO Tier I tables. (http://www.epa.illinois.gov/topics/cleanup-programs/taco/other-chemicals/index)
2.Total Organic Carbon (TOC) - The highest result of the multiple results reported by the lab for this sample was used on this table.

BOLD = result exceeds Groundwater Remediation Objective
Pink highlighting = result exceeds one or more screening criteria
Total PCB calculated by the laboratory
NS = No Standard
-- = Not Applicable

BTEX = Benzene, Toluene, Ethylbenzene and Xylene
GEO = Geotechnical Property
PAH = Polycyclic Aromatic Hydrocarbon
PCB = Polychlorinated Biphenyl
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Appendix P - Influent Composite Analytical Results Compared to the Groundwater Class I Remediation Objectives

Former South Plant Manufactured Gas Plant Site
Waukegan, IL
North Shore Gas, CERCLIS ID - ILD984809228

			PAH	PAH	PAH	PAH	SVOC	SVOC	SVOC	SVOC	SVOC	SVOC	SVOC	SVOC	Phenol	Fingerprint Forensics	Fingerprint Forensics	PCB	PCB	PCB	PCB	PCB	PCB	PCB	PCB	PHC
9-digit Code	Station Name	Sample Date	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	1,2,4-Trichlorobenzene	1,2-Dichlorobenzene	1,4-Dichlorobenzene	bis(2-Chloroethyl) ether	Bis(2-ethylhexyl)phthalate	Hexachlorocyclopentadiene	N-Nitroso-di-n-propylamine	N-nitrosodiphenylamine	Phenol	TPH (C06-C10)	TPH - Diesel (C10-C28)	PCB, Total	PCB-1016 (Aroclor 1016)	PCB-1221 (Aroclor 1221)	PCB-1232 (Aroclor 1232)	PCB-1242 (Aroclor 1242)	PCB-1248 (Aroclor 1248)	PCB-1254 (Aroclor 1254)	PCB-1260 (Aroclor 1260)	Oil and Grease
Reporting Units:			µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L
Groundwater Remediation Objective, Class I [1]:			**0.43**	**140**	**210**	**210**	**70**	**600**	**75**	**NS**	**6**	**50**	**NS**	**3.2**	**100**	**NS**	**NS**	**0.5**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
102717001	Influent Composite	10/27/2017	103	12,100	3,120	1,230	< 426 U	< 404 U	< 393 U	< 331 U	< 145 U	< 142 U	< 203 U	< 739 U	58.4	20,400	82.8	<0.24 U	<0.24 U	<0.24 U	<0.24 U	<0.24 U	<0.24 U	<0.24 U	<0.24 U	<0.24 U	50.6
Removal Efficiency			99.6	98.8	93.3	82.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Order of Magnitude Reduction			1000	100	10	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes
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Former South Plant Manufactured Gas Plant Site
Waukegan, IL
North Shore Gas, CERCLIS ID - ILD984809228

9-digit Code	Station Name	Sample Date	Metal: Aluminum	Metal: Aluminum, Dissolved	Metal: Antimony	Metal: Antimony, Dissolved	Metal: Arsenic, Dissolved	Metal: Arsenic, Total	Metal: Barium	Metal: Barium, Dissolved	Metal: Beryllium	Metal: Beryllium, Dissolved	Metal: Boron	Metal: Boron, Dissolved	Metal: Cadmium	Metal: Cadmium, Dissolved	Metal: Calcium	Metal: Calcium, Dissolved	Metal: Chromium	Metal: Chromium, Dissolved	Metal: Cobalt	Metal: Cobalt, Dissolved	Metal: Copper	Metal: Copper, Dissolved	Metal: Iron	Metal: Iron, Dissolved	Metal: Lead	Metal: Lead, Dissolved
Reporting Units:			µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Groundwater Remediation			**3,500**	**3,500**	**6**	**6**	**50**	**50**	**2,000**	**2,000**	**4**	**4**	**2,000**	**2,000**	**5**	**5**	**NS**	**NS**	**100**	**100**	**1,000**	**1,000**	**650**	**650**	**5,000**	**5,000**	**7.5**	**7.5**
102717001	Influent Composite	10/27/2017	<58.7 U	<58.7 U	0.30 J	0.39 J	8.1	9.6	210	209	<0.18 U	0.38 J	673	708	0.11 J	0.28 J	155,000	159,000	<1.0 U	<1.0 U	0.24 J	0.39 J	1.5 J	<1.1 U	**9,030**	**6,660**	0.41 J	0.39 J
Removal Efficiency			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	44.6	24.9	--	--
Order of Magnitude Reduction			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0	0	--	--

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Former South Plant Manufactured Gas Plant Site
Waukegan, IL
North Shore Gas, CERCLIS ID - ILD984809228

9-digit Code	Station Name	Sample Date	Metal Lithium	Metal Lithium, dissolved	Metal Magnesium	Metal Magnesium, Dissolved	Metal Manganese	Metal Manganese, Dissolved	Metal Mercury	Metal Mercury, Dissolved	Metal Molybdenum	Metal Molybdenum, Dissolved	Metal Nickel	Metal Nickel, Dissolved	Metal Potassium	Metal Potassium, Dissolved	Metal Selenium	Metal Selenium, Dissolved	Metal Silver	Metal Silver, Dissolved	Metal Sodium	Metal Sodium, Dissolved	Metal Strontium	Metal Strontium, dissolved	Metal Sulfur	Metal Thallium	Metal Thallium, Dissolved	Metal Tin, Dissolved
Reporting Units:			µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Groundwater Remediation Objective, Class I [1]:			**NS**	**NS**	**NS**	**NS**	**150**	**150**	**2**	**2**	**35**	**35**	**100**	**100**	**NS**	**NS**	**50**	**50**	**50**	**50**	**NS**	**NS**	**4,200**	**4,200**	**NS**	**2**	**2**	**NS**
102717001	Influent Composite	10/27/2017	24.5	24.4	69,200	71,300	**258**	**276**	<0.13 U	<0.13 U	<0.44 U	0.50 J	0.97 J	0.98 J	11,200	12,700	<0.32 U	0.42 J	<0.10 U	0.11 J	208,000	215,000	874	943	6,400	0.15 J	0.30 J	<0.79 U
Removal Efficiency			--	--	--	--	41.9	45.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Order of Magnitude Reduction			--	--	--	--	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

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			Metal	Metal	Metal	Metal	Metal	Metal	Metal	Metal	Inorganic	Inorganic	Inorganic	Inorganic	Inorganic	Inorganic	Inorganic	Inorganic	Organic	Organic	GEO	GEO
9-digit Code	Station Name	Sample Date	Tin, Total	Titanium, Dissolved	Titanium, Total	Tungsten, Total	Vanadium	Vanadium, Dissolved	Zinc	Zinc, dissolved	Alkalinity, Total as CaCO3	Bromide, Total	Chloride	Fluoride	Nitrate as N	Nitrite as N	Nitrogen, NO2 plus NO3	Sulfate	Mean Total Organic Carbon	Total Organic Carbon[2]	Total Dissolved Solids	Total Suspended Solids
Reporting Units:			µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Groundwater Remediation			**NS**	**NS**	**NS**	**NS**	**49**	**49**	**5,000**	**5,000**	**NS**	**NS**	**200**	**4**	**10**	**NS**	**NS**	**400**	**NS**	**NS**	**NS**	**NS**
102717001	Influent Composite	10/27/2017	<0.79 U	<7.9 U	<7.9 U	1.5	2.3	1.3	7.1 J	5.6 J	611	<0.50 U	**420**	<0.50 U	<0.38 U	<0.20 U	<0.095 U	20.8	22.2	22.9	1,210	48.8
Removal Efficiency			--	--	--	--	--	--	--	--	--	--	52.4	--	--	--	--	--	--	--	--	--
Order of Magnitude Reduction			--	--	--	--	--	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--

[O:ECK 2/1/18, C:SGW 2/7/18][U:ECK 2/26/18][U:ECK 2/28/18, C: ANS 2/28/18][U:ECK 4/23/18, C: ANS 4/23/18, U: ANS 6/13/18, U: ANS 6/19/18, C:] [QC: JQW 6/21/18]

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